Case No. 84739

IN THE SUPREME COURT OF THE STATE OF NEVADA

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ADAM SULLIVAN, P.E., NEVADA STATE ENGINEER, et al.

Appellants,

vs.

LINCOLN COUNTY WATER DISTRICT, et al.

JOINT APPENDIX

VOLUME 32 OF 49

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

March 2, 2006
File No. 1-5-05-FW-536-Tier 01
Cross Reference 1-5-00-FW-575

Ms. Susan Nall, Acting Chief
St. George Regulatory Office
U.S. Army Corps of Engineers
400 Rood Avenue, Room 142
Grand Junction, Colorado 81501

Dear Ms. Nall:

Subject: Biological Opinion for the Proposed Coyote Springs Investment Development in Clark County, Nevada (Army Corps of Engineers Permit Application No. 200125042)

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the U.S. Army Corps of Engineers' (Corps) proposed issuance of a Section 404 permit under the Clean Water Act of 1972, as amended for the Coyote Springs Investment, LLC (CSI) residential development project in Coyote Spring Valley, Clark County, Nevada. This biological opinion will evaluate the effects of the proposed action on the threatened desert tortoise (*Gopherus agassizii*) (Mojave population) and its designated critical habitat, and the endangered Moapa dace (*Moapa coriacea*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq*.). We have assigned log number 1-5-05-FW-536-Tier 01 to this consultation. Please reference this number in future correspondence relating to this consultation.

Incidental take of the desert tortoise on private lands in Clark County, including CSI's lands in Coyote Spring Valley, is authorized under a section 10(a)(1)(B) permit issued to Clark County for its Multiple Species Habitat Conservation Plan (MSHCP) (Regional Environmental Consultants 2000; hereafter, RECON). However, the Service's biological opinion for issuance of an incidental take permit for the Clark County MSHCP specifically analyzed a lower level of land use in the Coyote Spring Valley than what is currently proposed by CSI. We intend to amend the November 19, 2000 *Intra-Service Biological and Conference Opinion on Issuance of an Incidental Take Permit to Clark County, Nevada for a Multiple Species Habitat Conservation*

Plan (File No. 1-5-00-FW-575) with this biological opinion by analyzing herein the potential effects of CSI's proposed action on the desert tortoise and its critical habitat. The need to amend the MSHCP biological opinion arises from a change in the amount of anticipated disturbance to lands within Coyote Spring Valley from a relatively small area, as analyzed in the MSHCP biological opinion, to a substantially larger area, as proposed by CSI. The total number of acres of disturbance and the associated take permitted under Clark County's incidental take permit will not change. Also, this amendment is valid only for the desert tortoise and its critical habitat; the Service's analysis and conclusions for all other species evaluated in the MSHCP biological opinion remains valid and unchanged. The amendment to the Clark County MSHCP biological opinion will be further discussed in the *Description of the Proposed Action* section of this biological opinion.

Incidental take of desert tortoise and other covered species due to mortality or habitat loss within Corps-delineated jurisdictional wetlands, such as those that may be affected by CSI's proposed project, is not authorized by the section 10(a)(1)(B) incidental take permit for the Clark County MSHCP. Incidental take of federally-listed species for projects that affect such jurisdictional wetlands needs to be authorized through section 7 consultations between the Service and the Corps under the Act, pursuant to section 404 of the Clean Water Act. For that reason, the Corps requested formal consultation on its proposed issuance of a section 404 permit to discharge dredged and fill material into Waters of the United States (WOUS) required for the private action considered herein.

Moapa dace is not included as a covered species in Clark County's MSHCP, and thus, incidental take for the dace is not authorized through Clark County's section 10(a)(1)(B) permit. Additionally, activities associated with surface and groundwater withdrawal are outside of the scope of the MSHCP and the 10(a)(1)(B) incidental take permit for the MSHCP. For the CSI biological opinion, the Moapa dace effects analysis is based off of and tiered to the January 30, 2006, *Intra-Service Programmatic Biological Opinion for the Proposed Muddy River Memorandum of Agreement Regarding the Groundwater Withdrawal of 16,100 Acre-Feet per Year from the Regional Carbonate Aquifer in Coyote Spring Valley and California Wash Basins and Establish Conservation Measures for the Moapa Dace, Clark County, Nevada.* This intra-Service biological opinion took a programmatic (landscape-level) approach to evaluating potential effects to the endangered Moapa dace from groundwater pumping by multiple parties in the Coyote Spring Valley and California Wash hydrographic basins, considered in light of conservation measures proposed in the Muddy River Memorandum of Agreement (MOA). Included in this evaluation was the pumping of CSI's State-appropriated water right of 4,600 acre-feet per year (afy) from Coyote Spring Valley to serve the proposed CSI residential development.

The Service prepared the programmatic biological opinion in the absence of site-specific information for individual projects; and while a non-jeopardy opinion was issued, incidental take was not authorized for any action with a Federal nexus. This approach assumes that site-specific actions proposed under the "umbrella" of the MOA will be submitted to the Service and evaluated pursuant to section 7 or section 10 of the Act, as appropriate. The specific effects associated with, and the incidental take authorized for individual projects, such as the CSI residential development, will be assessed separately and tiered to the programmatic document, incorporating portions of it by reference. Because the programmatic consultation did not evaluate impacts to species other than the Moapa dace, effects to other federally-listed species will be evaluated in the tiered section 7 consultations. The programmatic document was assigned log number 1-5-05-FW-536 and is appended to this tiered biological opinion (see Appendix A for the programmatic opinion and supporting documents, including the Muddy River MOA; see below for further description of the tiered-programmatic consultation approach).

As the lead Federal agency for this consultation, the Corps has determined that the proposed action is likely to adversely affect the threatened desert tortoise and its designated critical habitat, and the endangered Moapa dace. No critical habitat has been designated for the Moapa dace; therefore, none will be affected and no such analysis is required. The Corps' June 27, 2005, request for formal consultation included a request for the Service's concurrence on "may affect, not likely to adversely affect" determinations for two listed and one candidate avian species: the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), the endangered Yuma clapper rail (*Rallus longirostris yumanensis*), and the western U.S. distinct population segment of the Federal candidate yellow-billed cuckoo (*Coccyzus americanus*) (67 FR 40666). The Corps based these determinations on water monitoring and conservation measures that will allow for early detection of decreased groundwater levels and surface water flows, as well as CSI's commitment to reduce and redirect pumping should in-stream flow levels on the upper Muddy River drop to certain levels (trigger points), as measured at the Warm Springs West Flume on the Moapa Valley National Wildlife Refuge (NWR) and as specified in the Muddy River MOA.

Habitat for all three avian species exists in the Muddy River system. The Nevada Department of Wildlife (NDOW) has conducted annual surveys for southwestern willow flycatchers on the Warm Springs Ranch, upper Muddy River, since 2003; surveys for yellow-billed cuckoos have been conducted since 2000. Nesting and/or territorial flycatchers and cuckoos have been detected in all survey years (C. Tomlinson, NDOW, pers. comm., 2005). Additionally, nesting and territorial flycatchers regularly occupy habitat in the Muddy River Delta, and have been detected in the area since 1997 (McKernan and Braden 1998, 2001, 2002; SWCA 2005; C. Tomlinson, pers. comm., 2005). In 1999 and 2001, NDOW documented a single Yuma clapper rail in surveys at the Overton Wildlife Management Area, lower Muddy River. NDOW has since discontinued surveys for Yuma clapper rails in southern Nevada, which is the northernmost distribution of the subspecies (Resource Concepts, Inc. 2005; hereafter, RCI). Groundwater pumping in Coyote Spring Valley has the potential to impact habitat for these species along the Muddy River by decreasing groundwater levels; spring outflow and in-stream flow; prey (invertebrate) availability; and the distribution, structure, and species composition of riparian vegetation. The Corps anticipates that the water monitoring program will allow for early detection of changes in groundwater levels and surface flows; if in-stream flows drop below levels specified in the Muddy River MOA, commitments made by CSI and other parties to the MOA should restore flow levels in the Muddy River system before: 1) effects to riparian vegetation occur and 2) effects perpetuate downstream to the Overton area. Therefore, no significant impacts to these species or their habitats are expected as a result of CSI's proposed action.

Based on the reasons discussed above, our knowledge of the activities and the affected area, and our review of information provided in the various documents supplied to us in support of this consultation [biological assessment (RCI 2005); application for section 404 permit, including supplemental materials (The Huffman-Broadway Group, Inc. 2005); and the Environmental Assessment (ENTRIX 2005), the latter of which supersedes previous project descriptions], we concur with the Corps' determination that the proposed project may affect, but is not likely to adversely affect southwestern willow flycatcher and Yuma clapper rail. The western yellow-billed cuckoo is a candidate species, which does not require consultation under section 7; however, we acknowledge and agree with the Corps' determination for this candidate species. Should the project description or habitat conditions change from what is described in the Environmental Assessment, effects determinations should be reevaluated.

When consultation was initiated on June 27, 2005, the Corps considered potential project effects to proposed critical habitat (Pahranagat Management Unit) for the southwestern willow flycatcher (69 FR 60705). The proposed Pahranagat Management Unit was to be located approximately 15 miles up-gradient of the CSI project area along the Pahranagat River near Nesbitt Lake and the Upper and Lower Pahranagat Lakes, and approximately 30 miles down-gradient of the CSI project area along the Muddy River near Overton, Nevada. On October 19, 2005, the final rule to designate critical habitat for the southwestern willow flycatcher was published in the Federal Register, and the proposed Pahranagat Management Unit was not included (70 FR 60886). While the areas contained in the proposed Pahranagat Management Unit were identified as having features essential to the southwestern willow flycatcher, the Service determined that these areas did not need to be designated as critical habitat due to existing Federal and State management of the land. The closest designated critical habitat to the CSI project area is the Virgin Management Unit, a 73.8-mile stretch of the Virgin River which includes an 18.6-mile stretch in Clark County, Nevada, from the Arizona border to the upstream boundary of the Overton State Wildlife Area. The Virgin Management Unit is located in the Virgin River Flow System, a different groundwater flow system than that in which the CSI project is located. Therefore, we do not anticipate that this project will affect designated critical habitat for the southwestern willow flycatcher.

Regardless, the Service does not anticipate that CSI's pumping of groundwater from locations in Coyote Spring Valley identified herein will affect non-critical flycatcher habitat up-gradient in the Pahranagat Valley due to the large head difference (1,200 – 1,500 feet) between the two areas. Additionally, the Pahranagat Shear Zone, which lies between these two areas, is believed to act as a barrier to groundwater flow (T. Mayer, Service, pers. comm.). We also do not anticipate that groundwater pumping associated with this project will affect non-critical flycatcher habitat along the lower Muddy River near Overton due to the early-detection water monitoring program that is being implemented, and the commitment by CSI to redistribute and redirect groundwater pumping should in-stream flows at the Warm Springs West Flume, which is approximately 20 miles upstream from the Overton area, decline to levels specified in the MOA.

This biological opinion is based on information in the May 31, 2005, section 404 permit application (The Huffman-Broadway Group, Inc. 2005); the June 2005 Biological Assessment (RCI 2005); the June 23, 2005, letter from the Corps to the Service initiating formal consultation; the Service's July 14, 2005, letter to the Corps acknowledging receipt of the formal consultation letter; meetings and correspondence among the Service, Corps, Environmental Protection Agency (EPA), project applicant, and/or the applicant's consultants regarding the section 404 permit application and/or the biological assessment; supplemental information for the section 404 permit application requested of the Corps by the Service on July 8, 2005, and received on August 23, 2005; the December 2005 Final Environmental Assessment, Coyote Springs Project, Clark County, Nevada; the Desert Tortoise (Mojave Population) Recovery Plan (Service 1994); the Desert Tortoise Recovery Plan Assessment Report (Tracy et al. 2004); Endangered and Threatened Wildlife and Plants- Determination of Critical Habitat for the Mojave Population of the Desert Tortoise (59 FR 5820); the Clark County MSHCP and Environmental Impact Statement (RECON 2000); the Clark County MSHCP biological opinion (Service 2000); the January 30, 2006, programmatic biological opinion for the Muddy River MOA (Appendix A); discussions with species experts familiar with the ecology of the species; and other sources of available information cited herein. A complete administrative record of this consultation is on file in the Southern Nevada Field Office located in Las Vegas, Nevada.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (No. 03-35279) to complete the following analysis with respect to desert tortoise critical habitat.

Programmatic Consultation

Due to the number of impending groundwater-withdrawal actions by different entities from two hydrographic basins near the Muddy River Springs area, we determined that a tiered programmatic approach would best analyze potential effects of these actions to the federally-endangered Moapa dace. Programmatic consultations can provide the benefit of streamlining the consultation process while leading to a more landscape-based approach to consultations that can minimize the potential "piecemeal" effects that can occur when evaluating individual projects out of the context of a complete agency program. Some of the benefits of programmatic consultations include: (1) better and more cost effective integration of ecosystem/recovery planning activities with agency activities; (2) streamlined consultation processes; (3) added predictability for all signatories of the MOA; (4) minimization of the potential "piecemeal" effects that can occur when evaluating individual projects out of the context of a complete agency program; and (5) the opportunity to better and more efficiently integrate the action agency's 7(a)(1) responsibilities at the program level.

The tiered programmatic approach is a two-stage consultation process with the two stages fulfilling the same purposes. The first stage biological opinion or concurrence, as appropriate, evaluates the landscape-level effects. The second stage results in the completion of project-specific documentation that addresses the specific effects of each individual project. Under the tiered approach, two complete biological opinions are completed for each proposed action, with the second-stage documents "tiering" to the first-stage document by incorporating portions of it by reference. Thus each action has its own individual consultation document that is supported by the programmatic document.

Project-Specific Level Consultation under the Tiered Programmatic Consultation Approach

As individual projects are proposed under the tiered programmatic consultation approach, project-specific information will be provided that: (1) describes each proposed action and the specific areas to be affected; (2) identifies the species and critical habitat that may be affected; (3) describes the manner in which the proposed action may affect listed species; (4) describes the anticipated effects; (5) specifies the *anticipated effects from the proposed project are consistent with those analyzed in the programmatic biological opinion*; (6) describes proposed measures to minimize potential effects of the action; and (7) describes any additional effects, if any, not considered in the programmatic consultation. The Service reviews this information and then completes a tiered biological opinion with a project-specific incidental take statement. This document, while meeting the basic requirements of biological opinions as specified at 50 CFR 402.14(h), generally requires less effort to complete because it references back, or tiers, to the program-level biological opinion.

The CSI biological opinion represents our project-level consultation for a proposed action previously considered and included in the *Intra-Service Programmatic Biological Opinion for the Proposed Muddy River Memorandum of Agreement Regarding the Groundwater Withdrawal of 16,100 Acre-Feet per Year from the Regional Carbonate Aquifer in Coyote Spring Valley and California Wash Basins and Establish Conservation Measures for the Moapa Dace, Clark County, Nevada* (File No. 1-5-05-FW-536) (Appendix A). The tiered and programmatic biological opinions were prepared in accordance with the July 16, 2003, *Draft Programmatic Consultation Guidance* (Service 2003).

Consultation History

On September 22, 2004, the Service issued a letter to the Clark County manager in Las Vegas, Nevada, raising concerns about the potential effects of residential and commercial developments in the Coyote Spring Valley on threatened and endangered species. Specifically, concerns were raised about potential effects to the Moapa dace from groundwater pumping activities associated with the proposed CSI development. While incidental take of desert tortoise is currently covered under the Clark County MSHCP for those actions that occur in Clark County, the Moapa dace is not covered under the MSHCP and incidental take is not authorized for this species. Also, activities associated with surface and groundwater withdrawal are outside of the scope of the MSHCP and incidental take permit.

On October 7, 2004, the Muddy River MOA was revised to include CSI due to the potential effects to the Moapa dace that could occur from CSI's pumping of existing permitted water rights in Coyote Spring Valley for their proposed development in Clark County. Inclusion of CSI in the MOA allowed the Service to analyze the potential effects of all the Parties' proposed actions related to water withdrawal activities in the Coyote Spring Valley hydrographic basin on Moapa dace.

On October 18, 2004, the Service received a request from RCI consulting firm for a list of federally threatened, endangered, and candidate species for the proposed CSI residential community development project in Clark County, Nevada.

On January 7, 2005, the Service sent project consultants at RCI a species list in response to their October 18, 2004, request (File No. 1-5-05-SP-410).

On January 27, 2005, the Corps, Service, and project consultants from Huffman-Broadway Group, RCI, and ROBCYN met to discuss future Service and Corps permits related to the proposed CSI development project and related agency NEPA compliance requirements.

On April 19, 2005, the Service met with the project applicant and a project consultant from ROBCYN to review the status of on-going development actions being taken by CSI in Clark County. Conservation measures for the proposed CSI development in Clark County were also discussed.

On June 3, 2005, the Service provided comments on the draft Biological Assessment for Coyote Springs Investment to project consultants at RCI and ROBCYN.

On June 23, 2005, the Corps requested formal consultation for the proposed issuance of a Section 404 permit under the Clean Water Act of 1972, as amended, to discharge dredged and fill material into 7.78 acres of unnamed ephemeral washes delineated as WOUS for the proposed CSI development in Clark County, Nevada.

On June 28, 2005, a final Biological Assessment was prepared for the Corps by RCI. The Corps' earlier written request to the Service for formal consultation contained several inconsistencies with the June 2005 Biological Assessment for CSI (RCI 2005), particularly in regards to effects determinations and conservation measures. A follow-up phone call on July 13, 2005, from the Service to the Corps, as well as the Service's July 14, 2005, formal consultation initiation letter, served to rectify these discrepancies.

On July 8, 2005, the Service requested additional information from the Corps relative to the section 404 Clean Water Act permit application, including maps depicting the location of detention/retention basins and created wetlands, and specifics regarding re-vegetation of constructed washes.

On July 14, 2005, an MOA was agreed to in principle by the Moapa Band of Paiutes (Tribe), Southern Nevada Water Authority (SNWA), Moapa Valley Water District (MVWD), CSI, and the Service to ensure that conservation actions were in place prior to potential impacts associated with groundwater pumping in the Coyote Spring Valley and California Wash basins.

On July 19, 2005, the Service determined that given the multiple parties involved and the complexity of issues at hand, a programmatic approach would most effectively evaluate the effects of actions included in the Muddy River MOA. This approach would assess landscape-level effects of the cumulative pumping of groundwater from the regional carbonate aquifer on the endangered Moapa dace, including conservation measures proposed in the MOA to offset these potential impacts. Future, site-specific actions and associated impacts to federally-listed species other than the Moapa dace would be evaluated in subsequent biological opinions that tier to the programmatic document, as appropriate.

On August 3, 2005, the Service responded to the Corps' Public Notice 200125042 for issuance of a section 404 Clean Water Act permit to discharge dredged and fill material into 7.78 acres of unnamed ephemeral streams (WOUS) associated with the CSI development project. The Service reiterated that additional project information had been requested of the Corps and project consultant on two occasions (the week of June 27, 2005 and July 8, 2005), and this request had been unanswered as of August 3, 2005.

On August 16, 2005, the Service met with the Corps, EPA, project applicant, and ROBCYN to discuss issues related to the section 404 Clean Water Act permit application. The purpose of the meeting was to clarify project scope; potential effects to WOUS; and proposed measures to avoid, minimize, and mitigate impacts to WOUS. At this meeting, the Federal agencies requested printed supplemental materials to clarify project scope, impacts to WOUS, and proposed conservation measures.

On August 23, 2005, project consultants from Huffman-Broadway Group in conjunction with RCI provided the Corps, EPA, and the Service with supplemental material for their May 31, 2005 application for a section 404 permit for the Coyote Springs Project.

On September 15, 2005, the Service, Corps, EPA, project applicant, and the applicant's consultants met at the CSI project site to discuss avoidance, minimization, and mitigation measures for impacts to WOUS. To follow up, EPA sent electronic mail correspondence to all parties summarizing the points of agreement from this meeting on September 21, 2005.

On September 19, 2005, the Service completed a follow-up site visit to view an additional wash that potentially warranted protection within the project area. A summary of the site visit and our recommendations were provided to the project consultants on October 3, 2005.

On October 12, 2005, the Service met with the project applicant to discuss protection of an additional wash on the CSI project site.

On November 2, 2005, the Service submitted a letter to the project applicant to acknowledge resolutions reached on the concerns outlined in the Service's comment letter dated August 3, 2005. These concerns were addressed through a series of meetings and site visits between August 16 and October 12, 2005, as well as supplemental information provided by the project consultant to the Service on August 23, 2005.

On November 28, 2005, the Service provided a draft biological opinion to the project applicant (CSI) for their review. On December 12, 2005, CSI provided comments to us. This biological opinion incorporates the comments, as appropriate.

On December 21, 2005, the Service received a copy of the Final Environmental Assessment for the Coyote Springs Project, Clark County, Nevada from ENTRIX Environmental Consultants. The Environmental Assessment included an updated project description with revised estimates of impacts to WOUS based on updated conservation measures (4.75 acres of dry wash impacted instead of the previously estimated 7.78 acres), as well as additions and clarifications to conservation measures.

On January 27, 2006, the final Muddy River MOA was agreed to in principle by the Tribe, SNWA, MVWD, CSI, and the Service to ensure that conservation actions were in place prior to potential impacts associated with the project's groundwater pumping.

On January 30, 2006, the Service finalized the *Intra-Service Programmatic Biological Opinion for the Proposed Muddy River Memorandum of Agreement Regarding the Groundwater Withdrawal of 16,100 Acre-Feet per Year from the Regional Carbonate Aquifer in Coyote Spring Valley and California Wash Basins, and Establish Conservation Measures for the Moapa Dace, Clark County, Nevada* (File No. 1-5-05-FW-536) (Appendix A).

On February 1, 2006, the Service received an updated request for formal consultation under section 7 of the Act from the Corps for individual permit Application No. 200125042 for the CSI development. The Corps' written request, provided via electronic mail, indicated that the project description and conservation measures had changed since the original consultation submitted to the Service on June 23, 2005, and that these changes are reflected in various documents and correspondence, including the August 23, 2005, supplemental application materials and the December, 2005, Final Environmental Assessment and mitigation plan.

On February 9, 2006, the Service provided comments via electronic mail to the Corps on the draft Permit Evaluation and Decision Document for CSI, Application No. 200125042.

On February 13, 2006, the Service provided a draft biological opinion to the Corps, Clark County, project applicant (CSI), the applicant's consultants (ROBCYN, ENTRIX), and the Tribe for their review. By electronic mail dated February 15, 2006, CSI (via ROBCYN) provided comments to us. This biological opinion incorporates the comments, as appropriate.

Clark County Multiple Species Habitat Conservation Plan

On November 19, 2000, the Service issued a biological and conference opinion on issuance of an incidental take permit to Clark County, Nevada for its MSHCP. Subsequently, the Service issued a section 10(a)(1)(B) incidental take permit (#TE034927-0) under the Act to Clark County and cities therein (Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite), and the Nevada Department of Transportation (NDOT) for the MSHCP. This permit authorized the incidental take of 78 species ("covered species") for private actions on non-Federal lands to the extent that take of these species would otherwise be prohibited under section 9 of the Act and its implementing regulations, or pursuant to a rule promulgated under section 4(d) of the Act. Covered species include two federally-listed species: the threatened desert tortoise and the endangered southwestern willow flycatcher. However, under the special permit terms and conditions, take of southwestern willow flycatcher and five other covered, non-listed avian species is conditioned on the acquisition of private lands in desert riparian habitats along the Muddy and Virgin rivers, and Meadow Valley Wash.

As mentioned previously, incidental take of the desert tortoise on CSI's private lands in Clark County is authorized under the section 10(a)(1)(B) permit (#TE034927-0) issued to Clark County for its MSHCP. However, the Service's biological opinion for issuance of an incidental take permit for the MSHCP specifically analyzed a lower level of land use in the Coyote Spring Valley than what is currently proposed by CSI. We intend to amend the November 19, 2000, *Intra-Service Biological and Conference Opinion on Issuance of an Incidental Take Permit to Clark County, Nevada for an MSHCP* (File No. 1-5-00-FW-575) with this biological opinion by analyzing herein the potential effects of CSI's proposed action on the desert tortoise and its critical habitat. The total number of acres of disturbance and the associated take permitted under Clark County's incidental take permit will not change. Also, this amendment is valid only for the desert tortoise and its critical habitat; the Service's analysis and conclusions for all other species evaluated in the Clark County MSHCP biological opinion remains valid and unchanged.

BIOLOGICAL OPINION

Description of the Proposed Action

Groundwater Rights in Coyote Spring Valley and Muddy Springs Area

Relevant State Engineer rulings, permitted groundwater rights, rights held in abeyance, and pending applications for the Coyote Spring Valley (Basin 210) and Muddy Springs Area (Basin 219) hydrographic basins are summarized below. For further information, please refer to pages 6-10 in the programmatic biological opinion (Appendix A).

To date, the Nevada State Engineer has granted 16,300 afy of groundwater right permits in Coyote Spring Valley basin, which includes 4,600 afy owned by CSI and 9,000 afy owned by SNWA and Las Vegas Valley Water District (LVVWD). So far, there has been almost no pumping of the permitted rights in Coyote Spring Valley (see below). The Nevada State Engineer has granted approximately 14,800 afy of groundwater right permits in the Muddy River Springs Area basin, including the MVWD's permits totaling 10 cfs or 7,240 afy from the carbonate aquifer in the Warm Springs Area, point of diversion at the Arrow Canyon Well, located approximately 2.3 miles west of the Moapa Valley NWR. In Ruling 4243, the Nevada State Engineer ordered MVWD to take a phased-in pumping approach to the withdrawal of its groundwater rights at Arrow Canyon Well, increasing pumping incrementally from 1996 through 2004, with monitoring to evaluate impacts to springs and groundwater levels (Nevada State Engineer 1995). Demand for this water was less than forecasted by the MVWD and groundwater pumping from the Arrow Canyon Well has lagged behind the incremental pumping rate ordered by the State Engineer in Ruling 4243. Pumping was stepped up to 2.7 cfs in 1998, in part at the request of the Federal agencies to allow collection of data related to the effects of groundwater production from the carbonate aquifer. Approximately 2,400 afy has been pumped on average between 1998 and 2003 from the carbonate aquifer of the Muddy River Springs Area basin at the Arrow Canyon Well location.

In March 2002, in response to water right protests filed by the Department of the Interior [Service, National Park Service (NPS), Bureau of Land Management (BLM)] and other entities, the Nevada State Engineer issued a ruling (Order 1169) on groundwater applications in Coyote Spring Valley and other nearby hydrographic basins within the regional carbonate aquifer system (Nevada State Engineer 2002). The State Engineer required that, before any additional water right permits would be granted in the area, the major permit holders to groundwater rights should participate in a five-year study to provide information on the effect of pumping existing water right permits on the regional carbonate aquifer system, including the Warm Springs Area.

During the Order 1169 study, a minimum of half the existing permitted groundwater rights in Coyote Spring Valley- at least 8,150 afy- are to be pumped for a period of two consecutive years. To meet the requirements of this study, various participating entities, including CSI, SNWA, and the LVVWD, will pump their existing groundwater rights in Coyote Spring Valley. SNWA, in conjunction with co-applicant MVWD, will pump its existing rights of 9,000 afy of groundwater from Coyote Spring Valley to water users in Moapa Valley. SNWA and the LVVWD have begun implementing the study in cooperation with other water right holders and Federal agencies (Service, NPS, and BLM) by expanding existing monitoring efforts and drilling additional monitoring wells in Coyote Spring Valley and the Upper Moapa Valley.

CSI proposes to withdraw their 4,600 afy of State-appropriated water from two well locations in Coyote Spring Valley in order to help meet the water demands of its proposed residential community. These water rights were originally appropriated under Nevada Division of Water Resources (DWR) Permit No. 46777 (5,000 afy), with the point of diversion and place of use subsequently changed under Permit Nos. 70429 and 70430 (4,600 afy combined); the remainder of CSI's water under this permit was sold to SNWA. In early 2005, CSI filed an application with the Nevada State Engineer to change the point of diversion for CSI Well No. 1 (Permit No. 70430) from the SW ¼ of the SE ¼ of Section 22, Township 13 S, Range 63 E to a location approximately 2,900 feet west-northwest of this point. Additionally, CSI applied for a temporary point-of-diversion change for CSI Well No. 1 to the MX-5 well site for initial construction and nursery water production (February 4, 2005, facsimile from C. Savely, Wingfield Nevada Group to P. Fahmy, Office of the Solicitor, Rocky Mountain Region). This well was developed and pump tested during the spring of 2005, and production has commenced to meet construction needs. CSI Well No. 2 (Permit No. 70429) is located approximately 1.5 miles north of State Route 168 (SR 168) and just west of Pahranagat Wash. This well was developed and pump tested during the fall of 2005, and will be operational by April 2006. To date, CSI pumping has been limited to approximately 240 acre-feet. CSI anticipates a phased-in pumping approach over five years for production of its permitted water rights: 600 acre-feet the first year, 1,600 acre-feet the second year, 2,600 acre-feet the third year, 3,600 acre-feet the fourth year, and 4,600 acre-feet the fifth year (see Appendix A, pg. 11).

Monitoring of surface flows and groundwater levels is required by the State Engineer as a condition of CSI's groundwater permits in Coyote Spring Valley. This monitoring will provide necessary information to assess long-term impacts to the aquifer and down-gradient flows (RCI 2005). SNWA has agreed to conduct the monitoring associated with CSI's permitted water rights as part of a 2002 agreement between multiple parties, including CSI, aimed at settling claims to groundwater in the Coyote Spring Valley hydrographic basin. In March 2005, the Nevada State Engineer accepted SNWA's groundwater monitoring plan for applications and permits in Coyote Spring Valley and neighboring basins. Currently, SNWA monitors eight carbonate wells in the Coyote Spring Valley hydrographic basin on a continuous basis, and one carbonate well and four alluvial wells on a monthly basis. A copy of the monitoring plan, including a summary of the applications and permits monitored by SNWA in Coyote Spring Valley, is attached as an appendix to the CSI biological assessment (RCI 2005).

Land Ownership in Coyote Spring Valley and Surrounding Area

Prior to 1988, the lands currently owned by CSI were Federal lands administered by BLM. In 1988, Congress enacted Public Law 100-275, or *The Nevada-Florida Land Exchange Authorization Act of 1988* (NV-FL Act), authorizing the exchange of 29,055 acres of BLM-administered lands in Coyote Spring Valley, Clark and Lincoln counties, Nevada, for roughly 5,000 acres of private land in the Florida Everglades owned by Aerojet-General Corporation (Aerojet). The purpose of the land trade was to provide habitat protection for environmentally sensitive areas needed for recovery of federally-protected species in Florida. The NV-FL Act also entitled Aerojet to lease approximately 13,767 acres of BLM-administered land in Coyote Spring Valley for 99 years, with an option for a 99-year lease renewal. Aerojet intended to use approximately 2,760 acres of the conveyed (fee) lands for the construction of rocket manufacturing, assembly, and testing facilities. Much of the remaining fee lands (15,560 acres) and the entirety of BLM-leased lands were to remain largely undeveloped containing only wells, utilities, and some access infrastructure, thus serving as a conservation area and buffer for the rocket facilities (RCI 1987, Service 2000). Also included in the NV-FL Act was a provision for a federally-reserved electrical transmission line Right-of-Way (ROW) corridor on 10,735 acres of the patented land in Lincoln and northern Clark counties. In 2004, the Federal government relinquished all right, title, and interest in the ROW corridor and it was moved to public land west of Highway 93 (hereafter, US 93) as part of the *Lincoln County Conservation, Recreation, and Development Act of 2004* (LCCRDA). This action expanded development opportunities on the former Aerojet lands.

Aerojet never built the facilities intended for this land and in 1996, sold and assigned its interests to Harrich Investments, LLC, which in turn sold and assigned those interests to CSI in 1998. The Secretary of the Interior approved the assignment of the lease and all its rights from Aerojet to Harrich Investments, LLC in 1996, and then again to CSI in 1998, in accordance with the NV-FL Act (RCI 2005). Prior to the lease assignment, CSI informed the Secretary of Interior of the plan to build a community at the site (ENTRIX 2005).

The original land-ownership configuration in Coyote Spring Valley had BLM-leased land as an island within the Aerojet/CSI private land. When CSI initially proposed developing both fee and leased lands, the Service, BLM, and CSI realized that this land-ownership configuration would pose management problems for all parties and would not be in the best interest of tortoise conservation and protection of WOUS. Working with the Service and BLM, CSI agreed to a reconfiguration of its Clark County fee and leased lands that consolidated the private lands to the west side of Pahranagat Wash and the BLM-leased land to the east. This land-ownership pattern, finalized in February 2005, will help protect habitat linkages between 1) Pahranagat Wash, the alluvial fans, and the Meadow Valley Mountains, and 2) the alluvial fans of the Meadow Valley Mountains and the Arrow Creek Range.

CSI has agreed to protect in perpetuity the approximately 6,219 acres of leased lands lying east of Pahranagat Wash in Clark County by establishing a reserve to be known as the Coyote Springs Resource Management Area and recording a permanent conservation easement on the lands. These leased lands may eventually be relinquished to the Federal government, perhaps in association with the development of a Habitat Conservation Plan for CSI lands in Lincoln County (RCI 2005). Any future use of these reserve lands will be limited to passive recreation, and no real property improvements, roads, or other development is planned (ENTRIX 2005). Creation of the Coyote Springs Resource Management Area and conservation easement recordation is considered mitigation for impacts to WOUS associated with CSI's development of lands in Clark County, and is thus linked to issuance of the Corps' permit for this project. Timing of work within WOUS relative to recording of the conservation easement will be in accordance with the 404 permit special conditions. While creation of the reserve clearly provides conservation benefit to tortoises and other wildlife, the Service is not considering this as mitigation for impacts to the desert tortoise associated with CSI's development in Clark County. CSI is providing other conservation measures for the desert tortoise that are specific to this action, described below under *Conservation Measures Specific to the Desert Tortoise*.

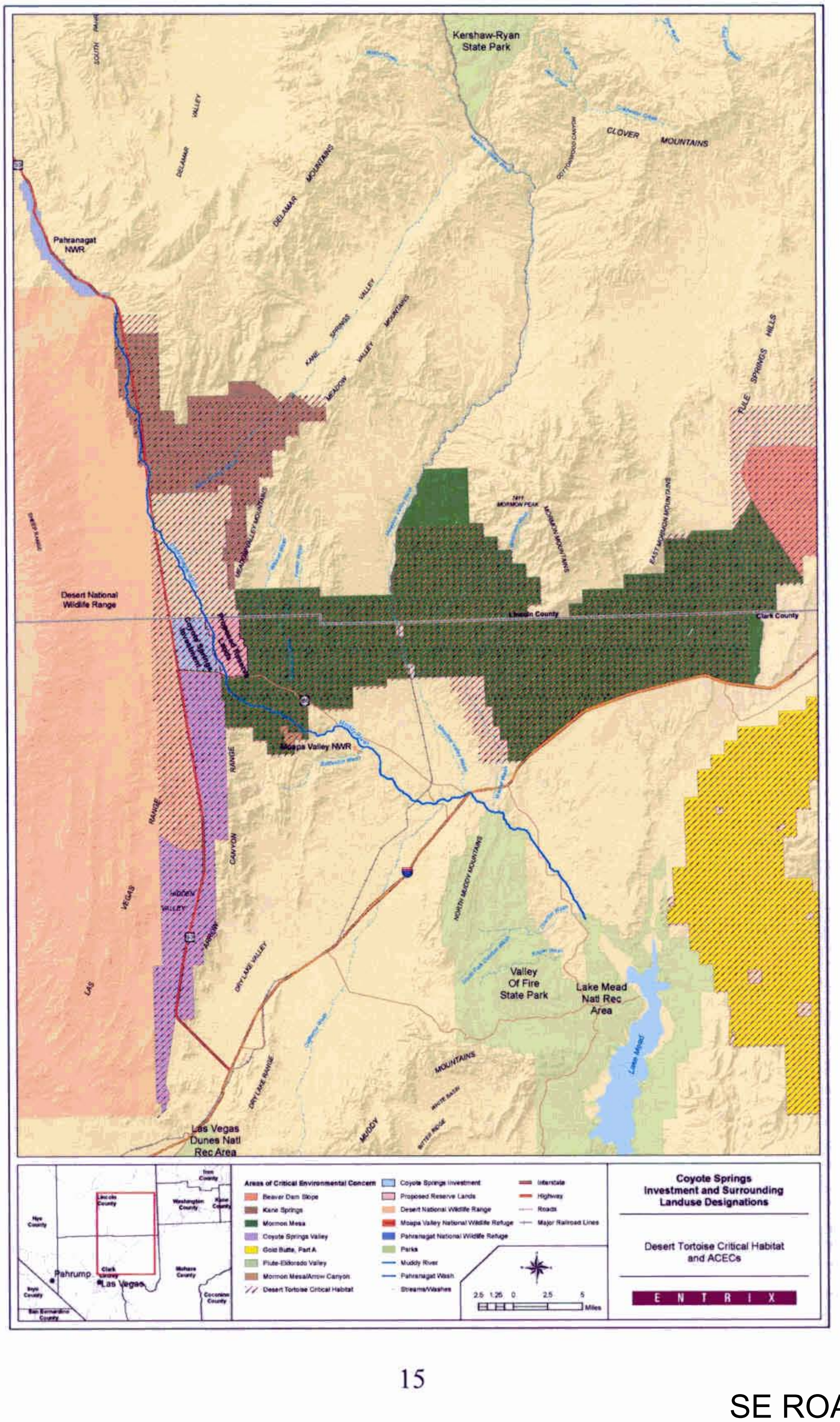
As described below, the action under consideration is the development of CSI's private lands in Clark County, Nevada. Lands immediately to the north of the project area in Lincoln County are owned by CSI or leased to CSI from BLM in accordance with Public Law 100-275. Federal lands surround CSI's land in all other directions. To the west of US 93 lies the Desert NWR: encompassing roughly 1.6 million acres, this refuge was established in 1936 for preservation and management of the desert bighorn sheep and its habitat and is administered by the Service. The remainder of the surrounding lands is managed by BLM, with large areas designated as Areas of Environmental Concern (ACEC) specifically for conservation of the desert tortoise: the Coyote Springs ACEC to the south, Kane Springs ACEC to the north, and Mormon Mesa ACEC to the east (Figure 1). Combined, the three tortoise ACECs and CSI's land largely comprise the Mormon Mesa Critical Habitat Unit (CHU), designated by the Service for conservation and recovery of the desert tortoise. When critical habitat for the desert tortoise was designated in 1994, the Service included the Aerojet lands in the Mormon Mesa CHU due to their present and projected function as important tortoise habitat (59 FR 5820, Service 2000).

Proposed Action

The following description of the proposed action has been summarized from the Environmental Assessment (ENTRIX 2005), Biological Assessment (RCI 2005), the section 404 Clean Water Act permit application (The Huffman-Broadway Group, Inc. 2005), and supplemental materials supplied by the applicant's consultants in support of the 404 permit application. Information related to the Service's amendment of the Clark County MSHCP biological opinion is summarized from the Desert Conservation Plan (DCP) (RECON 1994), the Clark County MSHCP (RECON 2000), and the respective biological opinions (Service 1995, 2000). These documents can be referenced for additional detail.

The project applicant, CSI, proposes to build a residential and golf community on private land in Coyote Spring Valley, northern Clark County, Nevada, approximately 50 miles northeast of Las Vegas. The entire project area comprises approximately 13,100 acres, of which 6,881 acres are planned for residential and commercial development (Project Development Area) and 6,219 acres are planned as a natural reserve that will ultimately be named the Coyote Springs Resource Management Area (Figure 1). The project area is located in Township 13 South, Range 63 East, encompassing all or parts of Sections 1-5, 8-17, and 20-26; and Township 13 South, Range 64 East, encompassing all or parts of sections 6, 7, 18, 19, and 30. The Project Development Area is generally bounded on the south by SR 168, on the north by the Clark-Lincoln county line, on the east by Pahranagat Wash, and on the west by US 93. The Project Development Area includes the NDOT ROW west of US 93 where project infrastructure (stormwater detention basins) is planned.

Figure 1


Kershaw-Ryan State Park
CLOVER MOUNTAINS
DELAMAR MOUNTAINS
Pahranagat NWR
KANE SPRINGS VALLEY
MEADOW VALLEY MOUNTAINS
MORMON MOUNTAINS
EAST MORMON MOUNTAINS
Desert National Wildlife Range
Lincoln County
Clark County
Moapa Valley NWR
Valley Of Fire State Park
Lake Mead Natl Rec Area
LAS VEGAS RANGE
NORTH MUDDY MOUNTAINS
MUDDY MOUNTAINS
Las Vegas Dunes Natl Rec Area
Pahrump
Las Vegas
Areas of Critical Environmental Concern
Beaver Dam Slope
Kane Springs
Mormon Mesa
Coyote Springs Valley
Gold Butte, Part A
Piute-Eldorado Valley
Mormon Mesa/Arrow Canyon
Desert Tortoise Critical Habitat
Coyote Springs Investment
Proposed Reserve Lands
Desert National Wildlife Range
Moapa Valley National Wildlife Refuge
Pahranagat National Wildlife Refuge
Parks
Muddy River
Pahranagat Wash
Streams/Washes
Interstate
Highway
Roads
Major Railroad Lines
2.5 1.25 0 2.5 5
Miles
Coyote Springs Investment and Surrounding Landuse Designations
Desert Tortoise Critical Habitat and ACECs
ENTRIX

The development will impact approximately 4.75 acres of the 61.26 acres of delineated WOUS within the project area, thus necessitating compliance with section 404 of the Clean Water Act. The potentially affected WOUS are west-east running dry desert washes subject to infrequent surface flows during large precipitation events. These washes drain into Pahranagat Wash, a large north-south running ephemeral drainage on the eastern edge of the development and a tributary to the Muddy River via Arrow Canyon.

Development of the property will occur in four phases, starting in the southern/southwestern part of the project area and moving north and east (Table 1). Development, including residential, commercial, recreational (e.g., golf), and public facilities, will occur over 25 years, with an eventual build out of 29,000 residential units and approximately 72,500 residents and a visitor capacity equal to 14,500 residents (based on full-time equivalency). The applicant anticipates that 2,500 residential units and approximately 80 acres of commercial development will occur over the first five years. By year ten, the number of residential units may reach 16,000, with 29,000 units possible by year fifteen.

Table 1. Project Phasing and Acreage for Coyote Springs Investment Project

Phase	Development Type/Mix	Acreage of Development	Estimated Implementation Time Frame
1	Mixed Use-residential, commercial and public facilities	3,110	2-7 Years
2a	Mixed Use-residential, commercial and public facilities	1,155	8-13 Years
2b	Mixed Use-residential, commercial and public facilities	650	14-15 Years
3	Mixed Use-residential, commercial and public facilities	1,327	16-20 Years
4	Utility Infrastructure, Trails, Parks and Open Space	639	2-25 Years
Total		**6,881**	**25 Years**

CSI has determined that the current WOUS are inadequate to convey flood flows through the proposed community; stormwater will need to be redirected and several drainages will need to be enlarged and expanded to comply with Clark County flood control standards. CSI proposes to fill 15 drainages within the Project Development Area, widen 41,623 linear feet of existing drainages to expand the carrying capacity of the channels, and restore three desert dry washes (identified as F11-LP3, F10-BFD, and the lower portion of F7 in the Environmental Assessment). Reconstructed drainages will be "naturalized" by using local or on-site substrate material and revegetated with native plant species. The restored desert dry washes will be permanently protected with a protective (created or restored) upland buffer of 40 to 80 feet from bank on each side of the wash. This will result in 76.44 acres of created or restored upland buffers to protect these drainages.

A site visit on September 15, 2005, with CSI's consultants, the Service, Corps, and EPA resulted in the identification of three west-east dry washes (WOUS) in the Project Development Area that were subsequently recommended for protection in their natural condition. CSI has since agreed to protect in perpetuity the length of two of the more substantial washes in the northern part of the Project Development Area (identified as F14-LP4 and F17-LP5B in the Environmental Assessment; hereafter, referred to simply as F14 and F17) from US 93 to the proposed stormwater detention zone west of Pahranagat Wash. Additionally, CSI agreed to permanently protect approximately 1,650 linear feet of the western-most portion of wash F7 within the Project Development Area due to it having unique characteristics for the site, including dense catclaw acacia (*Acacia greggii*), deep structured side walls, and a more natural hydrologic connection to the west side of US 93. CSI will avoid impacts to washes F14 and F17 and the western-most 1,650 linear feet of wash F7 by: 1) avoiding construction activities on these sites, 2) preserving an approximate 100-foot upland buffer from bank on each side of wash F14 and wash F17, 3) preserving an approximate 75-foot upland buffer from bank on each side of the 1,650-foot stretch of wash F7, 4) avoiding, where possible, modification of wash F7 on the west side of US 93, and 5) replacing the existing pipe culverts under US 93 with appropriately-sized, open-bottom culverts to improve hydrological connectivity between the west and east sides of US 93 at washes F7, F14, and F17. Additionally, existing culverts will be replaced with resized culverts at five other wash locations. The 100-foot buffer width along washes F14 and F17 will serve as a general guideline; actual width will vary and be based on detailed site surveys of channel morphology and site topography. A trail system may be incorporated into these buffer zones as long as trail design minimizes impacts to the washes. The upland buffers along the preserved desert dry washes, totaling 143.11 acres, will remain in situ and will not be disturbed by construction activities. This, along with the 76.44 acres of created or restored upland buffers mentioned above, will result in the preservation of 219.55 acres of protective upland buffer.

Impacts to Pahranagat Wash will be minimized by preserving a minimum 100-foot buffer from edge of bank on the west side of the Wash. To the west of this buffer zone will be a stormwater retention zone that will further buffer Pahranagat Wash from development to the west. Within this retention zone, CSI will construct a series of stormwater retention basins consisting of 100 acres of treatment wetlands to attenuate stormwater flows at the end of the desert dry washes before they enter the Pahranagat Wash channel. The length of Pahranagat Wash running adjacent to the Project Development Area and the approximate 100-foot protective buffer will be included in CSI's proposed Coyote Springs Resource Management Area to the east and protected in perpetuity through a conservation easement. Additionally, a tortoise exclusion fence will be constructed along the eastern edge of the development that will also serve to minimize impacts to Pahranagat Wash.

All of the preserved and restored desert dry washes (totaling 20.49 acres) within the Project Development Area and the 219.55 acres of protective upland buffer zones will be permanently protected with a Natural Wash Buffer Zone Perpetual Conservation Easement. Once mitigation success criteria have been met, as outlined in the Environmental Assessment (ENTRIX 2005), management responsibility will be assumed by the grantee of the conservation easement. The grantee, the selection of which will be approved by the Corps and Service, will be responsible for assuring long-term protection of the site in accordance with the conservation easement agreement. Implementation of the above-described conservation buffers and easement areas will involve the future recordation of survey maps acceptable to all Parties, incorporating all of the above conservation features within the 13,100-acre project area and maintaining the previously agreed configuration of 6,881 developable acres and 6,219 acres set aside for conservation purposes.

A long-term stormwater management and flood control plan has been developed that aims to minimize impacts to the quality of water reaching Pahranagat Wash from future on-site and off-site storm events. A series of stormwater detention ponds will be located west of US 93 in the Nevada Department of Transportation (NDOT) ROW, and will be designed to capture the 100-year flood event (ENTRIX 2005). Off-site stormwaters captured in these ponds will be released into the preserved/reconstructed washes that traverse the development, emptying into the stormwater retention zone located west of Pahranagat Wash. The stormwater retention zone will include a system of constructed wetland ponds intended to filter urban and stormwater runoff, pollutants, and sediment prior to release (spill) into Pahranagat Wash. CSI intends to capture the two-year, six-hour flood events, using this water for on-site irrigation and other consumptive uses (ENTRIX 2005). Waters above the two-year, six-hour event would move through the conveyance system (drainages) and stormwater retention zone to Pahranagat Wash.

At present, infrastructure for the proposed development will occur strictly on CSI lands, other than the potential widening of existing roads to accommodate increased traffic flow. Currently, NDOT has no plan to widen US 93 or SR 168 (ENTRIX 2005). A CSI traffic demand study will be used by NDOT and Clark County to determine when these roads need to be widened. However, CSI anticipates that a deceleration lane for northbound traffic on US 93 and additional lanes on SR 168 will be needed to accommodate increased traffic at some point during Phase 1 of the development (ENTRIX 2005). CSI is considering several options for supplying power to the proposed development, including use of an existing 69 Kv transmission line that runs adjacent to the project area along US 93 and SR 168. A portion of the transmission line, which is owned and operated by Lincoln County Power District, was recently upgraded and could be converted to a 138 Kv line to serve the CSI community. Initial studies indicate that the upgrade could serve a large percentage of homes within the proposed development, but alternative sources or upgrades to the existing power grid will be needed for build-out. Additionally, CSI is exploring options for the production, distribution, and use of clean and efficient and/or renewable energy on site, such as solar, micro-turbine, or internal combustion engine technologies (ENTRIX 2005). CSI currently has no plans to use the ROW corridor west of US 93 established through the LCCRDA to supply the energy needs of the proposed development (L. Zonge, RCI, pers. comm.).

Plans for gas service have not been finalized at this point. Natural gas may be provided by extending a gas main down US 93 to the project area, should the primary gas utility company in southern Nevada decide to provide service to the CSI community. Otherwise, propane will be provided and utilized on-site to serve the gas needs of the development. No landfills will be built within the project area, and refuse will be trucked to a transfer station in Moapa and from there to an existing landfill in Apex (ENTRIX 2005). There is a Class III landfill application pending before the Nevada Division of Environmental Protection for a site within or adjacent to the Pahranagat Wash channel north of the project area in Lincoln County (The Huffman-Broadway Group, Inc. 2005). A water treatment plant to treat drinking water pumped from on-site wells will be located east of US 93, and a wastewater treatment plant will be located north of SR 168 and west of Pahranagat Wash. Exact locations for these facilities have not been determined, but they will be located within the CSI project area and outside the Pahranagat Wash 100-year floodplain (ENTRIX 2005; L. Zonge, pers. comm.).

Water for the proposed development will be provided from production wells located within the CSI project area (Nevada DWR Permit Nos. 70429 and 70430). These wells will be drawing water from the carbonate aquifer of the Coyote Spring Valley hydrographic basin, which is part of a regional carbonate aquifer system known as the White River Flow System. As mentioned above, CSI owns 4,600 afy of State-appropriated water rights within the Coyote Spring Valley basin, and pumping will be phased in over five years until the maximum amount is withdrawn in year five. Water needs for the proposed development will exceed CSI's appropriated water rights within the Coyote Spring Valley hydrographic basin within ten years of project initiation, given the proposed development schedule and assuming that the majority of residences built are occupied in this time frame and that one acre-foot of water will serve one to two urban households for a year. Withdrawal of water from other hydrographic basins for importation to Coyote Spring Valley and/or appropriation of additional water from Coyote Spring Valley hydrographic basin to service CSI will be evaluated in the future through appropriate Federal and State processes. CSI has agreed to dedicate to the conservation and recovery of the Moapa dace an amount equal to 5 percent of (1) all future water rights acquired by CSI within the Coyote Spring Valley and (2) all future water rights appropriated in other hydrographic basins by CSI which have been approved by the Nevada State Engineer for export to and use in the Coyote Spring Valley. Because this commitment is contingent on the future appropriation of water rights and/or the granting of Federal ROW permits for water importation to Coyote Spring Valley, the outcome of which is uncertain at present, this conservation measure is not considered part of the current proposed action and is not discussed below.

Conservation Measures

The resource conservation attributes of the proposed action will occur almost immediately, and in any case, before or contemporaneous with construction. As detailed below, dedication of funds to further conservation efforts is part of CSI's proposed conservation measures for both the desert tortoise and the Moapa dace. While contribution of funds is crucial to any conservation action, it is the completed, on-the-ground activity that results from the funding that provides the true benefit to the species. Therefore, the Service will consider the on-the-ground results when evaluating benefit to the species.

The creation of the Coyote Springs Resource Management Area and conservation easement recordation is considered mitigation for impacts to WOUS associated with CSI's development of lands in Clark County, and is thus linked to issuance of the Corps' permit for this project. The Service is not considering these reserve lands as mitigation for impacts to federally-endangered or threatened species associated with CSI's project in Clark County. While clearly of benefit to tortoises and other wildlife, CSI is providing other conservation measures for the desert tortoise that are specific to this action.

Conservation Measures Specific to the Desert Tortoise

Incidental take of desert tortoise and the effects associated with development of CSI's Clark County lands fall under purview of the Clark County Desert Conservation Program and permit issued to Clark County and cities therein by the Service pursuant to section 10(a)(1)(B) of the Act. The Corps proposes to minimize and mitigate the effects of the proposed action on the desert tortoise by requiring CSI, through enforceable conditions tied to the section 404 permit, to comply with the terms and conditions of the section 10(a)(1)(B) incidental take permit for the Clark County MSHCP. In this regard, CSI has agreed to pay $550 per acre as required under the section 10(a)(1)(B) permit for the Clark County MSHCP. The Corps will obtain confirmation of CSI's compliance with said terms and conditions and retain such proof of adherence in the project file, including payment receipts for mitigation fees assessed under the MSHCP prior to any surface-disturbing activity within the proposed action area.

By complying with the section 10(a)(1)(B) incidental take permit and MSHCP, effects of the proposed action will be minimized and mitigated through implementation of measures funded and administered through MSHCP activities and programs that are intended to enhance the survival and recovery of the desert tortoise in the wild. Conservation actions proposed under the MSHCP for the Mojave desert scrub ecosystem and the desert tortoise supplement ongoing conservation activities being carried out under various Federal agency management plans. Additionally, specific MSHCP measures that benefit the Mojave desert scrub ecosystem and desert tortoise include: 1) public information and education, 2) desert tortoise pickup and adoption, 3) agency public education projects, 4) desert tortoise translocation, 5) research on desert tortoise survivorship, 6) rare plant inventory and fencing, 7) desert tortoise line distance sampling, 8) protection and management of BLM ACEC's established specifically for conservation of the desert tortoise; 9) construction of desert tortoise fencing along roads and highways; 10) enhanced law enforcement and ranger capabilities on Federal lands; 11) predator control program; 12) upland restoration and rehabilitation; 13) management plans for state-listed plants; 14) acquisition of grazing allotments; and 15) development of conservation management plans for the DWMAs and low elevation plant species.

In addition to paying the development fee required under the Clark County MSHCP and 10(a)(1)(B) permit, CSI has agreed to provide for tortoise clearance surveys of the project area and fencing of the northern and eastern perimeter of the development with tortoise-proof barriers. Above and beyond these measures, CSI has agreed to pay $750,000 to fund research and activities that will further conservation efforts for the desert tortoise in Coyote Spring Valley and the Mormon Mesa CHU. These funds will be paid within 30 days of the issuance of the Corps' section 404 permit and will be put in an interest-bearing account to be used at the Service's direction for activities that will minimize and mitigate effects of the CSI development on the desert tortoise, as well as contribute to desert tortoise conservation and recovery efforts locally, regionally, and potentially range-wide. CSI has established a Science Advisory Team composed of tortoise and conservation strategy experts from the Service, U.S. Geological Survey (USGS), and University of Nevada, Reno (UNR), to advise and direct these activities.

The following summarizes the agreed-upon conservation measures to minimize impacts of the proposed CSI development on the desert tortoise:

Project Area Surveys and Clearance: The CSI project area will be surveyed and cleared of desert tortoises prior to ground disturbance. Tortoises cleared from the project area will be genotyped, marked, and moved to the Desert Tortoise Conservation Center (DTCC), and will be kept separate from tortoises collected from other locales. A detailed survey and clearance plan will be developed by the CSI Science Advisory Team and approved by the Service to provide adequate coverage of the project area, as well as collection of supplemental information (see below). Because construction will occur over an extended time and will be phased, measures will likely be incorporated to prevent tortoises from re-entering areas cleared of tortoises, potentially including multiple clearance surveys, use of temporary tortoise exclusion fencing, and/or use of Service-approved, trained dogs and handlers to assist with locating tortoises. Timing of clearance surveys in relation to construction activities, as well as timing requirements for notifying the Service of ground-disturbing activities (i.e., blading), will follow the recommendations of the Service and CSI Science Advisory Team and will depend on seasonal tortoise activity patterns, the amount of area to be cleared, and the recommended survey protocol.

CSI Science Advisory Team and Service-approved translocation protocols will be followed to ensure the well-being of tortoises. Tortoises cleared from the project site and moved to the DTCC may be used for translocation and/or captive breeding and tortoise recruitment programs, the progeny of which may be used for head-starting tortoises in suitable habitat in Coyote Spring Valley (e.g., CSI reserve lands) as well as historically-occupied lands beyond.

Desert Tortoise Fencing: CSI will provide permanent tortoise-proof barriers on the northern and eastern perimeter of the project area to prevent tortoises from entering the development area post-construction and to minimize impacts of the development on adjacent lands. Fencing of highways on the western and southern perimeter of the project area (US 93 and SR 168) in Clark County will be done by NDOT and may be accomplished with MSHCP fees and/or other development-related fees. All permanent fencing, as well as temporary tortoise exclusion fencing used during construction, will be located, designed, inspected, and maintained according to recommendations of the Service and CSI Science Advisory Team, and will likely be based on the August 2005 or most-recent version of *Recommended Specifications for Desert Tortoise Exclusion Fencing.*

Provision of $750,000 for Desert Tortoise Research and Conservation Actions: CSI will pay an additional $750,000 to fund research and conservation measures for the desert tortoise in Coyote Spring Valley and potentially the Mormon Mesa area. Under direction of the CSI Science Advisory Team, data will be collected from the project area that will help determine the status of the desert tortoise and its habitat in the Coyote Spring Valley. Data collected may include, but is not limited to: location of all tortoises and tortoise sign (burrows, scat, carcasses, etc.); habitat characteristics, including vegetation structure and composition; and physiognomy of the cleared areas. This information can contribute to tortoise conservation in the Coyote Spring Valley and Mormon Mesa area by providing needed data on local tortoise distribution, density, and habitat associations. These data can be used to model tortoise presence/absence or density in relation to environmental factors. Additionally, research related to the distribution of tortoises and tortoise sign relative to US 93 and SR 168 will aid in the understanding of how paved roads impact tortoise populations. The quantification and mapping of tortoise sign in the project area could potentially be used to refine multivariate models predicting population densities from indicators in tortoise sign, testing the power of this approach in the Coyote Spring Valley.

As available, funds may contribute to an intensive survey effort of the Coyote Spring Valley beyond the proposed project area to map densities of tortoises, as well as assess sites for experimental head-starting of tortoises generated at the DTCC. CSI funds associated with this project may also contribute to research on the efficacy of weed-control measures and fire effects to tortoise habitat, thus providing important and needed information for habitat enhancement and restoration programs. These activities will be implemented in accordance with their priority, as determined by the Service and the CSI Science Advisory Team. As mentioned above, tortoises collected from the project area can be translocated and/or their progeny can be used for head-starting tortoises at sites in Coyote Spring Valley and/or historically-occupied lands in an effort to enhance tortoise recruitment. Thus, tortoises cleared from CSI lands (and/or their progeny) will eventually play a role in local, regional, and range-wide, long-term recovery efforts by contributing to a regional captive-breeding and tortoise-recruitment program. Additionally, research associated with the head-starting program will increase our understanding of effective release methods; movement, growth, health, and survivorship in relation to habitat; and the effectiveness of head-starting as a means to enhance desert tortoise populations.

Conservation Measures Specific to the Moapa Dace

Incidental take of Moapa dace and the effects associated with development of CSI lands do not fall under purview of the Clark County MSHCP and the permit issued to Clark County and cities therein by the Service pursuant to section 10(a)(1)(B) of the Act. The Corps and/or CSI will implement the following general measures to minimize and mitigate adverse effects of the proposed action on the federally-endangered Moapa dace:

Maintenance of Water Quantity-Muddy River System: On January 27, 2006, a final MOA was agreed to in principle by participating Parties, including CSI, which outlined specific conservation actions that each Party would complete in order to minimize potential impacts to the Moapa dace from the cumulative withdrawal of 16,100 afy of groundwater from two basins within the regional carbonate aquifer system (see Appendix A; programmatic biological opinion for the analysis of the MOA). The Service issued the programmatic opinion for the Muddy River MOA on January 30, 2006; however, the MOA has yet to be signed and become effective. Interim conditions will be placed on CSI's groundwater pumping until the MOA is signed; we will address this through the Incidental Take Statement associated with this biological opinion.

CSI shall implement specific conservation measures analyzed in the programmatic biological opinion to minimize effects to the Moapa dace, and consequently, other aquatic sensitive/dependent species that occur in the Muddy River ecosystem. CSI agreed to honor these commitments irrespective of MOA execution and the other Parties' commitments, and has agreed that their commitments be incorporated as conditions to the section 404 Clean Water Act permit or memorialized into a separate agreement with the Service in the event that the MOA is not executed. In order to be considered a benefit to the species, it is assumed that CSI's proposed conservation measures will be initiated or fully implemented prior to the proposed groundwater withdrawal associated with the proposed action.

The pertinent terms identified in the MOA (Appendix A) and agreed to by the applicant are as follows:

1. Participate in the establishment of a Recovery Implementation Program (RIP), and employ the principles of adaptive management, to outline and carry out conservation measures necessary to protect and recover the Moapa dace and allow for development and operation of regional water facilities.

2. Dedicate 460 afy, an amount equal to ten percent of CSI's State-appropriated water rights in Coyote Spring Valley, to the survival and recovery of the Moapa dace, in perpetuity. This dedication shall be recorded as a conservation easement with the Nevada State Engineer and Clark County Recorders Office prior to commencement by CSI of any of the permitted activities enumerated in the Corps' section 404 permit.

3. Dedicate $50,000 annually for four years for restoration of Moapa dace habitat outside the boundaries of the Moapa NWR along Apcar Stream or other agreed-upon locations.

4. Protect in-stream flows in the Muddy River system by restricting and redistributing groundwater pumping from wells in Coyote Spring Valley per the Muddy River MOA should water flows at the Warm Springs West Flume on Moapa NWR reach average flow levels identified in the MOA.

Maintenance of Water Quality and Quantity - Stormwater Flows: Both off- and on-site ephemeral surface flows will be managed within the Project Development Area to minimize impacts to the quality and quantity of water entering Pahranagat Wash and downstream sites, as described above under *Proposed Action*. Design and construction of flood control channels will follow the *Clark County Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual* of August, 1999, incorporating special requirements for developing on alluvial fans. CSI will design and construct drainage facilities for both minor and major (100-year) storm events, and develop emergency measures for flows exceeding major storm events. Stormwater will be filtered prior to reaching Pahranagat Wash through a series of constructed wetlands (i.e., stormwater retention ponds). This system of constructed ponds, to be located outside the Pahranagat Wash 100-foot buffer zone, is intended to filter urban and stormwater runoff, some pollutants, and sediment prior to release into Pahranagat Wash.

The detention basins located west of US 93 will be constructed to attenuate flood flows through the Project Development Area. The proposed detention facilities west of Pahranagat Wash will temporarily store stormwater emptying out of constructed and/or preserved drainages of the Project Development Area, thus attenuating flood flows before they enter Pahranagat Wash. These measures will help minimize impacts to the Wash and downstream sites from increased stormwater runoff volumes and peak flow rates that will likely accompany urban development. Other measures to be included in project design include the reuse of effluent on site and the development of an Aquifer Recharge Program.

Two of the more substantial, well-vegetated west-east washes (WOUS) in the northern part of the project area will be avoided and protected in perpetuity with an approximate 100-foot buffer from bank on each side of the channel. Additionally, CSI will protect roughly 1,650 linear feet of the western-most portion of wash F7, which is characterized by incised banks and dense acacia growth, with 75-foot upland buffers from bank on each side of the channel. Upland buffers along preserved desert dry washes will remain in situ and not be disturbed by construction activities. The remainder of drainage F7 and two other drainages will be restored and protected with a linear upland buffer of 40 to 80 feet from bank on each side of the wash. Reconstructed drainages within the project area will use on-site substrate materials and the banks will be revegetated with native plant species.

Impacts to Pahranagat Wash will be minimized through a protective buffer between the Wash and development to the west: a 100-foot buffer zone extending from the west bank of the Wash will be preserved, and to the west of this will be a stormwater retention zone that further buffers the Wash from development activities. The length of Pahranagat Wash along the proposed development and its 100-foot buffer zone will be included in the proposed Coyote Springs Resource Management Area to the east and will be protected in perpetuity with a conservation easement. Additionally, a fence will be constructed along the eastern boundary of the development to help minimize impacts to Pahranagat Wash.

Within the Project Development Area, all preserved and restored desert dry washes (totaling 20.49 acres) and preserved and created/restored upland buffer zones (totaling 219.55 acres) will be permanently protected with a Natural Wash Buffer Zone Perpetual Conservation Easement. Implementation of the above-described conservation buffers and easement areas will involve the future recordation of survey maps acceptable to all Parties, incorporating all of the above conservation features within the 13,100-acre project area and maintaining the previously agreed configuration of 6,881 developable acres and 6,219 acres set aside for conservation purposes.

Defining the Action Area

In this document, *project area* refers to CSI's private and leased lands in Clark County (13,100 acres), whereas *action area* refers to the entire area in which we anticipate impacts to federally-listed species as a result of the proposed action. Thus, the action area includes those areas that will be affected both directly and indirectly by the proposed action, including inter-related and interdependent actions. Within the project area, the *Project Development Area* refers to the 6,881 acres that will be developed as described herein.

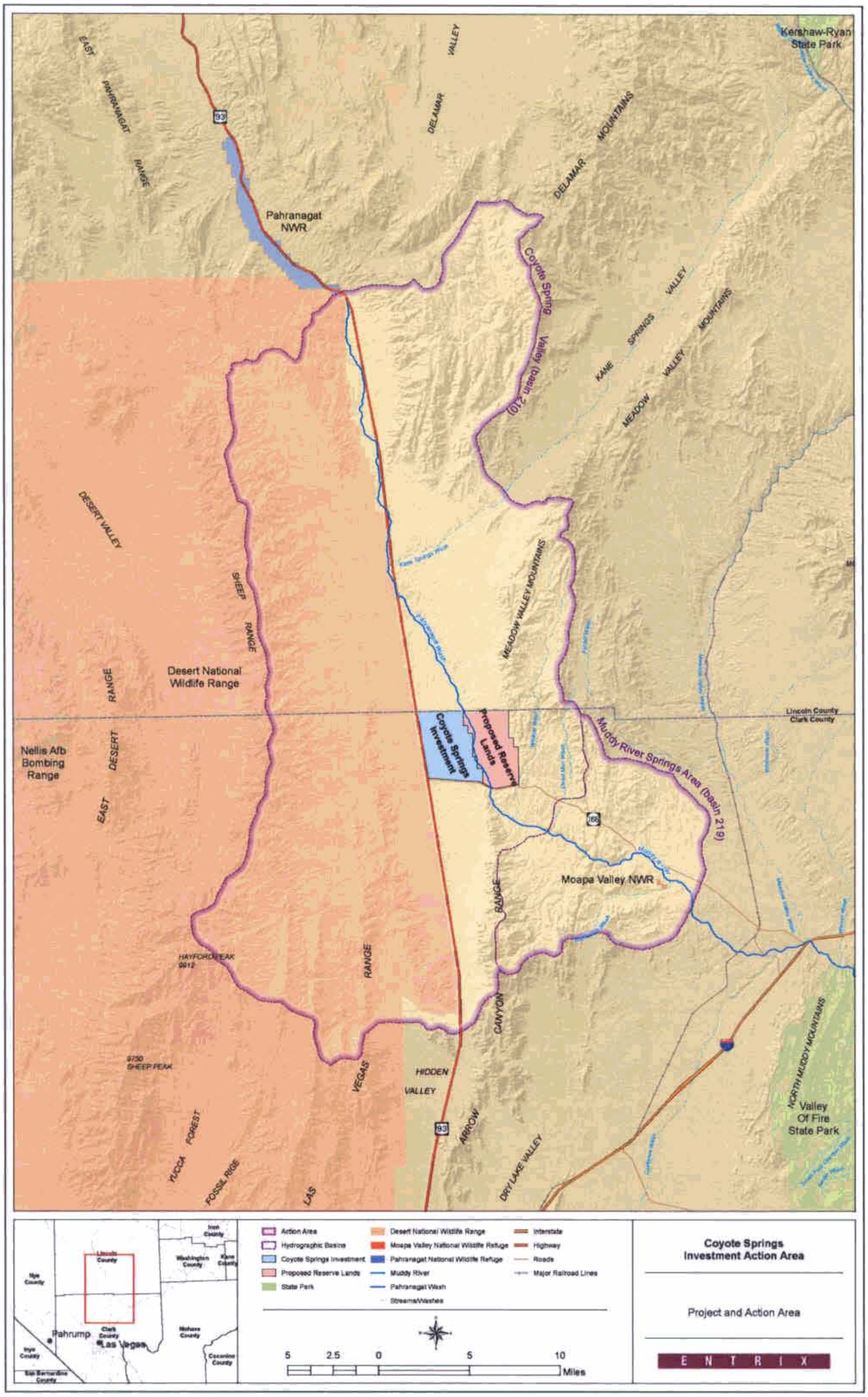
For the CSI project, the Service's description of the action area differs from that provided by the Federal action agency (Corps) in the Biological Assessment (RCI 2005). In the Biological Assessment, the action area is defined as the 6,881-acre project site and Pahranagat Wash from the north-eastern edge of the development downstream to the Muddy River-Meadow Valley Wash confluence. These downstream sites were included in the action area due to: 1) proposed modifications to WOUS (dry washes) within the project area that drain into Pahranagat Wash, a tributary of the Muddy River; and 2) pumping of groundwater from the carbonate aquifer of Coyote Spring Valley, which is part of a regional aquifer system with regional discharge points in the Muddy River Springs area. Thus, project actions could potentially affect stormwater flow, sediment movement, and water quality and quantity entering Pahranagat Wash and hence the Muddy River, as well as spring outflow and resulting surface flow in the Muddy River at and below the Muddy River Springs. The Corps considered the Meadow Valley Wash the downstream boundary of the action area because below this point the Muddy River is greatly influenced by numerous groundwater withdrawals for agricultural, municipal, and private use. The Corps anticipated that these downstream impacts would likely overshadow those associated with CSI's proposed actions roughly 20 miles upstream (RCI 2005). Additionally, water monitoring measures and commitments by CSI to redistribute and redirect groundwater pumping per the Muddy River MOA are expected to restore water levels within the Muddy River system to original flow levels before effects perpetuate as far downstream as the Meadow Valley Wash confluence.

The project description in the Environmental Assessment supersedes that found within the Biological Assessment. While the Environmental Assessment describes a project area, it does not explicitly define an action area. The project area descriptions for the Environmental Assessment and this biological opinion are the same. However, the Service's definition of the action area is different from that described in the Biological Assessment and summarized above. First, we have expanded the action area to include the entirety of two hydrographic basins that are hydrologically connected to the Muddy River ecosystem: Coyote Spring Valley (Basin 210) and Muddy River Springs Area (Basin 219) (Figure 2). These two basins fall within the White River Groundwater Flow System, a regional carbonate aquifer system that extends from Long Valley in the north to the Warm Springs Area (as originally defined by Eakin 1966). While the entire flow system is hydrogeologically connected, we only included within the action area those basins that are closest to the points of groundwater withdrawal for this proposed action. Second, we have defined the downstream boundary of the project area as the border of the Muddy River Springs Area hydrographic basin approximately two miles southeast of the Moapa Valley NWR; this boundary location does not extend as far downstream on the Muddy River as the Meadow Valley Wash confluence. The Service acquired the Moapa Valley NWR to secure habitat and assist the recovery efforts for the endangered Moapa dace, a species restricted to the Warm Springs area and the main-stem of the upper Muddy River. Springs in this area are considered regional discharge points for the carbonate aquifer of the White River flow system.

The CSI project site is located within the Coyote Spring Valley hydrographic basin, as are surrounding lands that are likely to be directly or indirectly impacted by non water-related aspects of the proposed action. Public, leased, and private lands adjacent to CSI will be subject to increased human activity [recreation, traffic, Off Highway Vehicle (OHV) use, target shooting] and elevated numbers of predatory animals [ravens (*Corvus corax*), coyotes (*Canis latrans*), domestic and feral dogs] resulting from human habitation and the provision of supplemental food and water in a normally resource-limited area. While impacts to adjacent lands from these sources are expected to occur with a high degree of certainty, the exact location and magnitude of these effects is largely unknown. These effects will be discussed in detail in the *Effects of the Proposed Action* section of this consultation, but are mentioned here as they must be considered within the context of the action area.

The applicant envisions that the CSI development will provide additional and affordable housing in southern Nevada outside of the Las Vegas Valley (The Huffman-Broadway Group, Inc. 2005). However, the primary job opportunities will still be in Las Vegas, at least initially and probably for the foreseeable long-term, necessitating regular commuting between the two areas. Thus, the

Figure 2


Pahranagat NWR
Kershaw-Ryan State Park
Coyote Spring Valley (basin 210)
Desert National Wildlife Range
Nellis Afb Bombing Range
Proposed Reserve Lands
Coyote Springs Investment
Muddy River Springs Area (basin 219)
Moapa Valley NWR
Valley Of Fire State Park
Lincoln County
Clark County
DELAMAR MOUNTAINS
SHEEP RANGE
LAS VEGAS RANGE
HIDDEN VALLEY
ARROW CANYON RANGE
DRY LAKE VALLEY
Pahrump
Las Vegas
Coyote Springs Investment Action Area
Project and Action Area
ENTRIX
Miles

stretch of US 93 between the proposed development and Las Vegas will likely experience increased traffic, necessitating inclusion in the action area. State Route 168 will likely experience increased traffic volumes as well.

Amendment to the Biological Opinion for the Clark County MSHCP

As noted above, the biological opinion for the proposed CSI project serves to amend the November 19, 2000, *Intra-Service Biological and Conference Opinion on Issuance of an Incidental Take Permit to Clark County, Nevada for a MSHCP* (Service 2000). The need to amend the MSHCP biological opinion arises from a change in the amount of anticipated disturbance to lands within Coyote Spring Valley from a relatively small area [as analyzed in the MSHCP and its precursor, the Desert Conservation Plan (DCP)] to a substantially larger area (as proposed by CSI) within designated critical habitat for the desert tortoise. Also, CSI's proposal represents a departure from previously considered land uses for this area by planning a new residential community in an area currently removed from human habitation and relatively unmodified by factors associated with human occupancy. The amendment will not change the total number of acres of disturbance and the associated take permitted under Clark County's 10(a)(1)(B) permit. Also, the amendment only concerns the desert tortoise and its critical habitat; the Service's analyses and conclusions for all other species evaluated in the MSHCP biological opinion remain valid and unchanged.

The 1995 DCP biological opinion analyzed the effects of the Service's proposed issuance of a 30-year incidental take permit to Clark County on the threatened desert tortoise and its designated critical habitat. The permit authorized take of all desert tortoises and allowed disturbance of tortoise habitat within 111,000 acres of non-Federal land (including those resulting from sale or transfer of Federal lands) in Clark County, as well as 2,900 acres associated with NDOT activities in Clark, Lincoln, Esmeralda, Mineral, and Nye counties over a 30-year period (RECON 1994, Service 1995). The exact location of lands to be developed was unknown, so coverage was sought for all non-Federal lands in Clark County. The Service concluded that this level of take would not jeopardize the desert tortoise nor appreciably diminish the value of critical habitat because: 1) the majority of take would occur within the Las Vegas Valley where viable desert tortoise populations likely cannot be maintained over the long-term; 2) private land in Clark County represents less than two percent of designated desert tortoise critical habitat, and thus only a small percentage of critical habitat could be developed or disturbed under the DCP; and 3) proposed mitigation measures in the DCP would further tortoise recovery objectives in the Eastern and Northeastern Mojave Recovery Units (Service 1995). In 2000, the DCP was integrated into the Clark County MSHCP.

In 2000, the Service issued a biological opinion for the Clark County MSHCP evaluating the effects of the Service's proposed issuance of an incidental take permit to Clark County; the cities of Las Vegas, North Las Vegas, Boulder City, Mesquite, and Henderson; and NDOT (applicants) on the threatened desert tortoise, endangered southwestern willow flycatcher, and 76 unlisted species that may become listed under the Act during the 30-year term of the permit. The permit area includes all of Clark County and NDOT rights-of-way south of the 38th parallel and below 5,000 feet elevation in Lincoln, Esmeralda, and Mineral counties. The number of non-Federal lands available for future development was estimated at roughly 418,200 acres. However, the scope of the permit is limited to activities that may directly or indirectly affect the covered species as a result of activities on 145,000 acres of non-Federal lands in Clark County over a period of 30 years (RECON 2000, Service 2000). As with the DCP, the permittees for the MSHCP were not able to predict precisely which non-Federal lands would or would not involve a Federal action. Therefore, the permittees obtained coverage under the section 10(a)(1)(B) incidental take permit for the MSHCP for all non-Federal lands that existed at that time and all non-Federal lands which would result from sales or transfers from the Federal government within Clark County. Thus, CSI's private lands were included in the coverage area and acreage calculations for the Clark County MSHCP and Service-issued incidental take permit for the MSHCP. However, the scope of development currently proposed by CSI for the Coyote Spring Valley was not analyzed, as discussed below. The Service's non-jeopardy conclusion for the desert tortoise in the original opinion was based in part on the assumption that development would occur primarily in urbanized and previously-degraded areas within the permit area. The Service also determined that this action as proposed would not directly or indirectly impact desert tortoise critical habitat to the extent that the CHUs no longer functioned as reserves for the tortoise. This was considered in conjunction with past and on-going conservation actions, such as BLM's establishment of ACECs within the permit area in accordance with the Desert Tortoise Recovery Plan (Service 2000).

When the DCP was developed, the private lands in Coyote Spring Valley were owned by Aerojet. As mentioned previously, Aerojet intended to use 2,760 acres out of the roughly 43,000 acres of combined conveyed/leased lands in Coyote Spring Valley, Clark and Lincoln counties, for developing rocket testing and manufacturing facilities. Additionally, Aerojet anticipated that another 81 acres of tortoise habitat would be permanently lost and 225 acres temporarily disturbed during construction (RCI 1987). The remaining land (other than the 10,735-acre federally-reserved ROW) was to serve as a conservation area and buffer to the rocket facilities (RCI 1987, Service 2000). Because these lands would continue to function as important desert tortoise habitat, the Service incorporated them into the Mormon Mesa CHU when critical habitat was designated in 1994 (59 FR 5820, Service 2000). When the MSHCP (RECON 2000) and the Service's biological opinion (Service 2000) were finalized in 2000, it was still anticipated that only a small amount of development would occur on private lands in Coyote Spring Valley despite a change in land ownership. In the MSHCP, estimates of Clark County growth patterns were based on comprehensive regional land use and development planning documents, which anticipated that greater than 90 percent of the County's population would be centered in the Las Vegas Valley, with major growth increases in existing master planned communities. Growth of rural communities was expected on a smaller scale near Mesquite, Primm, and Laughlin, with *small* pockets of development elsewhere, including on private lands in Coyote Spring Valley (RECON 2000).

In the MSHCP biological opinion, the Service anticipated that some landscape-level changes to the Mojave desert scrub ecosystem, and population-level effects to species covered under the MSHCP (i.e., desert tortoise), would occur in the Coyote Spring Valley as a result of activities covered under the section 10(a)(1)(B) permit for the MSHCP (Service 2000). And while take of tortoises would generally only be allowed in areas not proposed for recovery, an exemption was made for a relatively *small* area in Coyote Spring Valley. Regardless, the Service anticipated that both Federal and non-Federal lands in Coyote Spring Valley would contribute to recovery of the desert tortoise (59 FR 5820, Service 2000). Now, CSI is proposing to develop considerably more acres than was previously envisioned within the Clark County portion of Coyote Spring Valley, necessitating an evaluation of potential impacts to the desert tortoise and its critical habitat above what we considered in the MSHCP biological opinion. However, while we are amending the Clark County MSHCP biological opinion with the CSI opinion in regards to the desert tortoise, the total number of acres of disturbance and the associated take of desert tortoises permitted under Clark County's incidental take permit will remain at 145,000 acres, and this will *include* the 6,881 acres of tortoise habitat associated with CSI's development in Clark County.

Status of the Species/Critical Habitat

Desert Tortoise- Rangewide Status

The desert tortoise is a large, herbivorous reptile found in portions of California, Arizona, Nevada, and Utah. It also occurs in Sonora and Sinaloa, Mexico. The Mojave population of the desert tortoise includes those animals living north and west of the Colorado River in the Mojave Desert of California, Nevada, Arizona, southwestern Utah, and in the Sonoran Desert in California. Desert tortoises reach 8 to 15 inches in carapace length. Adults have a domed carapace and relatively flat, unhinged plastron. Shell color is brownish, with yellow to tan scute centers. The forelimbs are flattened and adapted for digging and burrowing. Optimal habitat has been characterized as creosote bush scrub (*Larrea tridentata*) in which precipitation ranges from 2 to 8 inches, where a diversity of perennial plants is relatively high, and production of ephemerals is high (Luckenbach 1982; Turner 1982; Turner and Brown 1982). Soils must be friable enough for digging of burrows, but firm enough so that burrows do not collapse. Desert tortoises occur from below sea level to an elevation of 7,300 feet, but the most favorable habitat occurs at elevations of approximately 1,000 to 3,000 feet (Luckenbach 1982).

Desert tortoises are most commonly found within the desert scrub vegetation type, primarily in creosote bush scrub. In addition, they occur in succulent scrub, cheesebush scrub, blackbrush scrub, hopsage scrub, shadscale scrub, microphyll woodland, Mojave saltbush-allscale scrub, and scrub-steppe vegetation types of the desert and semidesert grassland complex (Service 1994). Within these vegetation types, desert tortoises potentially can survive and reproduce where their basic habitat requirements are met. These requirements include a sufficient amount and quality of forage species; shelter sites for protection from predators and environmental extremes; suitable substrates for burrowing, nesting, and overwintering; various plants for shelter; and adequate area for movement, dispersal, and gene flow. Throughout most of the Mojave Region, desert tortoises occur most commonly on gently sloping terrain with soils ranging from sandy-gravel and with scattered shrubs, and where there is abundant inter-shrub space for growth of herbaceous plants. Throughout their range, however, desert tortoises can be found in steeper, rockier areas.

The size of desert tortoise home ranges varies with respect to location and year. Females have long-term home ranges that are approximately half that of the average male, which range from 25 to 200 acres (Berry 1986). Over its lifetime, each desert tortoise may require more than 1.5 square miles of habitat and may make forays of more than seven miles at a time (Berry 1986). In drought years, the ability of desert tortoises to drink while surface water is available following rains may be crucial for desert tortoise survival. During droughts, desert tortoises forage over larger areas, increasing the likelihood of encounters with sources of injury or mortality including humans and other predators.

Desert tortoises are most active during the spring and early summer when annual plants are most common. Additional activity occurs during warmer fall months and occasionally after summer rainstorms. Desert tortoises spend the remainder of the year in burrows, escaping the extreme conditions of the desert. In Nevada and Arizona, desert tortoises are considered to be active from approximately March 15 through October 15. Further information on the range, biology, and ecology of the desert tortoise can be found in Berry and Burge (1984), Burge (1978), Burge and Bradley (1976), Bury *et al.* (1994), Germano *et al.* (1994), Hovik and Hardenbrook (1989), Karl (1981, 1983a, 1983b), Luckenbach (1982), Service (1994), and Weinstein *et al.* (1987).

On August 4, 1989, the Service published an emergency rule listing the Mojave population of the desert tortoise as endangered (54 FR 42270). On April 2, 1990, the Service determined the Mojave population of the desert tortoise to be threatened (55 FR 12178). Reasons for the determination included significant population declines, loss of habitat from construction projects such as roads, housing and energy developments, and conversion of native habitat to agriculture. Grazing and off-highway vehicle activity have degraded additional habitat. Also cited as threatening the desert tortoise's continuing existence, were illegal collection by humans for pets or consumption, upper respiratory tract disease (URTD), predation on juvenile desert tortoises by common ravens, coyotes, and kit foxes (*Vulpes velox*), fire, and collisions with vehicles on paved and unpaved roads.

On June 28, 1994, the Service approved the final Desert Tortoise (Mojave Population) Recovery Plan (Recovery Plan) (Service 1994). The Recovery Plan divides the range of the desert tortoise into 6 recovery units and recommends establishment of 14 Desert Wildlife Management Areas (DWMAs) throughout the recovery units. Within each DWMA, the Recovery Plan recommends implementation of reserve-level protection of desert tortoise populations and habitat, while maintaining and protecting other sensitive species and ecosystem functions. The design of DWMAs should follow accepted concepts of reserve design. As part of the actions needed to accomplish recovery, the Recovery Plan recommends that land management within all DWMAs should restrict human activities that negatively impact desert tortoises (Service 1994). The

DWMAs/ACECs have been designated by the BLM through development or modification of their land use plans in Arizona, Nevada, Utah, and parts of California.

The California Desert Conservation Area Plan (BLM 1980) is the primary plan that guides the overall management of desert tortoise habitat in California. Land use planning activities are underway in California to complete designation of DWMAs/ACECs. Desert tortoise habitat management in Arizona is covered primarily by the Mojave Amendment to BLM's Arizona Strip Resource Management Plan, which was prepared to implement the Recovery Plan. BLM Arizona Strip Field Office designated 167,065 acres of desert tortoise habitat as ACECs. In Nevada, BLM's Las Vegas, Ely, and Battle Mountain field offices manage desert tortoise habitat; 941,800 acres of desert tortoise habitat were designated as ACECs by the Las Vegas and Ely field offices. No desert tortoise critical habitat or proposed ACECs occur within the jurisdiction of the Battle Mountain Field Office. The regulation of activities within critical habitat through section 7 consultation is based on recommendations in the Recovery Plan (Service 1994).

Long-term monitoring of desert tortoise populations is a high priority recovery task as identified in the Recovery Plan. From 1995 to 1998, pilot field studies and workshops were conducted to develop a monitoring program for desert tortoise. In 1998, the Desert Tortoise Management Oversight Group identified line distance sampling as the appropriate method to determine rangewide desert tortoise population densities and trends. Monitoring of populations using this method is underway across the range of the desert tortoise. Successful rangewide monitoring will enable managers to evaluate the overall effectiveness of recovery actions and population responses to these actions, thus guiding recovery of the Mojave desert tortoise. Rangewide desert tortoise population monitoring began in 2001 and is conducted annually.

Disease was identified in the 1994 Recovery Plan as an important threat to the desert tortoise. Disease is a natural phenomenon in wild populations of animals and can contribute to population declines by increasing mortality and reducing reproduction. However, URTD appears to be a complex, multi-factorial disease interacting with other stressors to affect desert tortoises (Brown *et al.* 2002; Tracy *et al.* 2004). The disease occurs mostly in relatively dense desert tortoise populations, as mycoplasmal infections are dependent upon higher densities of the host (Tracy *et al.* 2004).

Changing ecological condition as a result of natural events or human-caused activities may stress individuals and result in a more severe clinical expression of URTD (Brown *et al.* 2002). For example, the proliferation of non-native plants within the range of the desert tortoise has had far-reaching impacts on desert tortoise populations. Desert tortoises have been found to prefer native vegetation over non-natives (Tracy *et al.* 2004). Non-native annual plants in desert tortoise critical habitat in the western Mojave Desert were found to compose over 60 percent of the annual biomass (Brooks 1998). The reduction in quantity and quality of forage may stress desert tortoises and make them more susceptible to drought- and disease-related mortality (Brown *et al.* 1994). Malnutrition has been associated with several disease outbreaks in both humans and turtles (Borysenko and Lewis 1979). What is currently known with certainty about disease in the desert tortoise relates entirely to individual desert tortoises and not populations; virtually nothing is known about the demographic consequences of disease (Tracy *et al.* 2004).

Land managers and field scientists identified 116 species of alien plants in the Mojave and Colorado Deserts (Brooks and Esque 2002). The proliferation of non-native plant species has also contributed to an increase in fire frequency in desert tortoise habitat by providing sufficient fuel to carry fires, especially in the intershrub spaces that are mostly devoid of native vegetation (Service 1994; Brooks 1998; Brown and Minnich 1986). Changes in plant communities caused by alien plants and recurrent fire may negatively affect the desert tortoise by altering habitat structure and species composition of their food plants (Brooks and Esque 2002).

Desert Tortoise Recovery Plan Assessment and Recommendations

The General Accounting Office (GAO) Report, *Endangered Species: Research Strategy and Long-Term Monitoring Needed for the Mojave Desert Tortoise Recovery Program* (U.S. General Accounting Office 2002), directed the Service to periodically reassess the Recovery Plan to determine whether scientific information developed since its publication could alter implementation actions or allay some of the uncertainties about its recommendations. In response to the GAO report, the Service initiated a review of the existing Recovery Plan in 2003.

In March 2003, the Service impaneled the Recovery Plan Assessment Committee (Committee) to assess the Recovery Plan. The Committee was selected to represent several important characteristics with particular emphasis on commitment to solid science. The charge to the Committee was to review the entire Recovery Plan in relation to contemporary knowledge to determine which parts of the recovery plan will need updating. The recommendations of the Committee were presented to the Service and Desert Tortoise Management Oversight Group approximately a year later, on March 24, 2004. The recommendations will be used as a guide by a recovery team of scientists and stakeholders to modify the 1994 Recovery Plan. A revised recovery plan is anticipated by the end of 2006.

The Committee recognized that the distribution and abundance data indicate trends leading away from recovery goals in some parts of the species' range. These results indicate a need for more aggressive efforts to facilitate recovery. Many of the original prescriptions of the Recovery Plan were never implemented although these prescriptions continue to be appropriate. New prescriptions should be prioritized to assess redundancies and synergies within individual threats.

The following paragraphs include a description of each of the six desert tortoise recovery units as proposed in the June 28, 1994 Desert Tortoise Recovery Plan (Service 1994), as well as a summary of analyses conducted relative to the recovery units for the 2004 Recovery Plan Assessment Report (Service 2004).

Northeastern Mojave Recovery Unit: The Northeastern Mojave Recovery Unit occurs primarily in Nevada, but it also extends into California along the Ivanpah Valley and into extreme southwestern Utah and northwestern Arizona. CSI's lands are located within this Recovery Unit. Vegetation within this unit is characterized by creosote bush scrub, big galleta-scrub steppe, desert needlegrass scrub-steppe, and blackbrush scrub (in higher elevations). Topography is varied, with flats, valleys, alluvial fans, washes, and rocky slopes. Much of the northern portion of the Northeastern Mojave Recovery Unit is characterized as basin and range, with elevations from 2,500 to 12,000 feet. Desert tortoises typically eat summer and winter annuals, cacti, and perennial grasses. Desert tortoises in this recovery unit, the northern portion of which represents the northernmost distribution of the species, are typically found in low densities (about 10 to 20 adults per square mile).

A kernel analysis was conducted in 2003-2004 for the desert tortoise (Tracy *et al.* 2004) as part of the assessment of the 1994 Recovery Plan. The analyses revealed several areas in which the kernel estimations for live desert tortoises and carcasses did not overlap. The pattern of non-overlapping kernels that is of greatest concern is those in which there were large areas where the kernels encompassed carcasses but not live animals. These regions represent areas within DWMAs where there were likely recent die-offs or declines in desert tortoise populations. The kernel analysis indicated large areas in the Piute-Eldorado Valley where there were carcasses but no live desert tortoises. For this entire area in 2001, there were 103 miles of transects walked, and a total of six live and 15 dead desert tortoises found, resulting in a live encounter rate of 0.06 desert tortoises per mile of transect for this area. This encounter rate was among the lowest that year for any of the areas sampled in the range of the Mojave desert tortoise (Tracy *et al.* 2004).

Kernel analysis for the Coyote Springs DWMA showed areas where the distributions of carcasses and living desert tortoises do not overlap; however, densities of adult desert tortoises for the region do not show a statistical trend over time. Thus, while there may be a local die-off occurring in the northern portion of this DWMA, this does not appear to influence the overall trend in the region as interpreted by study plot data. Because permanent study plots for this region were discontinued after 1996, if there have been recent declines in numbers they are not reflected in the analysis. Nevertheless, large regions of non-overlapping carcass and live desert tortoise kernels in the regions were not identified adjacent to the Coyote Springs DWMA. The probability of finding either a live desert tortoise or a carcass was relatively very low for Beaver Dam Slope and Gold-Butte Pakoon, and moderately low for Mormon Mesa/Coyote Springs.

Eastern Mojave Recovery Unit: The Eastern Mojave Recovery Unit is situated primarily in California, but also extends into Nevada in the Amargosa, Pahrump, and Piute valleys. In the Eastern Mojave Recovery Unit, desert tortoises are often active in late summer and early autumn in addition to spring because this region receives both winter and summer rains and supports two distinct annual floras on which they can feed. Desert tortoises in the Eastern Mojave Recovery Unit occupy a variety of vegetation types and feed on summer and winter annuals, cacti, perennial grasses, and herbaceous perennials. They den singly in caliche caves, bajadas, and washes. This recovery unit is isolated from the Western Mojave Recovery Unit by the Baker Sink, a low-elevation, extremely hot and arid strip that extends from Death Valley to Bristol Dry Lake. The Baker Sink area is generally not considered suitable for desert tortoises. Desert tortoise densities in the Eastern Mojave Recovery Unit can vary dramatically, ranging from 5 to as much as 350 adults per square mile (Service 1994).

Ivanpah and Piute–Eldorado valleys contained study plots that were analyzed in the Eastern Mojave Recovery Unit analysis. While there was no overall statistical trend in adult density over time, the 2000 survey at Goffs and the 2002 survey at Shadow Valley indicate low densities of adult desert tortoises relative to earlier years. Unfortunately, there are no data in the latter years for all five study plots within this recovery unit, and therefore, while there is no statistical trend in adult densities, we cannot conclude that desert tortoises have not experienced recent declines in this area. The probability of finding a carcass on a distance sampling transect was considerably higher for Ivanpah, Chemehuevi, Fenner, and Piute-Eldorado, which make up the Eastern Mojave Recovery Unit.

Northern Colorado Recovery Unit: The Northern Colorado Recovery Unit is located completely in California. Here desert tortoises are found in the valleys, on bajadas and desert pavements, and to a lesser extent in the broad, well-developed washes. They feed on both summer and winter annuals and den singly in burrows under shrubs, in intershrub spaces, and rarely in washes. The climate is somewhat warmer than in other recovery units, with only two to 12 freezing days per year. The desert tortoises have the California mitochondrial DNA (mtDNA) haplotype and phenotype. Allozyme frequencies differ significantly between this recovery unit and the Western Mojave, indicating some degree of reproductive isolation between the two.

Desert tortoises in the Eastern Colorado Recovery Unit, also located completely in California, occupy well-developed washes, desert pavements, piedmonts, and rocky slopes characterized by relatively species-rich succulent scrub, creosote bush scrub, and Blue Palo Verde-Ironwood-Smoke Tree communities. Winter burrows are generally shorter in length, and activity periods are longer than elsewhere due to mild winters and substantial summer precipitation. The desert tortoises feed on summer and winter annuals and some cacti; they den singly. They also have the California mtDNA haplotype and shell type.

Upper Virgin River Recovery Unit: The Upper Virgin River Recovery Unit encompasses all desert tortoise habitat in Washington County, Utah, except the Beaver Dam Slope, Utah population. The desert tortoise population in the area of St. George, Utah is at the extreme northeastern edge of the species' range and experiences long, cold winters (about 100 freezing days) and mild summers, during which the desert tortoises are continually active. Here the animals live in a complex topography consisting of canyons, mesas, sand dunes, and sandstone outcrops where the vegetation is a transitional mixture of sagebrush scrub, creosote bush scrub, blackbush scrub, and a psammophytic community. Desert tortoises use sandstone and lava caves instead of burrows, travel to sand dunes for egg-laying, and use still other habitats for foraging. Two or more desert tortoises often use the same burrow. Shell morphology and mtDNA have not been studied in this recovery unit, but allozyme variation is similar to that found in the Northeastern Mojave Recovery Unit.

Western Mojave Recovery Unit: The Western Mojave Recovery Unit occurs completely in California and is exceptionally heterogeneous and large. It is composed of the Western Mojave, Southern Mojave, and Central Mojave regions, each of which has distinct climatic and vegetation characteristics. The most pronounced difference between the Western Mojave and other recovery units is in timing of rainfall and the resulting vegetation. Most rainfall occurs in fall and winter and produces winter annuals, which are the primary food source of desert tortoises. Above-ground activity occurs primarily in spring, associated with winter annual production. Thus, desert tortoises are adapted to a regime of winter rains and rare summer storms. Here, desert tortoises occur primarily in valleys, on alluvial fans, bajadas, and rolling hills in saltbrush, creosote bush, and scrub steppe communities. Desert tortoises dig deep burrows (usually located under shrubs on bajadas) for winter hibernation and summer aestivation. These desert tortoises generally den singly. They have a California mtDNA haplotype and a California shell type.

Reproduction: Desert tortoises possess a combination of life history and reproductive characteristics that affect the ability of populations to survive external threats. Desert tortoises grow slowly, require 15 to 20 years to reach sexual maturity, and have low reproductive rates during a long period of reproductive potential (Turner *et al.* 1984; Bury 1987; Tracy *et al.* 2004). At Yucca Mountain, Nye County, Nevada (Northeastern Mojave Recovery Unit), Mueller *et al.* (1998) estimated that the mean age of first reproduction was 19 to 20 years; clutch size (1 to 10 eggs) and annual fecundity (0 to 16 eggs) were related to female size but annual clutch frequency (0 to 2) was not. Further, Mueller suggested that body condition during July to October may determine the number of eggs a desert tortoise can produce the following spring.

McLuckie and Fridell (2002) determined that the Beaver Dam Slope desert tortoise population, within the Northeastern Mojave Recovery Unit, had a lower clutch frequency (1.33 ± 0.14) per reproductive female and fewer reproductive females (14 out of 21) when compared with other Mojave desert tortoise populations. In the 1990's, Beaver Dam Slope experienced dramatic population declines due primarily to disease and habitat degradation and alteration (Service 1994). The number of eggs that a female desert tortoise can produce in a season is dependent on a variety of factors including environment, habitat, availability of forage and drinking water, and physiological condition (Henen 1997; McLuckie and Fridell 2002).

Numbers and Population Trends: Data collected on one-square-mile permanent study plots indicate that desert tortoise populations have declined both in numbers of desert tortoises found during surveys and in densities of live desert tortoises at most sites since the plots were first established 20-30 years ago (Berry *et al.* 2002). Declines of 50 to 96 percent have occurred regardless of initial desert tortoise densities. Increases in the occurrence of shell-skeletal remains have been found to correspond with declines in numbers and densities of live desert tortoises with the exception of certain plots where poaching has been documented (Berry 2003).

Results of desert tortoise surveys at three survey plots in Arizona indicate that all three sites have experienced significant die-offs. Six live desert tortoises were located in a 2001 survey of the Beaver Dam Slope Exclosure Plot (Walker and Woodman 2002). Three had definitive signs of

URTD, and two of those also had lesions indicative of cutaneous dyskeratosis. Previous surveys of this plot detected 31 live desert tortoises in 1996, 20 live desert tortoises in 1989, and 19 live desert tortoises in 1980. The 2001 survey report indicated that it is likely that there is no longer a reproductively viable population of desert tortoises on this study plot. Thirty-seven live desert tortoises were located in a 2002 survey of the Littlefield Plot (Young *et al.* 2002). None had definitive signs of URTD. Twenty-three desert tortoises had lesions indicative of cutaneous dyskeratosis. Previous surveys of this plot detected 80 live desert tortoises in 1998 and 46 live desert tortoises in 1993. The survey report indicated that the site might be in the middle of a die-off due to the high number of carcasses found since the site was last surveyed in 1998. Nine live desert tortoises were located during the mark phase of a 2003 survey of the Virgin Slope Plot (Goodlett and Woodman 2003). The surveyors determined that the confidence intervals of the population estimate would be excessively wide and not lead to an accurate population estimate, so the recapture phase was not conducted. One desert tortoise had definitive signs of URTD. Seven desert tortoises had lesions indicative of cutaneous dyskeratosis. Previous surveys of this plot detected 41 live desert tortoises in 1997 and 15 live desert tortoises in 1992. The survey report indicated that the site may be at the end of a die-off that began around 1996-1997.

The Western Mojave has experienced marked population declines as indicated in the Recovery Plan and continues today. Spatial analyses of the Western Mojave show areas with increased probabilities of encountering dead rather than live animals, areas where kernel estimates for carcasses exist in the absence of live animals, and extensive regions where there are clusters of carcasses where there are no clusters of live animals. Collectively, these analyses point generally toward the same areas within the Western Mojave, namely the northern portion of the Fremont-Kramer DWMA and the northwestern part of the Superior–Cronese DWMA. Together, these independent analyses, based on different combinations of data, all suggest the same conclusion for the Western Mojave. Data are not currently available with sufficient detail for most of the range of the desert tortoise with the exception of the Western Mojave (Tracy *et al.* 2004).

Declines in desert tortoise abundance appear to correspond with increased incidence of disease in desert tortoise populations. The Goffs permanent study plot in Ivanpah Valley, California, suffered 92 to 96 percent decreases in desert tortoise density between 1994 and 2000 (Berry 2003). The high prevalence of disease in Goffs tortoises likely contributed to this decline (Christopher *et al.* 2003). Upper respiratory tract disease has not yet been detected at permanent study plots in the Sonoran Desert of California, but is prevalent at study plots across the rest of the species' range (Berry 2003) and has been shown to be a contributing factor in population declines in the Western Mojave Desert (Brown *et al.* 1999; Christopher *et al.* 2003). High mortality rates at permanent study plots in the Northeastern and Eastern Mojave and Sonoran Deserts appear to be associated with incidence of shell diseases in tortoises (Jacobson *et al.* 1994). Low levels of shell diseases were detected in many populations when the plots were first established, but were found to increase during the 1980s and 1990s (Jacobson *et al.* 1994; Christopher *et al.* 2003). A herpesvirus has recently been discovered in desert tortoises, but little is known about its effects on desert tortoise populations at this time (Berry *et al.* 2002; Origgi *et al.* 2002).

The kernel analysis of the Eastern Colorado Recovery Unit shows that the distributions of the living desert tortoises and carcasses overlap for most of the region. The Chuckwalla Bench study plot occurs outside the study area, which creates a problem in evaluating what may be occurring in that area of the recovery unit. However, the few transects walked in that portion of the DWMA yielded no observations of live or dead desert tortoises. This illustrates our concern for drawing conclusions from areas represented by too few study plots and leaves us with guarded concern for this region. The percentage of transects with live animals was relatively high for most DWMAs within the Eastern Colorado Recovery Unit. In addition, the ratio of carcasses to live animals was low within this recovery unit relative to others.

The status and trends of desert tortoise populations are difficult to determine based only upon assessment of desert tortoise density due largely to their overall low abundance, subterranean sheltering behavior, and cryptic nature of the species. Thus, monitoring and recovery should include a comprehensive assessment of the status and trends of threats and habitats as well as population distribution and abundance.

Recommendations for Revised Recovery Unit Delineation: The prescriptions for recovery in the 1994 Recovery Plan were for individual populations and assumed that preserving large blocks of habitat and managing threats in that habitat would be principally all that would be necessary to recover the species. However, that original paradigm, and the prescriptions made within that paradigm, may be wrong. Existing data have revealed population crashes that have occurred asynchronously across the range. There are reports that some populations, which have crashed previously, have subsequently increased in population density. Additionally, all know dense populations of desert tortoises have crashed. This suggests that density-dependent mortality occurs in desert tortoise populations, and that population dynamics may be asynchronous.

These characteristics indicate that desert tortoises may exist in a classic metapopulation structure (Hanski 1999; Levins and Culver 1971; Levins *et al.* 1984), and this should portend profoundly different prescriptions for recovery. In particular, if desert tortoises have historically existed in metapopulations, then connections among habitat patches are a necessary part of conservation prescriptions. Additionally, habitat which is suitable for desert tortoises but currently unoccupied should be regarded as equally necessary for recovery. Long-term persistence cannot be determined from desert tortoise density or desert tortoise numbers alone, but assessment must include the complexities of metapopulation dynamics and the habitat characteristics that promote metapopulation dynamics including habitat connectivity through inefficient corridors (*i.e.*, partial connectivity), asynchrony of subpopulation dynamics, and several separate habitat patches. Some of the characteristics of proper metapopulation function may already have been obviated by proliferation of highways, and habitat fragmentation due to satellite urbanization. Thus, management may require artificially facilitating metapopulation processes such as movement among patches.

The genetic distinctness of desert tortoise populations and their pathogens should be assessed to guide all manipulative management actions (*e.g.*, head starting, translocation, habitat restoration, and corridor management). The Committee proposed a revision to the previous delineation of recovery units, or distinct population segments (DPSs) based on new scientific information. The recommended delineations reflect the prevailing concepts of subpopulation "discreteness," and "significance," and incorporate morphological, behavioral, genetic, and environmental information. The Committee's recommendation reduces the number of DPSs from six to five by leaving the original Upper Virgin River and Western Mojave units intact and recombining the four central units into three reconfigured units: Lower Virgin River Desert, Northeastern Mojave Desert (including Amargosa Valley, Ivanpah Valley, and Shadow Valley), and Eastern Mojave and Colorado Desert. These recommended DPSs are based largely on the best resolving biochemical/genetic data of Rainboth *et al.* (1989), Lamb *et al.* (1989), Lamb and Lydehard (1994), and Britten *et al.* (1997). Because these delineations are general and not definitive at this time, more data and analyses are required which may result in additional modification. Although DPSs have been proposed by the Committee, no DPSs have been officially designated by the Service.

The 1994 Recovery Plan conceived desert tortoises to be distributed in large populations that required large areas and large densities to recover. However, existing data are consistent with the possibility that desert tortoises have evolved to exist in *metapopulations*. Metapopulation theory conceives that desert tortoises are distributed in metapopulation patches connected with corridors that allow inefficient and asynchronous movements of individuals among the patches. This paradigm conceives that some habitat patches within the range of the desert tortoise will have low population numbers or no desert tortoises at all, and others will have higher population numbers. Movement among the patches is necessary for persistence of the "system." If desert tortoises evolved to exist in metapopulations, then long-term persistence requires addressing habitat fragmentation caused by highways and satellite urbanization. Ensuring the integrity and function of natural corridors among habitat patches might require active management of desert tortoise densities in habitat patches and associated corridors.

For more information on desert tortoise or expanded discussions on recovery units and recommended DPSs, please refer to the Recovery Plan (Service 1994) and report prepared by the Recovery Plan Assessment Committee (Tracy *et al.* 2004).

Moapa Dace

Please refer to pages 14-30 of the parent programmatic biological opinion (Appendix A) for a complete description of the Moapa dace status, including the hydrogeological setting, distribution, and abundance, reproduction, and threats.

Desert Tortoise Critical Habitat- Rangewide Status

On February 8, 1994, the Service designated approximately 6.45 million acres of critical habitat for the Mojave population of the desert tortoise in portions of California (4.75 million acres), Nevada (1.22 million acres), Arizona (339 thousand acres), and Utah (129 thousand acres)

(59 FR 5820-5846, also see corrections in 59 FR 9032-9036), which became effective on March 10, 1994 (Table 2). Desert tortoise critical habitat was designated by the Service to identify the key biological and physical needs of the desert tortoise and key areas for recovery, and focuses conservation actions on those areas. Desert tortoise critical habitat is composed of specific geographic areas that contain the primary constituent elements of critical habitat, consisting of the biological and physical attributes essential to the species' conservation within those areas, such as space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats. The specific primary constituent elements of desert tortoise critical habitat are:

1. sufficient space to support viable populations within each of the six recovery units, and to provide for movement, dispersal, and gene flow;

2. sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species;
3. suitable substrates for burrowing, nesting, and over-wintering; burrows, caliche caves, and other shelter sites;

4. sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality.

Critical habitat units were based on recommendations for DWMAs outlined in the *Draft Recovery Plan for the Desert Tortoise (Mojave Population)* (Service 1993). These DWMAs are also identified as desert tortoise ACECs by BLM. Because the critical habitat boundaries were drawn to optimize reserve design, the CHU may contain both "suitable" and "unsuitable" habitat. Suitable habitat can be generally defined as areas that provide the primary constituent elements.

Although recovery of the tortoise will focus on DWMAs/ACECs, section II.A.6. of the Recovery Plan and section 2(b) of the Act provide for protection and conservation of ecosystems on which federally-listed threatened and endangered species depend, which includes both recovery and non-recovery areas. The Mojave Desert ecosystem, of which the desert tortoise and its habitat are an integral part, consists of a dynamic complex of plant, animal, fungal, and microorganism communities and their associated non-living environment interacting as an ecological unit (Noss and Cooperrider 1994). Actions that adversely affect components of the Mojave Desert ecosystem may directly or indirectly affect the desert tortoise. The Recovery Plan further states that desert tortoises and habitat outside recovery areas may be important in recovery of the tortoise. Healthy, isolated tortoise populations outside recovery areas may have a better chance of surviving catastrophic effects such as disease, than large, contiguous populations (Service 1994).

Table 2. Desert Tortoise Critical Habitat, DWMAs, and Recovery Units - Size and Location.

Critical Habitat Unit	DWMA	Recovery Unit	State	CHU[1] Size (acres)
Chemehuevi	Chemehuevi	Northern Colorado	CA	937,400
Chuckwalla	Chuckwalla	Eastern Colorado	CA	1,020,600
Fremont-Kramer	Fremont-Kramer	Western Mojave	CA	518,000
Ivanpah Valley	Ivanpah Valley	Eastern Mojave	CA	632,400
Pinto Mtns.	Joshua Tree	Western Mojave/Eastern Colorado	CA	171,700
Ord-Rodman	Ord-Rodman	Western Mojave	CA	253,200
Piute-Eldorado - CA	Fenner	Eastern Mojave	CA	453,800
Piute-Eldorado- NV	Piute-Eldorado	Northeastern Mojave/Eastern Mojave	NV	516,800
Superior-Cronese	Superior-Cronese Lakes	Western Mojave	CA	766,900
Beaver Dam:		Northeastern Mojave (all)		204,600
NV	Beaver Dam		NV	87,400
UT	Beaver Dam		UT	74,500
AZ	Beaver Dam		AZ	42,700
Gold Butte-Pakoon		Northeastern Mojave (all)		488,300
NV	Gold Butte-Pakoon		NV	192,300
AZ	Gold Butte-Pakoon		AZ	296,000
Mormon Mesa[2]	Mormon Mesa Coyote Springs	Northeastern Mojave	NV	427,900
Upper Virgin River	Upper Virgin River	Upper Virgin River	UT	54,600
Total				**6,446,200**

[1]Critical Habitat Unit
[2]CSI lands are located within the Mormon Mesa CHU of the Northeastern Mojave Recovery Unit.

The Recovery Plan recommended DWMAs and subsequently the Service designated CHUs based on these proposed DWMAs (Service 1993). When designated, desert tortoise critical habitat contained all the primary constituent elements of desert tortoise critical habitat. The following seven principles of conservation biology serve as the standards by which the Service determines whether or not the CHUs are functioning properly:

1. *Reserves should be well-distributed across the species' range.* The entire range of the Mojave desert tortoise occurs within six recovery units identified in the Recovery Plan and at least one DWMA and CHU occurs within each recovery unit. The reserves remain well-distributed across the range of the desert tortoise.

2. *Reserves should contain large blocks of habitat with large populations of target species.* The desert tortoise requires large, contiguous areas of habitat to meet its life requisites.

Each DWMA and its associated CHUs were designated to conserve contiguous blocks of habitat that exceed 500,000 acres, with the exception of the Upper Virgin River Recovery Unit (Table 1). The Upper Virgin River Recovery Unit does not meet the minimum size requirement identified in the Recovery Plan; however the Service anticipates that reserve-level management will adequately conserve the desert tortoise within this recovery unit. Designation of CHUs were based largely on transect data and included areas with the largest populations of desert tortoises.

3. *Blocks of habitat should be close together.* This principle was met when CHUs were designated and remains valid.

4. *Reserves should contain contiguous rather than fragmented habitat.* This principle was met when CHUs were designated, and generally continues to be met. Desert tortoise-proof fencing has been constructed along major roads and highways that traverse critical habitat including I-15 in Nevada and California (Ivanpah Valley DWMA/CHU), U.S. Highway 95 in Nevada (Piute-Eldorado DWMA/CHU), and Highway 58 in California (Fremont-Kramer DWMA/CHU). Major roads and highways alone constitute a barrier to tortoise movements without fencing; however, fencing minimizes take of tortoises, and culverts or underpasses allow for limited tortoise movement across the road or highway.

5. *Habitat patches should contain minimal edge-to-area ratios.* This principle was met when CHUs were designated and generally continue to be valid. Notable exceptions include the northern Gold Butte-Pakoon CHU, and the southern termini of the Mormon Mesa, Ivanpah Valley, and Chuckwalla CHUs which have large edge-to-area ratios and are further compromised by highways that traverse relatively narrow areas within the CHUs.

6. *Blocks should be interconnected by corridors or linkages connecting protected, preferred habitat for the target species.* Most CHUs are contiguous with another CHU with the exception of Ord-Rodman, Ivanpah Valley, Gold Butte-Pakoon, and Upper Virgin River CHUs. I-15 and the Virgin River separate the Gold Butte-Pakoon CHU from other CHUs in the Northeastern Mojave Recovery Unit. Similarly, Interstate 40 separates the Piute-Eldorado and Chemehuevi CHUs, and Ord Rodman and Superior-Cronese CHUs.

7. *Blocks of habitat should be roadless or otherwise inaccessible to humans.* Achieving this principle is the most problematic. A 2001 inventory of roads in the Western Mojave Desert suggests that road density increased since the mid-1980's. Further evaluation should be conducted, especially with the advent of effective mapping capabilities, as some of the recently mapped roads may actually be historical roads (Tracy *et al.* 2004). Roads provide means for human access to tortoise habitat, thereby increasing human-tortoise encounters and disturbance of constituent elements.

The recommendations for desert tortoise critical habitat in the Recovery Plan include elimination of specified activities that are incompatible with desert tortoise conservation including habitat destruction that diminishes the capacity of the land to support desert tortoises, and grazing by livestock, and feral burros and horses. Since approval of the Recovery Plan, livestock grazing in desert tortoise critical habitat has been eliminated in some areas, and substantially reduced and managed to minimize potential impacts to desert tortoise critical habitat in other areas. BLM and NPS manage for zero burros in desert tortoise critical habitat in Nevada, and the California Desert Managers Group developed a draft burro management plan in 2004.

2005 Fires

Numerous wildfires occurred in desert tortoise habitat across the range of the species in 2005 due to abundant fuel from the proliferation of non-native plant species after a very wet winter. These wildfires heavily impacted two of the six desert tortoise recovery units: the Upper Virgin River and Northeastern Mojave recovery units (Table 3). In the Upper Virgin River Recovery Unit, 19 percent of the Upper Virgin River CHU burned. In the Northeastern Mojave Recovery Unit, three CHUs were impacted by fire: 46,757 acres (23 percent) within the Beaver Dam Slope CHU; 62,466 acres (13 percent) within the Gold Butte-Pakoon CHU; and 15,559 (4 percent) within the Mormon Mesa CHU. A small amount of fire damage occurred in the Piute-Eldorado CHU (154 acres) and Ivanpah CHU (1,065 acres). Acreages are based on BLM burn perimeter data and may include patches of unburned habitat as fire moved in a mosaic pattern across the landscape. Although it is known that tortoises were burned and killed by the wildfires, tortoise mortality estimates are not available at this time.

Table 3. Summary of 2005 Fire Activity in Desert Tortoise Recovery Units and Critical Habitat Units. Note: all data are preliminary and need further analysis.

Recovery Unit	Tortoise Habitat Burned (acres)	Percent Habitat Burned	CH[1] Burned (acres)	Percent CH Burned
Upper Virgin River[2]	10,446	< 19	10,446	19
Northeastern Mojave[3]	500,000	10	124,782	11
Eastern Mojave	6,000	< 1	1,219	<1
Western Mojave	0	0	0	0
Northern Colorado	0	0	0	0
Eastern Colorado	0	0	0	0
Total	**516,446**	-	**136,447**	-

[1]CH – critical habitat
[2]Estimates only for Upper Virgin River; needs GIS analysis.
[3]Potential habitat was mapped and calculated as Mojave Desert less than 4,200 feet in elevation minus playas, permanent waters, developed and agricultural/cultivated lands (Source: GIS analysis conducted by Portland Fish and Wildlife Service Office).

Further information on the status of desert tortoise critical habitat can be found in the following documents:

- Desert Tortoise Recovery Plan Assessment Report (Tracy *et al.* 2004)-all CHUs.
- Final Environmental Impact Report and Statement for the West Mojave Plan (BLM 2005)-Fremont-Kramer CHU, Superior-Cronese CHU, Ord-Rodman CHU, and Pinto Mountains CHU.
- Mojave National Preserve General Management Plan (National Park Service 2002)-Ivanpah Valley CHU and Piute-Eldorado CHU.
- Approved Northern and Eastern Colorado Coordinated Management Plan (BLM 2002a)-Chemehuevi CHU, Pinto Mountains CHU, and Chuckwalla CHU.
- Approved Northern and Eastern Mojave Desert Management Plan (BLM 2002b)-Ivanpah Valley CHU, Piute-Eldorado CHU, and Chemehuevi CHU.
- Clark County MSHCP (RECON 2000)- Beaver Dam Slope CHU, Mormon Mesa CHU, Gold Butte-Pakoon CHU, and Piute-Eldorado CHU.
- Washington County Habitat Conservation Plan (HCP) (Washington County Commission 1995).
- Biological Assessment for the Proposed Addition of Maneuver Training Land at Fort Irwin, CA (U.S. Army National Training Center 2003)-Superior-Cronese CHU.

Environmental Baseline

Description of Affected Habitats

The following descriptions of the action area are summarized from the biological assessment (RCI 2005), section 404 Clean Water Act permit application with supplemental materials (The Huffman-Broadway Group, Inc. 2005), and the Environmental Assessment (ENTRIX 2005). A detailed description of project area topography, climate, geology, vegetation, surface and groundwater resources can be found by referencing these documents. Additionally, information on the hydrogeologic setting of the action area is summarized from the parent programmatic biological opinion, and more detailed information can be found therein (see Appendix A).

The proposed project area of approximately 6,881 acres is located in Coyote Spring Valley just south of the Clark-Lincoln county line between 2,200 ft and 2,544 feet in elevation. The Sheep Range lies to the west of the project area, and the Meadow Valley Mountains lies to the east.

The western third of the project area consists of alluvial fans at roughly two percent slope bisected by numerous west-east oriented dry washes and arroyos that generally drain into Pahranagat Wash- a large, braided ephemeral wash that runs from north to south along the eastern edge of the project area. In the middle of the project site is an area frequently referred to as "badlands," which is associated with limestone outcrops (RCI 2005). The eastern part of the project area is characterized as having highly stratified sand, silt, and clay soils with large amounts of gypsum and calcium carbonate; slopes of 15 to 20 percent; and generally less vegetation cover (The Huffman-Broadway Group, 2005). Soils within the project area are generally cobbly and gravelly sandy loam or loamy sand and are calcareous (RCI 2005).

The biological community within and surrounding the project area consists primarily of Sonora-Mojave Creosotebush-White Bursage Desert Scrub, with the predominant vegetation consisting of creosotebush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*) with other co-dominant or understory species such as Mojave yucca (*Yucca schidigera*), barrel cactus (*Ferocactus* sp.), cholla (*Opuntia* sp.), and beavertail prickly pear cactus (*Opuntia basilaris*) (SW REGAP classifications; http://earth.gis.usu.edu/swgap). Other common shrub species include Mormon tea (*Ephedra nevadensis*), indigo bush (*Psorothamnus fremontii*), four-winged saltbush (*Atriplex canescens*), hopsage (*Grayia spinosa*), spiny mendora (*Mendora spinencens*), brittlebush (*Encelia farinosa*), and purple sage (*Salvia dorii*). Several non-native grasses are prevalent on site, including red brome (*Bromus rubens*) and Mediterranean grass (*Schismus barbatus*). Catclaw acacia and desert willow (*Chilopsis linearis*) are found in scattered locations along Pahranagat Wash, and small to medium-sized catclaw acacias can be found scattered throughout the project site, primarily along the west-east drainages. A small pocket of Mojave Mixed Salt Desert Scrub exists to the east of the project area, a vegetation community typified by one or more *Atriplex* species (*A. confertifolia, A. canescens, A. hymenelytra*), creosotebush, desert thorn (*Lycium* spp.), and iodine bush (*Allenrolfea occidentalis*) to name a few (RECON 2000).

The vegetation community within the action area does not change substantially until approximately 9.7 miles downstream of the Project Development Area, at the headwaters of the Muddy River in the Upper Moapa Valley. Here, along the Muddy River and its tributaries, are the only substantial areas of riparian vegetation in the action area, consisting primarily of two non-native species: saltcedar (*Tamarix* sp.) and a non-native palm tree (*Washingtonia filifera*). Historically, these areas hosted a native broad-leaf riparian community of Fremont cottonwood (*Populus fremontii*), willow (*Salix gooddingii, S. exigua*), and velvet ash (*Fraxinus velutina*) that now exists only as small pockets, primarily along the lower Muddy River and Virgin River in Clark County. Remnants of mesquite (*Prosopis glandulosa, P. pubescens*) bosques can still be found in the upper floodplain terraces, and along stream banks and ephemeral washes in the area (RECON 2000, The Huffman-Broadway Group, Inc. 2005).

There are no permanent surface waters in the Project Development Area. Stormwater travels through the site in numerous west-east ephemeral drainages and potentially as overland sheet flow, generally draining into Pahranagat Wash. The Pahranagat Wash watershed is bound on the west by the Sheep Mountain Range and on the east by the Meadow Valley Mountains. To the north, Pahranagat Wash is connected to the White River Valley, with headwaters in the White Pine Range. To the south, Pahranagat Wash drains, during large storm events, into the North Fork of the Muddy River in the upper Moapa Valley. Following its confluence with Wildcat Wash and Deadman Wash, Pahranagat Wash becomes known as Arrow Canyon Wash, which flows directly into the Muddy River. Flow from more than 20 thermal springs in the South Fork of the Muddy River (including the Muddy Springs, Warm Springs, Apcar Springs, Pederson Spring, and Plummer Spring) merge to form the perennial flows within the Muddy River, with smaller contributions from springs along the North Fork.

The action area is located primarily within the Coyote Spring Valley and Muddy River Springs Area hydrographic basins. These basins are part of the White River Groundwater Flow System, a regional groundwater flow system located in southern Nevada (Eakin 1966, Harrill et al. 1988, Prudic et al. 1993). As originally defined by Eakin (1966), the flow system encompasses thirteen hydrographic basins, extending at least 250 miles and terminating at the Warm Springs Area. The flow system consists of numerous local basin fill aquifers underlain by a large regional carbonate aquifer that transmits groundwater from basin to basin, beneath topographic divides. Groundwater inflow or recharge to the regional carbonate aquifer is primarily through precipitation. The regional groundwater flow is inter-basin and is generally south and southeast through the system. The terminal discharge of the White River Groundwater Flow System is most likely the Warm Springs in the Upper Moapa Valley, an area consisting of about twenty regional springs, with numerous seeps and wetlands. These thermal springs, discharging at a nearly constant temperature of 89.6° F (Scoppettone et al. 1992), occur within a 1.2-mile radius and form the headwaters of the Muddy River. Historically, this river was a major tributary to the Virgin River, which then joined the Colorado River; however, after the construction of the Hoover Dam, it now flows into Lake Mead at the Overton Arm.

The source water supporting spring discharge in the Warm Springs Area is primarily groundwater from beneath Coyote Spring Valley, with a small contribution possibly from Lower Meadow Valley Wash to the northeast (Eakin 1966, Prudic et al. 1993, Thomas et al. 1996, Bassett 2003). The production wells in Coyote Spring Valley that will be pumped under the proposed action are located about 10 to12 miles northwest of the Warm Springs area. Groundwater flow from Coyote Spring Valley to the Warm Springs Area appears to be through a zone of high permeability. Down-gradient of the Warm Springs area, a normal fault juxtaposes low permeability rock of the Muddy Spring Formation against the carbonate aquifer, forming a barrier of sorts to regional subsurface flow. This barrier is responsible for the location of the springs. Hydrogeologic evidence suggests the presence of a zone of well-developed hydraulic continuity and high flow rates extending from Coyote Spring Valley to the Warm Springs area. Pumping stresses imposed at any point in this zone are expected to be readily propagated to all areas in the high transmissivity zone. While this represents the Service's interpretation of the hydrogeology, existing hydrologic data, and the effects or groundwater pumping, we also acknowledge that other interpretations exist. Further information on the hydrogeologic setting of the proposed action can be found in the programmatic biological opinion (Appendix A, pp. 14-17).

Current Disturbances and/or Habitat Protections in Action Area

As of January 30, 2006, CSI had initiated ground-disturbance activities (grading) on roughly 325 acres in the southwest corner of the project area for a golf course and nursery (C. Savely, Wingfield Nevada Group, pers. comm.). While incidental take of the desert tortoise on non-Federal land in Clark County is currently covered under the County's 10(a)(1)(B) permit, CSI must avoid impacts to WOUS until such time as the Corps section 404 permit is issued. This is being done by cordoning off WOUS within the areas where ground disturbance will occur first. Prior to, and other than this recent ground disturbance, the lands and vegetation within the project area are relatively undisturbed by anthropogenic factors. The project area is bordered by two highways: US 93 to the west and SR 168 to the south. Buried fiber optic lines run along the southern and western edge of the property and within the NDOT ROWs. Additionally, a 69 Kv transmission line runs adjacent to US 93 and SR 168, and a transmission line parallels Sawmill Road between US 93 and SR 168. A jeep trail traverses along the western edge of Pahranagat Wash through the project area with several spur roads to the east and west. Several old and partially over-grown dirt roads and two-tracks can be found on the project site, as well as old mining claim markers. Well sites (including access routes) are located within the project area, including the old MX-5 well just north of SR 168 in the southeastern corner of the project area; CSI Well No. 1 (Nevada DWR Permit No. 70430) located approximately 1.6 miles east of the US 93 and SR 168 intersection and just north of SR 168; and CSI Well No. 2 (Nevada DWR Permit No. 70429) located approximately 1.5 miles north of SR 168 and just west of Pahranagat Wash.

Land immediately adjacent to the CSI project area is also relatively undisturbed, other than effects associated with US 93, SR 168, and activities within NDOT ROWs. Old Highway 93, built in the early 1930s and abandoned in 1967, runs north-northwest from SR 168 starting approximately one mile east of Pahranagat Wash; several old borrow pits and spur roads can be found east and west of this road. An old gravel pit is located just east of US 93 and approximately one mile south of the project area. Other roads nearby include Sawmill Road and unimproved spur roads to the south and an unimproved road just north of the project area that runs east-west from US 93 to Pahranagat Wash. Kane Springs Road is located approximately 8.5 miles to the north of the project area. Several washes adjacent to the project area, including Pahranagat Wash, were classified by BLM as drivable washes during its recent and ongoing road inventory (Source: BLM 2005 road inventory data, Ely and Las Vegas Field Offices). Approximately 7 miles north of the CSI development area, an existing aggregate operation and pending Class III landfill is located in Lincoln County along US 93 within and adjacent to the Pahranagat Wash. Disturbance in and adjacent to the CSI project area also includes the military overflight zone related to the Nellis Air Force Base, monitoring wells, and access roads.

A provision of the *Lincoln County Conservation, Recreation, and Development Act of 2004* (LCCRDA) moved the ROW corridor established under Public Law 100-275 (NV-FL Act) from CSI lands in Lincoln and northern Clark counties to neighboring land west of US 93. The lands within the new ROW, previously in Service ownership and included in the Desert NWR, were relinquished to BLM in exchange for other lands per the LCCRDA. This newly-established ROW can be used for numerous purposes, including electrical transmission lines, gas lines, and water pipelines. No structures have been built to date, although ROW permit applications have been submitted to BLM and are under review.

Much of the land surrounding the CSI project area is public land managed by the Federal government for the protection of natural resources. BLM land to the south is within the designated Coyote Springs Valley ACEC, managed specifically for conservation of the desert tortoise. BLM lands to the north and east of CSI's Lincoln and Clark county lands are managed as the Kane Springs and Mormon Mesa ACEC, also designated and managed specifically for conservation of the desert tortoise. There are several BLM wilderness areas within close proximity to CSI lands and located at least partially within designated critical habitat for the desert tortoise (Mormon Mesa unit). The Arrow Canyon Wilderness, encompassing 27,530 acres, is located southeast and within one mile of the CSI project area. Three other BLM Wildernesses that fall partially within the Mormon Mesa CHU were designated as part of the LCCRDA of 2004: Meadow Valley Range Wilderness (approximately 123,509 acres) is directly east and northeast of proposed CSI reserve lands in Clark County and CSI lands in Lincoln County; Mormon Mountains Wilderness (approximately 157,718 acres) lies to the east of the Meadow Valley Range Wilderness; and the Delamar Mountains Wilderness (approximately 111,068 acres) lies in Lincoln County approximately 12 miles north of the project area. Together, these wilderness areas encompass 268,726 acres of desert tortoise habitat, including 83,841 acres within the Mormon Mesa CHU (Source: GIS analysis, Portland Fish and Wildlife Service Office, 2005).

Approximately 1.6 million acres of land west of the project area are managed by the Service as the Desert NWR. In 1974, approximately 1.4 million acres of land within the refuge were proposed for wilderness designation under the Wilderness Act of 1964. Since then, the refuge has been managed as "de facto" wilderness so as to retain the primitive character which initially made it eligible for inclusion within the National Wilderness Preservation System. The few designated roads within the refuge are primitive in condition. Vehicles must remain on road, and access to remote areas is by foot or horseback.

The Service's Moapa Valley NWR is a 106-acre area of springs and wetlands located in the Warm Springs area of the Upper Moapa Valley. The Moapa Valley NWR was established in 1979 for the protection of the endangered Moapa dace. The thermal headwaters of the springs on the Moapa Valley NWR are some of the most productive spawning habitat in the area. The Moapa Valley NWR consists of three units encompassing the major spring groups: the Pedersen Unit, Plummer Unit, and Apcar Unit (upper Apcar). Detailed descriptions of these units can be found in the parent programmatic biological opinion (Appendix A).

Desert Tortoise- Status within the Action Area

Biologists with Knight & Leavitt Associates, Inc. (K&LA) surveyed for desert tortoises between October 14 and 29, 2000, as part of the environmental studies for the proposed CSI project (K&LA 2000). Protocol followed the strip triangle method: 31 triangular transects of 0.5 miles per side were surveyed within a 34 square mile area of the Coyote Spring Valley, encompassing the CSI project area and adjacent lands to the south and west. One or two biologists from K&LA surveyed each transect, walking the length of each side and recording tortoises and sign (scat, burrows) observed within 16 feet of the transect line. The total number of tortoise sign per transect was then adjusted such that multiple sign obviously associated with a single individual was reduced to one sign (referred to as the Corrected Sign or CS). The total CS per transect was then averaged over the survey area, and this number was used to estimate the number of adult tortoises inhabiting the survey area based on methods described by Berry and Nicholson (1984).

The use of indices to estimate wildlife population sizes or density has been discouraged due to uncertainties (or unfounded assumptions) about the relationship between the index (e.g., scat, tracks, etc.) and the population parameter (e.g., density); high sampling variance; and a typical lack of validation, necessary during each year of survey (Anderson, 2001, 2003; Thompson et al., 1998). Berry and Nicholson (1984) examined the relationship between tortoise sign and density at several sites in the Mojave Desert of California in the 1970s, subsequently developing estimates of tortoise density based on CS counts that have been broadly applied across the range of the species. In 1981, Karl examined this relationship at sites in southern Nevada (Lincoln and Nye counties) and developed slightly different estimates of tortoise density based on CS. The relationship between tortoise sign and density in the Coyote Spring Valley and on the CSI project site has not been validated for these recent surveys. The CSI Science Advisory Team has proposed quantifying and mapping tortoise sign during clearance surveys of CSI lands; this information could be used to refine multivariate models predicting population densities from indicators in tortoise sign, testing the power of this approach in the Coyote Spring Valley.

Prior to 1987, BLM surveyed for tortoises within the CSI project area, Mormon Mesa CHU, and surrounding lands using the strip triangle method, recording all tortoise sign within approximately 16 feet of the transect and estimating species density based on methods described by Karl (1981) for southern Nevada (BLM 1998). We have converted the tortoise density estimates reported by K&LA (2000) using the methods described by Karl (1981) for southern Nevada, rather than methods described by Berry and Nicholson (1984) for California sites (Table 4). As noted above, estimating tortoise density from sign is clearly problematic, especially when such a relationship has not been validated temporally and spatially. Additionally, tortoise survey methods generally indicate the relative abundance of larger (adult and sub-adult) tortoises, but numbers of juveniles and hatchlings are more difficult to assess (BLM 1999). Despite these limitations and problems, density estimates from the CSI transect surveys may still be useful for identifying distribution patterns across the landscape: i.e., areas that tend to support higher or lower numbers of tortoises. Generally, tortoise densities appear to be very low to low (0-45 tortoises per square mile) in the southern part of the CSI Project Development Area and moderate to high (45-140 tortoises per square mile) in the northern part of the CSI Project Development Area. The majority of transects on proposed CSI reserve lands in Clark County (100 percent of BLM transects and 55 percent of K&LA transects) appear to have low to moderate tortoise densities (10-90 tortoises per square mile).

Table 4. Tortoise density estimates for CSI and adjacent lands in Clark County, Nevada based on triangular strip transect surveys.

Survey Area	Square Miles of Habitat	# Transects	Corrected Sign	Relative Density	Estimated # of Adult Tortoises
K&LA Triangular Strip Transect Surveys, 2000					
CSI Project Development Area	10.75	7	22	10 – 45	108 – 484
Proposed CSI Reserve	9.72	11	70	45 – 90	438 – 875
Total CSI Clark County Lands	20.47	18	92	45 – 90	921 – 1842
K&LA Survey Area: CSI & Adjacent Land	34.00	31	144	45 – 90	1530 - 3060
BLM Triangular Strip Transect Surveys, prior to 1987					
CSI Project Development Area	10.75	14	66.5	45 – 90	484 - 968
Proposed CSI Reserve	9.72	11	36	10 – 45	97 - 437
Total CSI Clark County Lands	20.47	25	102.5	45 – 90	921 - 1842

For K&LA surveys, tortoise remains were found on five transects on CSI lands and two transects on adjacent land. Surveys were conducted during the time of year when tortoise activity is generally slowing down, and while no live tortoises were encountered during surveys, one tortoise was encountered en-route to a transect location. Tortoise sign was found on all but one K&LA transect on CSI lands (transect #12 which fell over Pahranagat Wash) and all but two BLM transects, both of which were located in the southern half of the CSI Project Development Area.

Additionally, consultants hired by CSI recently conducted tortoise clearance surveys on roughly 660 acres (1 square mile) of land in the southwest corner of the project area for desert tortoises prior to initiating grading activities. Two tortoises were found for a density estimate of two tortoises per square mile (L. Zonge, pers. comm.). We do not know the search protocol used or the thoroughness of this clearance survey; thus, this may represent a low-end estimate for this particular site. Between October 29 and November 1, 2005, the Service conducted tortoise clearance surveys on another roughly 475 acres (0.74 square miles) north of the first cleared area and east of US 93. While tortoise sign was found, including numerous burrows and several scat, most of the sign appeared old. Two large carcasses were found and one live sub-adult tortoise. While the areas cleared to date appear to have low tortoise densities, this may be partly due to the close proximity of US 93 and SR 168. Researchers have found tortoise densities near paved highways to be depressed, potentially due to vehicle-related tortoise mortality as well as other impacts associated with roads (increased noise and vibrations that may disrupt behavior and communication, human access to areas that may result in increased collection of tortoises for food and pets, among other things) (59 FR 5820, Boarman 2002). Recent visits to the site by Service staff found that while some areas looked suitable for desert tortoises, little sign was observed (K. Field, Service, pers. comm.). However, it should be noted that the recently-surveyed area had largely cobbly soils. Sign, such as tortoise scat, is extremely difficult to detect on such substrates. Thus, low numbers of observed scat are not a good indicator of tortoise presence and use of this area, both past and present. Other sites within the project area, such as along west-east drainages and sites with sandier soils likely contain higher concentrations of desert tortoises. However, tortoise numbers may be depressed from historical densities due to numerous factors, including but not limited to: road effects, illegal collection, past grazing practices, and perhaps drought, which has been hypothesized to cause declines in desert tortoise populations (Tracy et al. 2004).

Other tortoise surveys in the vicinity of CSI may provide useful information on tortoise density and status in the Coyote Spring Valley and Mormon Mesa area. Two, 1-square-mile Permanent Study Plots (PSPs) are located within the Mormon Mesa CHU: the Coyote Spring PSP in Coyote Spring Valley, Lincoln County, Nevada; and the Mormon Mesa PSP in the eastern portion of the Mormon Mesa CHU. These plots have been surveyed periodically from the mid-1980s through the mid-1990s. The original purpose of these PSPs was to generate data on tortoise demography and population trends using 60-day mark-recapture survey protocol, and also collect data on habitat (biotic and abiotic) conditions and tortoise health (EnviroPlus Consulting 1995; Tracy et al. 2004). However, because plots were not randomly located, the ability to draw inferences about tortoise density, status, and trends beyond the plots themselves is limited. Still, realizing these limitations and using appropriate caution, data from these plots were used to estimate status and trends of tortoise populations in the Northeastern Mojave Recovery Unit and the Lower Virgin River DPS (in which these study plots and the CSI project area are located) as part of the 2004 assessment of the desert tortoise recovery plan (Tracy et al. 2004). This analysis found no significant statistical trend in adult density over the survey time period in these areas.

The closest PSP to the CSI project site is the Coyote Springs plot, which is located approximately 11 miles north of CSI, 1.9 miles east of US 93 and 1.9 miles north of Kane Springs Road. This plot was established in 1986 and resurveyed in 1992 and 1995. EnviroPlus Consulting (1995) characterized this site as having moderately high tortoise numbers, with a size distribution typical of that observed on other PSPs and a significantly skewed sex ratio with female tortoises comprising two-thirds of the observed sub-adult and adult population (however, this effect was not significant for tortoises >208 mm mid-carapace length). Over the three survey periods, total estimated population size on the plot ranged from 96 ± 31 to 116 ± 29 (Table 5) (Esque1986; Converse Environmental Consultants Southwest, Inc. 1992; EnviroPlus Consulting 1995). This is slightly higher than the high-end density estimate for all CSI lands in Clark County, and more than twice K&LA's high-end density estimate for CSI Project Development Area lands. The annual adult mortality rate for the Coyote Springs plot in 1995 was estimated at 4 percent, which is higher than the 2-3 percent rate that the Service believes necessary to sustain desert tortoise populations (Service 1994). However, the tortoise population at the Coyote Spring PSP was apparently stable over the 10 years that the surveys spanned (EnviroPlus Consulting 1995). Tortoises with symptoms of cutaneous dyskeratosis and URTD were observed during plot surveys; however, comparisons across survey periods are unreliable due to differences in diagnosis/evaluation criteria used to evaluate health status. In 1995, approximately one-third of tortoises had trauma-related injuries, likely caused by a predator. Overall, mortality by predation was characterized as present, but not at a high rate. Human impacts on tortoise populations in this area were considered low and inconsequential (EnviroPlus Consulting 1995).

Table 5. Population estimate for desert tortoises at the Coyote Springs 1-square-mile permanent study plot, Lincoln County, Nevada.

Year	All Size Classes[1]	Tortoises ≥180 mm MCL	Tortoises < 180 mm MCL
1986	96 ± 6	49 ± 4	N/A
1992	116 ± 29	67 ± 20	48 ± 19
1995	96 ± 31	58 ± 18	48 ± 42

[1] Population estimates include the 95% confidence interval, which was defined as 1.96 times standard deviation in 1986, and 2.00 times standard error in 1992 and 1995.

For the *Las Vegas Resource Management Plan and Final Environmental Impact Statement*, BLM estimated relative tortoise densities and numbers for proposed ACECs and adjacent areas (BLM 1998). Tortoise densities were estimated using both strip transect and PSP data. For the Aerojet property in Coyote Spring Valley, the estimated relative density of adult desert tortoises was 25 – 75 individuals per square mile and the estimated number of adult tortoises was 1,575 – 4,725 (median = 3,150) over the 63 square miles of Aerojet land. Relative density estimates for the Coyote Spring ACEC were generally 25 – 75 adult tortoises per square mile other than for that portion of the ACEC on Service land where densities were lower (10 – 45 adult tortoises per square mile).

For the *Proposed Caliente Management Framework Plan Amendment and Final Environmental Impact Statement for the Management of Desert Tortoise Habitat*, BLM also presented relative tortoise densities for proposed ACECs within the jurisdiction of the Caliente Field Office (BLM

1999). Relative densities were 25 – 75 adult tortoises per square mile for the Kane Springs ACEC (population estimate of 2,575 – 7,723 tortoises) and 10 – 20 adult tortoises per square mile for the Mormon Mesa ACEC (population estimate of 1,716 – 3,431 tortoises). The western portion of the Mormon Mesa DWMA/ACEC was classified as higher quality desert tortoise habitat with corresponding higher tortoise density estimates (25 – 75 adult tortoises per square mile) (BLM 1999). However, this does not correspond with strip transect data received from BLM, which indicates a concentration of transects with high to very high tortoise density estimates in the eastern part of the Mormon Mesa CHU.

Strip-transect data in the Coyote Spring Valley and adjacent ACECs (Karl 1981, Garcia et al. 1982 in BLM 1999, K&LA 2000) indicate wide variability in tortoise densities across the landscape: data from some areas suggest densities of close to 100 adult tortoises or more per square mile, including some sites within the Project Development Area and the northern portion of CSI's lands in Lincoln County, as well as to the north-northwest on adjacent BLM land; data from other areas suggest densities of less than 10 adult tortoises per square mile. This variability in tortoise density is also evident from strip-transect surveys on the CSI Project Development Area (Table 6). By considering this variability when calculating average tortoise density on the CSI Project Development Area, we arrive at an estimate of tortoise density of approximately 52 (K&LA) to 60 (BLM) adult tortoises per square mile or 559 - 645 tortoises on the project site. This falls above the high-end tortoise density estimate calculated using K&LA 2000 survey data and close to the mid-point of the tortoise density range calculated using pre-1987 BLM survey data.

The strip transect data (K&LA, BLM, others) and Coyote Spring PSP data represent the best available information for the species in the vicinity of the proposed project. Sampling on many of Nevada's PSPs was discontinued in the mid-1990s and new methods were sought for rangewide monitoring of desert tortoise populations (Tracy et al. 2004). In 2001, surveys were initiated in DWMAs throughout most of the tortoise's range (including Coyote Springs and Mormon Mesa) using the Line Distance Sampling (LDS) method and program DISTANCE to estimate population densities. At present, the Service anticipates that a draft report on the 2001 – 2004 LDS surveys will be available in early 2006. However, due to low sample sizes and the low incidence of tortoises per transect, density estimates will only be provided at the recovery unit level and not at the CHU level (R. Averill-Murray, Service, pers. comm.).

Given all of the information and factors described above, the Service concludes that the action area can and does support the desert tortoise in its present condition. Based on site conditions and previous surveys, the Service estimates that tortoise density in this area is roughly 60 adult tortoises per square mile and 645 adult tortoises may occur in the project area. Due to the lack of spatial and temporal validation of the relationship between tortoise sign and density, we choose to be conservative in our estimate of tortoise numbers by using the high-end estimate (BLM) that incorporates the potential patchiness of tortoise distribution across the CSI project site.

Moapa Dace- Status within the Action Area

Please refer to pages 31-43 of the parent programmatic biological opinion for a complete description of the Environmental Baseline for Moapa dace, including groundwater elevation/spring discharge relationships, current groundwater pumping activities and impacts, completed or on-going conservation actions, and conservation needs for the species (Appendix A).

Table 6. Number of triangular transects conducted on CSI lands in Clark County, Nevada, and corresponding relative adult tortoise densities.[1]

Number of Transects		Percent of Total Transects		Relative Density	Estimated Average Density[2] (per square mile)	Weighted Density by Category	
CSI Project Development Area							
K&LA	BLM	K&LA	BLM			K&LA	BLM
0	2	0	14	Very Low	5	0	1
4	4	57	29	Low	28	16	8
2	5	29	36	Moderate	68	20	25
1	2	14	14	High	115	16	16
0	1	0	7	Very High	140	0	10
Tot: 7	14	100	100			**52**	**60**
Proposed CSI Reserve							
K&LA	BLM	K&LA	BLM			K&LA	BLM
1	0	10		Very Low	5	1	0
3	7	27		Low	28	8	18
3	4	27		Moderate	68	18	25
2	0	18		High	115	21	0
2	0	18		Very High	140	25	0
Tot:11	11	100				**73**	**43**
Total CSI Clark County Lands							
K&LA	BLM	K&LA	BLM			K&LA	BLM
1	2	5		Very Low	5	1	1
7	11	39		Low	28	11	12
5	9	28		Moderate	68	19	24
3	2	17		High	115	20	9
2	1	11		Very High	140	15	6
Tot:18	25	100				**66**	**52**

[1] K&LA surveys were conducted in 2000. BLM surveys were conducted pre-1987.
[2] Mid-point of relative density estimates for each category, from Karl (1981).

Approximately 2,400 afy has been pumped on average from 1998 to 2003 from the carbonate aquifer of the Muddy River Springs Area basin at the Arrow Canyon Well location. To date, there has been almost no pumping of the permitted groundwater rights in Coyote Spring Valley. In 2005, CSI drilled and pump tested two wells in Coyote Spring Valley under DWR permit numbers 70429 and 70430. Limited pumping has commenced from CSI Well No. 1; and CSI Well No. 2 will be operational by April 2006. To date, CSI pumping has been limited to approximately 240 acre-feet to meet pump testing and construction needs.

Desert Tortoise Critical Habitat- Status within the Action Area and the Mormon Mesa CHU

The project area is located within the 427,900-acre Mormon Mesa CHU of the Northeastern Mojave Recovery Unit for the desert tortoise. The primary vegetation community within the Mormon Mesa CHU is the Sonora-Mojave Creosotebush-White Bursage Desert Scrub, which in Nevada is found in broad valleys, lower bajadas, plains and low hills of the Mojave Desert (SW ReGAP classification). Shrub cover is sparse to moderately dense, consisting primarily of creosotebush and white bursage with a variety of different shrubs and cacti as co-dominants or understory species (see *Description of Affected Habitats* for some of the more common species). Where poorly-drained soils with high salt and clay content are found on valley bottom floors, pockets of Salt Desert Scrub community may be present, typified by one or more *Atriplex* species.

The CHU boundaries were based on proposed DWMAs in the Draft Desert Tortoise Recovery Plan, which were drawn to conform to accepted principles of conservation biology as described under *Desert Tortoise Critical Habitat- Rangewide Status*. However, the Service recognizes that unsuitable (i.e., not containing the primary constituent elements of tortoise habitat) as well as suitable areas for tortoises may have been included in CHUs during the critical habitat designation process (59 FR 5820). For the analysis herein, we have defined suitable tortoise habitat as areas within the species' range that fall below 4,200 feet in elevation, excluding dry lakes (playas), permanent waters, urban (including paved roads), and agricultural/cultivated lands. As defined, all but seven acres of the CSI project area is potentially suitable desert tortoise habitat, as are the majority (98.5 percent) of the adjacent lands in the Mormon Mesa CHU (Source: GIS analysis, Portland Fish and Wildlife Service Office). The U.S. Geological Service Biological Resources Division (USGS BRD) is currently developing a Mojave desert tortoise habitat model, incorporating a high resolution precipitation model, geospatial data on perennial cover, and surface (i.e., soils, geology) data. This product is currently unavailable and likely will not be finished until 2006 (T. Esque, USGS BRD, pers. comm.).

As mentioned previously, the lands and vegetation within and adjacent to the project area are relatively undisturbed by anthropogenic factors other than that associated with recent CSI project activities. While Coyote Springs Valley has a long history of domestic livestock (cattle) grazing, this practice has been largely removed from rangelands in and surrounding the valley. Ranching in the Coyote Springs Valley centered on the valley's namesake, Coyote Spring, which is located approximately 12 miles north of the project area and was one of the few permanent water sources. The CSI action area falls primarily within the Arrow Canyon allotment. The formerly-public CSI lands were grazed until 1988, at which time Aerojet acquired the land through Public Law 100-275 and grazing of the lands ceased. In the 1990s, seasonal grazing restrictions were implemented in many of the allotments in known desert tortoise habitat; and by 1999, grazing preference in the Arrow Canyon allotment was reduced from 255 Animal Unit Months (AUMs) to zero AUMs (L. Zonge, pers. comm.). In 2001, grazing was effectively removed from the valley and surrounding areas with BLM's designation of the Kane Springs, Mormon Mesa, and Coyote Springs Valley ACECs.

EnviroPlus Consulting (1995) characterized the Coyote Spring PSP as having low historical and present-day human impact: Old Highway 93 was rarely used and had large shrubs growing through cracks in the pavement; little trash was observed on the plot; no power lines were present; no cattle or burros were observed; and while a few old two-track roads were discernible for short distances, none appeared to be recently made. On the other hand, low-level military over flights were not uncommon. Furthermore, this area was characterized as having somewhat variable but adequate tortoise habitat, with abundant forage and good soil for burrowing (EnviroPlus Consulting 1995).

The Mormon Mesa CHU is highly fragmented with an extensive network of primarily unimproved and two-track roads. The Desert Tortoise Recovery Plan (companion document for proposed DWMAs, Service 1994), describes this area as having the highest density of roads and trails (1.3 linear miles per square mile) of any desert tortoise *crucial* habitat in southern Nevada based on a 1984 status report [crucial habitat was defined by BLM in the California Desert Plan (1980) as "...Portions of the habitats of sensitive species that if destroyed or adversely modified *could result in their being listed as threatened or endangered pursuant to section 4 of the Act or in* some category implying endangerment by a State agency or legislature."]. Highway 93 runs along the western edge and bisects the southwestern tip of the unit, providing a substantial barrier between the unit and protected tortoise habitat in Desert NWR to the west. SR 168 also runs through the western part of the CHU; and I-15 traverses the southeastern edge of the unit. Other well-established roads include the Kane Springs Road approximately nine miles north of the CSI project area and the Carp-Elgin Road which bisects the unit. The Union Pacific Railroad, located adjacent to the Meadow Valley Wash, also bisects the unit into east and west portions. In at least one locale (outside Tucson, Arizona), a tortoise has been found unsuccessfully trying to cross a railroad and human intervention was required (Edwards et al. 2004); we also suspect that the Union Pacific Railroad in the Mormon Mesa unit represents a substantial barrier to tortoise movement. Powerlines and access roads, such as that associated with an Intermountain Power Project dissect much of the area (Service 1994). Additionally, a segment of the Kern River Gas Transmission Company's natural gas pipeline crosses through part of the Mormon Mesa CHU north of I-15. This project was recently expanded so as to more than double the capacity of the pipeline (Kern River Gas Transmission Company 2005). Ground disturbance associated with this project was partly mitigated through replanting of salvaged plants and shrubs in the vicinity of their original location (BRI 2005).

The Mojave Desert is a non-fire-adapted ecosystem, and fire has not historically played a large role in these areas, including in the Coyote Spring Valley. However, the proliferation of non-native annual grasses in the Mojave Desert is changing the fire ecology of the region: while relatively large interstitial spaces between vegetation used to serve as mini-fire breaks, carpets of dried, non-native annual grasses now carry fire quickly over large expanses, scorching native vegetation that is typically slow to recover from fire and potentially killing a high proportion of the seedbank beneath shrub canopies (Brown and Minnich 1986, D'Antonia and Vitousek 1992, Brooks 2002, Brooks and Esque 2002). The Coyote Spring Valley, including the CSI project area has been relatively un-impacted by fire to date, despite the prevalence of non-native annual grasses, such as red brome. There have been two lightning-ignited fires in the project area between 1981 and 2003 with minimal acreage burned (L. Zonge, pers. comm.). At least nine small fires occurred in or near the Mormon Mesa CHU and/or near the project area in 2004, including the Coyote Spring Fire which burned roughly 1,050 acres within eight miles of the CSI property on Desert NWR (Source: BLM GIS Fire data). The 2005 wildfire season in southern Nevada was extremely bad due in large part to the high bio-mass of flammable non-native annual grasses after above-average moisture conditions the previous winter. Twelve fires comprising the Southern Nevada Complex burned approximately 721,321 acres primarily on BLM-administered lands, including 32,581acres within desert tortoise critical habitat and 14,348 acres within the Mormon Mesa unit (BLM 2005). A separate, smaller fire (Lamb Fire) came within four miles of the CSI property. In total, 56 fires of various sizes in southern Nevada, Utah, Arizona, and California burned roughly 964,806 acres in the Northeastern Mojave Recovery Unit in 2005; including 15,559 acres within the Mormon Mesa CHU. Nearly half of the total acres burned and roughly three percent of those within the Mormon Mesa unit were potential desert tortoise habitat (Source: GIS analysis, Portland Fish and Wildlife Service Office). Clearly, the wildfire hazard in the Coyote Spring Valley and Mormon Mesa CHU is large.

The Mormon Mesa CHU is primarily in Federal ownership, administered by the BLM. In addition to CSI's property, there are several small privately-held parcels along the Meadow Valley Wash that are within or adjacent to the CHU. Other privately-held lands or Federal land slated for disposal adjacent or near the Mormon Mesa CHU have the potential for future development. BLM's Las Vegas Resource Management Plan (1998) identified Federal disposal land near the Mormon Mesa CHU in Clark County that will allow for the expansion of existing communities, including approximately 14,460 acres of BLM land near Mesquite and 40,950 acres near Moapa and Glendale. As development in Moapa and traffic increases on SR 168 and I-15, tortoise densities are likely to decline on adjacent critical habitat due to attending direct and indirect impacts. The City of Mesquite is expanding rapidly and the population is anticipated to grow from approximately 16,000 residents in 2004 to 47,000 residents by 2020 (Shipley Group 2005). Within the last ten years, the City of Mesquite has acquired Federal land north and west of the existing city for expansion purposes. Additionally, the 2004 LCCRDA directed BLM to offer for sale approximately 13,500 acres of land northwest of Mesquite in southeastern Lincoln County. While Mesquite's expansion will likely have the most immediate, direct impact on the Beaver Dam Slope CHU, both the Mormon Mesa and Gold Butte-Pakoon units are nearby and will likely experience direct and/or indirect impacts associated with Mesquite's growth. Land near the extreme southwestern tip of the Mormon Mesa CHU and northeast of Las Vegas is also in private ownership. Future development of these private lands, as well as possible future disposals of Federal land to allow for expansion of existing cities will create additional challenges for BLM and the Service in terms of management of the Mormon Mesa DWMA/ACEC and conservation and recovery of desert tortoises in the Mormon Mesa CHU.

BLM's management of the Mormon Mesa CHU is guided by planning documents such as the Las Vegas Resource Management Plan and the Caliente Management Framework Plan. These plans provide a framework for managing and protecting desert tortoise habitat as outlined in the following section.

Factors Affecting the Species Environment and Critical Habitat within the Action Area

<u>Major Activities Authorized under section 7 of the Act</u>

<u>File Nos. 1-5-94-F-334, 335, 336, and 035</u>. On May 15, 1995, the Service issued a non-jeopardy biological opinion to BLM for the issuance of a ROW to install four proposed fiber-optic lines in Clark and Lincoln counties, Nevada. Four applicants comprising the Fiber Toll Joint Venture Project requested a 7.6-m-wide (25-foot-wide) ROW for construction of four buried fiber-optic lines. Segments of these lines would parallel SR 168 for approximately 23 miles from Glendale to the junction of SR 168 and US 93; and for 43 miles along US 93 from the junction with SR 168 to Alamo, Nevada (File Nos. 1-5-94-F-334 and 336). Overall, the project was expected to result in the long-term disturbance of 144.36 acres of desert tortoise habitat and the short-term disturbance of 96.25 acres of habitat. Approximately 98 and 65 acres of long- and short-term habitat disturbance, respectively, was attributed to the two segments adjacent to US 93 and SR 168 described above, a majority of which runs through the action area for the CSI project. This included approximately 53 acres of long-term disturbance and 35 acres of short-term disturbance to designated critical habitat (Mormon Mesa CHU) for the desert tortoise. Based on triangular strip transect surveys for the project area, the Service anticipated that up to 34 tortoises would be incidentally taken, 8 through mortality and 26 through injury or harassment.

<u>File No. 1-5-94-F-28R.</u>. On March 23, 1994, the Service issued a non-jeopardy biological opinion to BLM for the issuance of a ROW permit for the Southwest Intertie Project (SWIP). The proposed project involves a 500-kV transmission line from Shoshone, Idaho to a new proposed substation site in the Dry Lake Valley northeast of Las Vegas. The proposed transmission line would traverse 53.2 miles of desert tortoise habitat in Coyote Spring Valley along US 93, resulting in long-term disturbance of approximately 380 acres and short-term disturbance of roughly 25 acres of desert tortoise critical habitat within the Mormon Mesa CHU. The Service anticipated that up to 95 desert tortoises would be incidentally taken, five through mortality or injury and 90 through harassment. While BLM issued a final Environmental Impact Statement and Record of Decision (ROD) for this project in 1994, construction has not been initiated. Subsequent to issuance of the Service's biological opinion and BLM's ROD, the ROW

corridor was moved off CSI lands per the LCCRDA of 2004. Revised plans for the utility project are currently being prepared.

File No. 1-5-97-F-251. On November 21, 1997, the Service issued a programmatic biological opinion to BLM for implementation of multiple-use actions within its Las Vegas District, excluding desert tortoise critical habitat, proposed desert tortoise ACECs, and the area covered by the Las Vegas Valley programmatic consultation. BLM proposes to authorize activities within the programmatic area that may result in loss of tortoises or their habitat through surface disturbance, land disposal, and fencing, for a period of five years. The total area covered by this programmatic biological opinion is approximately 2,636,600 acres, which includes approximately 263,900 acres of BLM-withdrawn lands in Clark County. This programmatic consultation is limited to activities which may affect up to 240 acres per project, and a cumulative total of 10,000 acres, of desert tortoise habitat excluding land exchanges and sales. Only land disposals by sale or exchange within Clark County may be covered under this consultation up to a cumulative total of 14,637 acres. Therefore, a maximum total of 24,637 acres of desert tortoise habitat may be affected by the proposed programmatic activities. BLM collects a remuneration fee of $682 per acre of disturbance of desert tortoise habitat, as indexed for inflation.

File No. 1-5-98-F-053, as amended: On June 18, 1998, the Service issued a programmatic biological opinion to BLM for implementation of the Las Vegas RMP. The project area for this consultation covers all lands managed by BLM's Las Vegas Field Office, including desert tortoise critical habitat, desert tortoise ACECs, and BLM-withdrawn land. The Las Vegas Field Office designated approximately 648 square miles of tortoise habitat as desert tortoise ACEC in the Northeastern Mojave Recovery Unit, and approximately 514 square miles of tortoise habitat as desert tortoise ACEC in the East Mojave Recovery Unit, through the final RMP. As identified in the RMP, BLM manages 743,209 acres of desert tortoise habitat within four tortoise ACECs for desert tortoise recovery. To accomplish desert tortoise recovery in the Northeastern and Eastern Mojave Recovery Units, the Las Vegas Field Office implements appropriate management actions in desert tortoise ACECs through the RMP including:

1. Manage for zero wild horses and burros within desert tortoise ACECs; close areas to livestock grazing

2. Limit utility corridors to 3,000 feet in width, or less.

3. Do not authorize new landfills or military maneuvers.

4. Require reclamation for activities which result in loss or degradation of tortoise habitat, with habitat to be reclaimed so that pre-disturbance condition can be reached within a reasonable time frame.

5. Limit all motorized and mechanized vehicles to designated roads and trails within ACECs and existing roads, trails, and defined dry washes outside ACECs.

6. Allow non-speed OHV events within ACECs, subject to restrictions and monitoring determinations.

7. Prohibit OHV speed events, mountain bike races, horse endurance rides, 4-wheel hill climbs, mini-events, publicity rides, high-speed testing, and similar speed based events.

8. Close to locatable minerals and solid leasables. Open to fluid mineral leasing subject to no surface occupancy stipulations. Allow free-use permits only within 0.5 miles of the centerline of Federal and State highways and specified county roads.

9. Within ACECs, do not allow commercial collection of flora. Only allow commercial collection of fauna within ACECs upon completion of a scientifically credible study that demonstrates commercial collection of fauna does not adversely impact affected species or their habitat. This action will not affect hunting or trapping, and casual collection as permitted by the State.

File No. 1-5-99-F-411. On December 8, 1999, the Service issued a non-jeopardy biological opinion to BLM for issuance of a ROW permit for the Nevada segment of the Las Vegas to Salt Lake City Long-haul Fiber-Optic Project. This consultation evaluated impacts to the desert tortoise and designated critical habitat from the construction, operation, and maintenance of a buried fiber-optic cable and related structures over an 180-mile linear stretch from Uvada at the Utah-Nevada border to its commercial terminus north of Nellis Air Force Base in Las Vegas. Much of the route was located in or parallel to existing ROWs for roads, utility lines, railroads, and existing fiber-optic lines. The section of the fiber-optic cable that runs through the Mormon Mesa CHU and CSI lands was located in NDOT's ROW east of US 93. BLM estimated that approximately 193 acres of desert tortoise critical habitat and 66 acres of non-critical tortoise habitat would be disturbed by the project. The final area of disturbance was calculated at approximately 270 acres. Of these, 158 acres were considered permanent impacts. Based on triangular strip transect survey data for the project area, the Service estimated that 4 desert tortoises may be incidentally injured or killed and 200 tortoises could potentially be affected by project activities. In May 2000, the Service was notified by project consultant SWCA, Inc. of a desert tortoise take (mortality) in the Evergreen Flats area to Delamar Valley.

File No. 1-5-99-F-450. On March 3, 2000, the Service issued a programmatic biological opinion to BLM for implementation of the Caliente Management Framework Plan Amendment (CMFPA). The planning area for this consultation covers all desert tortoise habitat managed by the BLM's Ely Field Office and Caliente Field Station within the Ely District. Desert tortoise habitat consists of areas below 4,000 feet in elevation within the defined range of the desert tortoise in Lincoln County, Nevada. The planning area for the CMFPA comprises approximately

754,600 acres of desert tortoise habitat, including 244,900 acres of designated desert tortoise critical habitat. The CMFPA was developed to assist in desert tortoise conservation.

As an initial step towards desert tortoise conservation, the BLM designated three ACECs with management prescriptions based on Recovery Plan recommendations that are consistent with those proposed by adjacent BLM districts. Programs included in the programmatic biological opinion include: Livestock grazing; wild horse and burro management; land disposal and acquisition; rights-of-way management; management of recreational activities including OHV use; minerals management; fire management; and public transportation and access. These actions may result in loss of tortoises or their habitat through programmatic activities over a 10-year period.

As part of the proposed action in the programmatic biological opinion, the Ely Field Office would implement the following management actions through the CMFPA:

1. Designate three ACECs covering 212,500 acres (332 square miles) and implement management prescriptions within these areas based on Recovery Plan recommendations.

2. Assist in monitoring desert tortoise populations; control tortoise predators; designate experimental management zones; research; translocation; and education programs.

3. Cooperate with the Service, Lincoln County road department, and NDOT to identify any roads and trails that are the cause of tortoise mortality due to impacts from vehicles. Install tortoise-proof fencing and culverts along heavily-traveled roads.

4. Within ACECs, authorize no commercial harvest of desert flora except through permits for educational and scientific purposes and salvage consistent with the National Environmental Policy Act (NEPA) and section 7 of the Act.

5. Close livestock grazing allotments or portions of allotments within ACECs.

6. Remove all wild horses and burros from the Mormon Mountain Herd Area (HA) and surrounding non-HA areas which occur in ACECs and will no longer be managed for wild horses and burros.

7. Allow no disposal of public land within ACECs or critical habitat through the Federal Land Policy and Management Act (FLPMA), sales, exchanges, Desert Land Entries (DLE), Indian Allotment, Recreation and Public Purposes Act (R&PP), Carey, or the Airport and Airway Improvement Acts.

8. Encourage local governments and private individuals to purchase environmentally sensitive private lands within ACECs for conservation purposes.

9. Resolve unauthorized land uses to facilitate reclamation and title retention, rather than title transfer. Reclaim surface disturbances from unauthorized uses to pre-disturbance conditions, if possible. Allow administrative land withdrawals for the purposes of facilitating management and construction of public information/environmental education facilities on such lands.

10. Designate three major corridors and consider areas outside of proposed corridors within ACECs as rights-of-way avoidance areas.

11. Limit casual OHV use to roads and vehicle trails designated for OHV use within ACECs. A future public process would identify routes for designation or closure.

12. ACECs would be closed to all speed competitive OHV use and impose restrictions on other types of events.

13. Participate in the development and implementation of an OHV monitoring plan with the Las Vegas Field Office and Clark County. Allow non-organized and commercial events on a case-by-case basis.

14. Close the proposed Kane Springs, Mormon Mesa, and Beaver Dam Slope ACEC to mineral material disposal except along a 1-mile corridor, ½-mile on each side of the road on designated roads, for the disposal of mineral material through free-use permits and Federal highway material site rights-of-way. These authorizations would be for local, county, State, and Federal governments. Existing pits and designations identified as not needed to meet current and future demand would be closed and reclaimed. There would be a restriction of ten miles between each mineral material site.

15. Initiate full fire suppression activities with minimum surface disturbances to reduce loss of tortoise cover and to minimize the spread of non-native annual grasses. Use prescribed fire or other tools consistent with recovery goals and objectives to help reduce the burn/reburn cycle.

16. Within ACECs: Close and rehabilitate any existing roads where no public or administrative need can be demonstrated; restrict the establishment of new permanent roads; allow temporary upgrading of existing roads only to reduce impacts on tortoise habitat; allow new roads only on a temporary basis or, if positive benefits to desert tortoise would occur; require reclamation of any temporary roads and reroute roads where feasible to improve manageability of habitat; implement closure to vehicular access with the exception of designated routes.

Implementation of multiple-use activities could result in the loss of 950 acres within ACECs and 7,645 acres within tortoise habitat outside of ACECs, with a 240-acre limit per project or action. Land disposal actions are limited to a cumulative total of 16,926 acres within desert tortoise habitat outside of ACECs. Cumulatively, 25,521 acres of desert tortoise habitat could be affected by the proposed activities within the planning area over a 10-year period.

Major Activities Authorized Under Section 10(a)(1)(B) of the Act

File No. 1-5-91-FW-40. On May 23, 1991, the Service issued a biological opinion on the issuance of a section 10(a)(1)(B) incidental take permit under the Act (No. PRT-756260) to Clark County, and the cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite. The Service concluded that incidental take of 3,710 desert tortoises on up to 22,352 acres of habitat within the Las Vegas Valley and Boulder City in Clark County, Nevada, was not likely to jeopardize the continued existence of the desert tortoise. The permit application was accompanied by the *Short-Term Habitat Conservation Plan for the Desert Tortoise in the Las Vegas Valley, Clark County, Nevada* (RECON 1991) (Short-term HCP) and an implementation agreement that identified specific measures to minimize and mitigate the effects of the action on desert tortoises.

File No. 1-5-94-FW-237. On July 29, 1994, the Service issued a non-jeopardy biological opinion on the issuance of an amendment to the section 10(a)(1)(B) incidental take permit (No. PRT-756260) for the Clark County Short-term Habitat Conservation Plan (HCP). This action extended the expiration date of the existing permit by one year (to July 31, 1995) and included an additional 8,000 acres of disturbance of desert tortoise habitat within the existing permit area. The amendment did not authorize an increase in the number of desert tortoises allowed to be taken under the existing permit. Additional measures to minimize and mitigate the effects of the amendment were also identified. Approximately 1,300 desert tortoises were taken under the authority of PRT-756260, as amended. In addition, during the Short-term HCP, as amended, approximately 541,000 acres of desert tortoise habitat have been conserved in Clark County on lands administered by BLM and the National Park Service.

File No. 1-5-95-FW-233. On July 11, 1995, the Service issued a section 10(a)(1)(B) incidental take permit under the Act (No. PRT-801045) to Clark County, Nevada; the cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite; and the NDOT. The permit became effective August 1, 1995, and allowed the incidental take of desert tortoises for a period of 30 years on 111,000 acres of non-Federal land in Clark County, and approximately 2,900 acres associated with NDOT activities in Clark, Lincoln, Esmeralda, Mineral, and Nye counties, Nevada. The Clark County DCP served as the permittees' habitat conservation plan and detailed their proposed measures to minimize, monitor, and mitigate the effects of the proposed take on the desert tortoise (RECON 1995). The permittees imposed a fee of $550 per acre of habitat disturbance to fund these measures. The permittees expended approximately $1.65 million per year to minimize and mitigate the potential loss of desert tortoise habitat. The majority of these funds were used to implement minimization and mitigation measures, such as increased law enforcement; construction of highway barriers; road designation, signing, closure, and rehabilitation; and tortoise inventory and monitoring within the lands initially conserved during the short-term HCP, and other areas being managed for desert tortoise recovery (e.g., ACECs or DWMAs). The benefit to the species, as provided by the

DCP, substantially minimized and mitigated those effects which occurred through development within the permit area and aided in recovery of the desert tortoise.

File No. 1-5-00-FW-575. On November 22, 2000, the Service issued a section 10(a)(1)(B) incidental take permit under the Act (No. TE-034927-0) to Clark County, Nevada; the cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite; and the NDOT. The permit supersedes the incidental take permit for the DCP. In the biological/conference opinion, the Service determined that issuance of the incidental take permit to Clark County would not jeopardize the continued existence of the listed desert tortoise or southwestern willow flycatcher, or any of the 76 unlisted, un-proposed species covered under the permit. Under the special permit terms and conditions of the permit, take of avian species, with the exception of American peregrine falcon (*Falco peregrinus anatum*) and phainopepla (*Phainopepla nitens*), would not be authorized until acquisition of private lands in desert riparian habitats in southern Nevada had occurred. The incidental take permit allows incidental take of covered species for a period of 30 years on 145,000 acres of non-Federal land in Clark County, and within NDOT rights-of-way, south of the 38th parallel in Nevada. The MSHCP and Environmental Impact Statement (RECON 2000), serves as the permittees' habitat conservation plan and details their proposed measures to minimize, mitigate, and monitor the effects of covered activities on the 78 species. In addition to measures specified in the MSHCP and its implementing agreement, the permittee shall comply with the special terms and conditions of the permit and measures stated in Sections 3C and 3D of the DCP, which were incorporated by reference into the MSHCP and incidental take permit.

Effects of the Action

Direct effects encompass the immediate, often obvious effect of the proposed action on the listed species or its habitat. Indirect effects are caused by or will result from the proposed action and are later in time, but still reasonably certain to occur. In contrast to direct effects, indirect effects can often be more subtle, and may affect species' populations and habitat quality over an extended period of time, long after project activities have been completed. Indirect effects are of particular concern for long-lived species such as the desert tortoise, because project-related effects may not become evident in individuals or populations until years later. Additionally, effects from actions such as groundwater withdrawal will likely manifest later in time; but could be of great consequence to aquatic-dependent species, such as the Moapa dace.

The CSI project area was previously included in the coverage area and acreage calculations for the Clark County MSHCP and Service-issued 10(a)(1)(B) permit authorizing incidental take of the desert tortoise under the MSHCP. However, the Service's biological opinion for issuance of an incidental take permit for the Clark County MSHCP specifically analyzed a lower level of land use in the Coyote Spring Valley than what is currently proposed by CSI; this was previously described under *Amendment to the Biological Opinion for the Clark County MSHCP*. We are therefore amending the original opinion by conducting such an analysis herein. Nonetheless, the number of acres of disturbance allowed under Clark County's incidental take permit will not change. Relevant portions of the original biological opinion (File No. 1-5-00-FW-575) and the Clark County MSHCP (RECON 2000) are herein incorporated by reference and summarized below.

The effects of the proposed action on the Moapa dace were previously analyzed in the January 30, 2006, parent programmatic biological opinion (Appendix A), which evaluated the effects of the cumulative groundwater withdrawal of 16,100 afy from the carbonate aquifer in Coyote Spring Valley and California Wash on the endangered Moapa dace. CSI is one of multiple parties that will be withdrawing groundwater from the Coyote Spring Valley and/or California Wash basins under this programmatic action. The anticipated effects from the CSI project are consistent with those anticipated in the programmatic biological opinion, though the effect attributable to CSI's groundwater pumping represents only a portion of the total effect. The overall effects analysis will be incorporated by reference and summarized below, with the impacts attributed to CSI described in detail.

Desert Tortoise

Direct effects to the desert tortoise from the proposed action include the permanent loss of 6,881 acres of desert tortoise habitat and all tortoises therein due to conversion from desert scrub to human residential and commercial uses; increased fragmentation of the Mojave desert scrub vegetation community in the Coyote Spring Valley and Mormon Mesa CHU; increased vehicular traffic and road mortality of tortoises attempting to cross roads; mortality or injury as a result of being crushed by vehicles and heavy equipment on the construction site, or falling into excavated areas or utility trenches upon entering a construction site for commercial or residential development; possible effects of noise and vibration from vehicles and heavy equipment; disruption of established home ranges and tortoise behavior; increased predation rates on tortoises by ravens, kit fox, and/or coyotes attracted to the construction site due to project-related trash, litter, and water; increased trash and litter leading to injury or mortality of tortoises through ingestion of harmful objects (e.g., plastics); exposure or ingestion of toxicants present in the environment from construction-related activities or spills; and illegal collection of tortoises by project personnel.

Additionally, tortoises could be inadvertently harmed if not handled properly during capture and transport to the DTCC. Urine and large amounts or urates are frequently voided during handling and may represent a severe water loss, particularly to juveniles (Luckenbach 1982). Overheating can occur if tortoises are not placed in the shade when ambient temperatures equal or exceed temperature maximums for the species (Desert Tortoise Council 1994, revised 1999). Minimization measures proposed by the Corps and applicant, including the use of Service-approved protocols for handling and transporting desert tortoises to the DTCC should reduce these potential effects.

Desert tortoises and Mojave desert scrub habitat beyond the project area may be adversely affected by the anticipated increase in human populations in the area, resulting in an overall increase in use of lands. This may lead to compacted soils, crushed or destroyed vegetation, removal of vegetation, increased soil erosion, altered hydrology, and increased non-point source pollution that may result in harm to the desert tortoise through habitat loss or degradation. Additional desert tortoise mortality and fragmentation of its habitat outside the project area may result from road and trail construction and maintenance, as well as OHV or other recreational uses, especially on adjacent public lands. These and other indirect effects are discussed in detail in *Threats to Desert Tortoise Populations: A Critical Review of the Literature* (Boarman 2002), prepared by the USGS for the BLM West Mojave Planning Team; the Desert Tortoise Recovery Plan (Service 1994); the Desert Tortoise Recovery Plan Assessment Report (Tracy et al. 2004); the final rule for designation of desert tortoise critical habitat (59 FR 5820); and other literature cited herein.

Threats to desert tortoises are generally associated with human presence in tortoise habitat, and thus are directly related to the amount of access people have to an area (Boarman 2002; Boarman refers to this as the most important general threat to tortoise populations). Elevated human use of public land adjacent to the proposed CSI development will result in additional loss, degradation, and/or fragmentation of desert tortoise habitat, but how far out these effects will radiate is unknown. Recreational activity on surrounding land will undoubtedly increase with the greatest and most frequent impacts likely occurring close to the development. The extensive road network that currently exists on adjacent BLM lands in the Mormon Mesa CHU will create easy access for incursions into desert tortoise critical habitat. Many of these roads are unimproved and/or require high-clearance or OHV for passage. Illegal routes (social trails) will likely proliferate as more people begin using the land. BLM's Las Vegas and Ely Field Offices are currently in the process of inventorying roads in the Mormon Mesa, Coyote Spring, and Kane Spring ACECs as part of a route-designation process (C. Ronning, BLM, pers. comm.). However, no transportation plan is associated with non-ACEC BLM land. Through this process, some of the roads on BLM land surrounding the CSI development may eventually be closed to vehicular and/or foot traffic; however, studies from other BLM sites indicate that people ignore road closure signs (Goodlett 1993, cited in Boarman 2002), so the effectiveness of signage in limiting human access and impacts to lands adjacent to CSI remains to be seen.

Roads have the obvious effect of increasing tortoise mortality rates due to vehicle collisions, and this may be more pronounced for juveniles which can be difficult to detect. Additionally, tortoise population densities are often depressed near paved roads/highways {though high tortoise densities have been found near I-15 in the East Mojave, California (T. Esque, pers. comm.)}, potentially due to road-related mortality and perhaps other factors such as vehicular noise and vibrations, pollution, and habitat loss due to roadside fires. This effect has been observed at least within 0.5 miles of paved highways (Boarman et al. 1997). Whether tortoise densities are lower near lightly-traveled dirt roads is not known; it is likely that road-kill rates are lower on unimproved than paved roads, but some mortality likely occurs (Boarman 2002). OHV use in the desert, which has greatly increased over the years and is the single greatest recreational use of public lands in southern Nevada (RECON 2000), can result in a significant cumulative loss of tortoise habitat and a significant impact on tortoise abundance and distribution (50 FR

5820). Roads may result in many other indirect impacts to tortoise populations by increasing opportunities for human access, such as the collection (poaching) of tortoises for pets, food, or sport; release of diseased, captive tortoises into wild populations and the subsequent spread of disease; littering and illegal dumping; increased chance and incidence of human-caused fire in tortoise habitat; and the spread of non-native, invasive weeds (Boarman 2002).

If we assume that 1) the greatest recreational impacts will occur on and stemming from existing roads (including unimproved roads), 2) that the greatest impact will be close to the development, and 3) the nearby BLM wilderness areas will be less impacted than non-wilderness areas due to restrictions on use of motorized/mechanized modes of travel, then we anticipate that most of the indirect impacts associated with motorized recreation will occur on CSI land surrounding the development (recreating from Old Hwy 93 and existing jeep trail near Pahranagat Wash) and non-wilderness BLM land to the south and southeast of CSI (access from US 93 and SR 168). Existing roads adjacent to Meadow Valley Wash may also receive heightened levels of recreation and associated impacts.

Passive or non-motorized recreation such as hiking, camping, wildlife viewing, rock climbing, mountain biking, and horseback riding may also have some level of adverse impact on wildlife, including tortoises. Little information is available on impacts of human recreation on desert tortoises; negative impacts on other taxonomic groups have been documented (e.g., ungulates, birds), and we anticipate that similar impacts to tortoises may occur (Service 2001). One 20-year study looked at the potential association of human recreation and wood turtle decline at two populations of wood turtles in a protected Connecticut watershed (Garber and Burger 1995). The study area was closed to recreation for nine years, and the wood turtle populations remained stable during this time period. When the study area was opened to human recreation (hiking, fishing), the two discreet populations started to decline and no wood turtles were found within ten years. All other measured environmental factors, including air and water quality, forest size, and road building restrictions remained constant. While the evidence in this example is only correlative, human recreation may have caused or contributed to this observed decline, possibly through collection and handling of wood turtles; increased numbers of turtle predators resulting from increased garbage; road kill; and/or disturbance by dogs.

Direct impacts of recreation may include vandalism or harassment of tortoises such as shooting; intentionally running over tortoises on roads; and collecting and handling, potentially causing tortoises to void their bladders, which in turn may adversely affect survival (R. Averill-Murray 2002). Additionally, tortoises may be inadvertently affected by human recreation through accidental trampling and/or vehicle collisions. The primary impact of human recreation on tortoises will likely be temporary disruption of activity and modification of behavior resulting from human-tortoise encounters, whether intentional or unintentional (Service 2001). Desert tortoises have excellent vision and audio acuity and can detect an approaching person even from within burrows and shelter sites. When disturbed, wild tortoises commonly sit still and remain inactive for many minutes afterward. This change in behavior can cause tortoises to cease feeding, seeking shelter, or interacting with other tortoises; ultimately increasing stress levels, exposure to extreme temperatures, and/or altering mating or nesting behavior (Service 2001).

The anticipated increase in human use and habitation of the Coyote Spring Valley may attract and concentrate predators such as ravens, coyotes, and kit fox, resulting in increased predation of desert tortoises. Predators are more likely to be attracted to the area if trash or other subsidized resources are present. Natural predation in undisturbed, healthy ecosystems is generally not a threat to the continued existence of the desert tortoise. However, predation rates may be altered when natural habitats are disturbed or modified. Common raven populations in some areas of the Mojave Desert have increased 1500 percent from 1968 to 1988, in response to expanding human use of the desert (Boarman 1992). Considering that ravens were very scarce in the Mojave Desert prior to 1940, it is assumed that the current level of raven predation on juvenile desert tortoises is an unnatural occurrence (BLM 1990). Because ravens make frequent use of food, water, and nest site subsidies provided by humans, their population increases can be tied to this increase in food and water sources, such as landfills and septic ponds (Boarman 1992, Boarman and Berry 1995, Service 1994). The existing extensive road network in the Coyote Spring Valley and Mormon Mesa area, as well as future trail systems that may be developed to accommodate recreational needs could create opportunities for trash dumping that will attract subsidized desert tortoise predators to the area. Desert tortoises may also be killed or injured as a result of encounters with trash (e.g., entanglement or ingestion of plastic).

It is not unreasonable to expect that raven populations in the Coyote Spring Valley will increase with human habitation and the increased availability of anthropogenic food and water resources, and nest-sites. Additionally, the anticipated increase in traffic volume on US 93 and SR 168 will likely result in more road-killed animals, thus providing more food for scavenger species such as the raven. As the human presence in the Valley increases, so will that of dogs; and the incidence of un-restrained domestic and/or feral dogs in tortoise habitat adjacent to CSI may subsequently increase. Dog attack or predation on tortoises has been identified by the Service as an emerging problem that warrants attention (59 FR 5820, Boarman 2002). Preliminary results from a study in the Mojave Desert of California indicate a significantly higher percentage of tortoises with moderate to severe canid-like shell trauma within approximately two miles of settlements than tortoises at more remote sites (Demmon and Berry 1995). Others have also reported high incidence of canid-like shell damage at sites with feral dogs and dog packs (Bjurlin and Bissonette 2001, cited in Boarman 2002).

The collection of desert tortoises for pets, food, or use in cultural observances may increase on lands adjacent to the proposed CSI development. Additionally, pet tortoises- both desert and exotic- kept by future residents of the CSI community may be intentionally or unintentionally released into surrounding areas. Well-meaning citizens may capture, transport, and release tortoises they find and perceive to be in harm's way. This could contribute to the spread of diseases such as URTD and/or the loss of unique, local characteristics through interbreeding and genetic mixing. By the early 1990's, NDOW had documented several cases of URTD in tortoises inhabiting the areas proposed for inclusion in the Coyote Spring and Mormon Mesa

DWMAs (Service 1994); and URTD has been documented in both the Coyote Springs and Mormon Mesa permanent study plots (BLM 1998). URTD appears to be spreading and may have been introduced to wild tortoise populations through the release or escape of diseased, captive tortoises (Jacobson 1994, cited in Service 1994), something that is more likely to occur near an urban area (Boarman 2002). A high or increased prevalence of URTD in tortoise populations adjacent to urbanized areas or within suburban areas has been documented in several regions: e.g., the Cecil Field/Brannon Mitigation Park in Florida (gopher tortoises; Brown et al. 2005); Tucson, Arizona (Sonoran population, desert tortoise; Jones et al. 2005). While evidence indicates a correlation between high rates of tortoise mortality/population decline and URTD incidence, a direct cause-effect relationship has not been established (Boarman 2002, Tracy et al. 2004). Additionally, tortoises that are physiologically stressed due to poor habitat conditions may be more likely to succumb to diseases such as URTD (Tracy et al. 2004).

Human use of lands adjacent to CSI could modify desert tortoise habitat within the Coyote Spring Valley and Mormon Mesa in subtle to not-so subtle ways. Vehicular and non-motorized recreation on adjacent lands could lead to soil compaction and vegetation changes, including decreased native plant cover and diversity, and increased erosion and non-native, invasive plant cover. Not only will the incidence of anthropogenic fire in the Valley and Mormon Mesa area likely increase due to greater human presence, but fires of any cause are likely to be more intense and burn more ground due to increased ground cover and fuel loads in the form of non-native, annual grasses. Historically, fires in the Mojave Desert were infrequent and did not spread far or fast due to gaps in vegetation that served as mini-firebreaks. Non-native grasses (*Bromus*, *Schismus*) have become increasingly more prevalent and dominant throughout the Mojave Desert, including in the Coyote Spring Valley, creating continuous fuel beds of highly-flammable, dead material. Additionally, increased human presence and recreational use of the valley will likely introduce and/or facilitate the spread of non-native, invasive plants, especially along roadways. Many native plant species cannot out-compete the non-native grasses that not only thrive in disturbed (e.g., burned) areas, but are extremely difficult to eradicate or control once established. A plant-fire regime cycle is created whereby non-native grass proliferation leads to higher frequency and intensity fires, which leads to greater non-native grass proliferation.

Fire may negatively impact tortoises and tortoise populations through direct mortality and injury, as well as loss, alteration, and fragmentation of habitat, at least for the short-term, including potential loss of forage species and shrubs that provide shelter (Brooks and Esque 2002, Esque et al. 2003). Creosote bush is slow to re-sprout and germinate following intense fire (Brown and Minnich 1986). Loss of these shrubs and other vegetation, even temporarily, may change the thermal environment and increase exposure of tortoises to temperature extremes (Esque and Schwalbe 2002). Loss of forage, water, or shelter sites can result in nutritional deficiencies and decreased reproductive rates. As mentioned under *Environmental Baseline*, the Coyote Spring Valley and Mormon Mesa area have been relatively unimpacted by fire to date. However, conditions are ripe for fire to occur in this area, as happened during the summer of 2005 when a complex of twelve fires (Southern Nevada Complex) burned approximately 403,644 acres of potential desert tortoise habitat, including 32,682 acres of designated critical habitat (14,348 acres within the Mormon Mesa unit) (BLM 2005). These fires, largely fueled by high fuel loads of non-native annual grasses and extreme wind conditions, moved through the landscape in a mosaic pattern, burning areas with different degrees of severity and leaving other patches within the fire perimeter unburned. In the Coyote Spring Valley, fire could be an especially important threat to tortoise populations due to the small size of the valley (CSI Science Advisory Team 2006).

Fire likely has or could have devastating population-level effects on desert tortoises, depending on the intensity and severity of the fire, acreage burned, fire pattern, and factors (e.g., post-fire precipitation) affecting vegetation rehabilitation of burned areas in the Mojave Desert. However, threats such as increased numbers of tortoise predators, recreation, roads, and disease are known to affect individual tortoises, but the demographic consequences of these threats on tortoise populations are largely unknown (Service 1994, Boarman 2002, Tracy et al. 2004). Additionally, these threats interact with one another synergistically, potentially compounding negative impacts and necessitating management actions that address threats simultaneously rather than one at a time (Tracy et al. 2004). Basically, this means that the combination of two or more threats acting on a tortoise population at the same time may cause an overall effect that is greater than the sum of each individual threat. Additionally, in an environment with multiple anthropogenic threats, the elimination of one threat through management action may be ineffective at protecting tortoise populations if another mortality factor simply takes its place (Tracy et al. 2004). This is important to consider in terms of CSI's proposed residential development because multiple threats (either new or intensified) will be acting on the tortoise population(s) of the adjacent reserve and CHU, land intended for the conservation and recovery of the species.

The incidental take of all desert tortoises within the CSI Project Development Area is currently covered under Clark County's 10(a)(1)(B) permit for the MSHCP. The Service's biological opinion for the Clark County MSHCP stated that covered activities may result in the loss of up to 145,000 acres of Mojave desert scrub vegetation (4 percent of total desert tortoise habitat within Clark County) and take of all desert tortoises therein. The 6,881 acres in the CSI Project Development Area will be applied toward the 145,000-acre incidental take area for the Clark County MSHCP. CSI's proposed action is a significant departure from actions and acreage of disturbance previously considered for the Coyote Spring Valley. Therefore, we must determine if the proposed action, which will result in a higher level of take of tortoises and disturbance to habitat within Coyote Spring Valley than anticipated in the original MSHCP biological opinion, could jeopardize the continued existence of the species or result in adverse modification of critical habitat.

The Service anticipates that all desert tortoises that occupy the 6,881 acres of Mojave desert scrub on the development site will be taken through harm, harass, kill, wound, capture, or collect as a result of the proposed action. The Service and the CSI Science Advisory Team are working together to develop a clearance protocol aimed at finding and removing as many tortoises as possible from the project site prior to ground-disturbance activities. All tortoises found on site will be captured and moved to the DTCC for potential use in a head-starting program, following protocol developed by the CSI Science Advisory Team and as approved by the Service. The Service believes that no more than 645 sub-adult and adult desert tortoises will be taken on the project site, either through capture, injury, or mortality. However, we anticipate that a majority of this take will be in the form of capture with subsequent removal to the DTCC, while acknowledging that some tortoises may be missed during clearance surveys and/or others may wander on to the construction site and not be detected, resulting in injury or death. An unknown number of juveniles, which will be difficult to detect during clearance surveys, will likely be taken through injury or mortality. Additionally, an unknown number of nests and eggs will be destroyed by construction-related activities.

The Service's analysis for the Clark County MSHCP biological opinion considered acreages of tortoise habitat lost, rather than absolute numbers of tortoises lost. Similarly, the incidental take permit issued for the MSHCP considered an incidental take area (in terms of acres lost), and the incidental take of all tortoises therein. As previously mentioned, CSI's proposed action represents a departure from what was previously considered in the Clark County MSHCP and the Service's MSHCP biological opinion, both in terms of type of land use and area of impact within the Clark County portion of Coyote Spring Valley. We know that Aerojet planned to use a relatively small area in Coyote Spring Valley for its rocket facilities and associated infrastructure, and that Aerojet anticipated that a majority of the impacts would be in Lincoln County and east of Pahranagat Wash (RCI 1987). Aerojet also anticipated that these losses would be at least partially offset by the establishment of the conservation reserve lands and the elimination of certain conflicting land uses, such as off-road vehicle use and other recreational activities within the exchange area boundary (RCI 1987). Therefore, we can safely assume that CSI's proposed development in Coyote Spring Valley will affect a larger area within Clark County than what was planned by previous owners and analyzed in the MSHCP opinion, but how this translates into number of tortoises taken in one action versus the other is largely unknown due to 1) the patchy distribution of tortoises in the Coyote Spring Valley and 2) uncertainties in terms of what impacts may have occurred on the land under Aerojet's ownership. Also, we do not know what other parcels of private land may have been developed under Clark County's existing incidental take permit if not for the 6,881 acres of development planned in Coyote Spring Valley, which will be applied to the total incidental take area for Clark County. We also do not know if the CSI project site has a higher or lower density of tortoises than similarly-sized parcel(s) of private land in Clark County that otherwise could have been developed under the existing permit.

However, the Service considers the desert tortoises and tortoise habitat in Coyote Spring Valley as valuable to tortoise conservation efforts locally, regionally, and rangewide. On the other hand, tortoises in or on the fringe of highly urbanized and fast-growing areas of southern Nevada (e.g., Las Vegas) may already be compromised and stressed from exposure to a large number of threats and a high degree of habitat fragmentation and isolation. To date, the primary impacts to tortoises in the Coyote Spring Valley have been limited to naturally occurring threats and those associated with the two major highways that bisect the valley (CSI Science Advisory Team 2006). While many of the threats to desert tortoises mentioned above are already present to some extent in the Valley, they will be greatly exacerbated by the increased human presence and use of this area post-CSI development. Some threats, such as dog predation, may be novel threats that tortoises in the area have not yet encountered. The CSI Science Advisory Team anticipates that three general threats will dominate the stress load on resident tortoises in the valley: population increases of known tortoise predators, roads and associated impacts, and invasive plant species and fire.

CSI has proposed several conservation measures as part of its proposed action that will help minimize effects of the development on desert tortoise and tortoise habitat in the Coyote Spring Valley, as well as further conservation efforts of the species locally, regionally, and potentially rangewide. By complying with the section 10(a)(1)(B) incidental take permit and Clark County MSHCP, effects of the proposed action will be minimized and mitigated through implementation of measures funded and administered through MSHCP activities/programs. These programs are intended to enhance the survival and recovery of the desert tortoise in the wild. The two highways bordering the proposed development (US 93 and Hwy 168) will be fenced with tortoise exclusion fencing using monies generated through administration of the MSHCP or collected by Federal agencies as part of the section 7 consultation process. This activity is intended to limit mortality and injury of tortoises on roadways. Studies indicate that tortoise-proof fencing reduces tortoise mortality along paved roads/highways (Boarman et al. 1997). Additionally, fencing of the highways bordering CSI could potentially make habitat available to tortoises adjacent to the roadways. Plant diversity and biomass (including that of preferred tortoise forage species) can be especially high adjacent to roadways due to favorable hydrological conditions. These highly-productive areas may attract desert tortoises to road edges; without tortoise-proof fencing, there is an increased risk of injury or mortality through vehicle-tortoise collision (Boarman et al. 1997). Law enforcement on surrounding BLM (ACEC) land is also at least partly funded through the MSHCP. A law enforcement presence will be important to help minimize indirect impacts to desert tortoises and tortoise habitat on lands adjacent to the CSI development; yet, it is presently unknown how much of a presence law enforcement officials will have on adjacent Federal and reserve lands.

CSI is also committing to survey and clear the project area of tortoises prior to ground disturbance. Tortoises removed from the project area will be moved to the DTCC for potential use in translocation or head-starting programs. Additionally, CSI has agreed to fence the northern and eastern boundaries of the Project Development Area with tortoise exclusion fencing (or some other type of Service-approved, tortoise-proof barrier) to prevent tortoise movement into the development. Lastly, CSI is providing an additional $750,000 above the $550 per acre development fee required under the MSHCP, to be used at the Service's discretion for research and conservation actions that further tortoise recovery efforts in the Coyote Spring Valley, Mormon Mesa area, and potentially rangewide. CSI has established a Science Advisory Team composed of tortoise and conservation strategy experts from the Service, USGS, and UNR to inform and direct these activities.

Tortoises cleared from the project area will be genotyped, marked, and moved to the DTCC, and will be kept separate from tortoises collected from other locales. On a regional scale, these individuals will contribute directly to the captive breeding and tortoise recruitment program, and can be used for translocation and head starting tortoises in the Coyote Spring Valley and Mormon Mesa. On a rangewide scale, this program will further the knowledge of head-starting as a tool for desert tortoise population enhancement. Desert tortoise populations have experienced rangewide population declines caused by high mortality rates due to the multitude of threats described above (Service 1994, Tracy et al. 2004, CSI Science Advisory Team 2006). Tortoise population stability appears to be especially dependent on high adult survival rates (Heppell 1998), and desert tortoises appear to experience relatively high mortality during early life stages leading to low recruitment rates (Germano 1994, Bjurlin and Bissonette 2004). Tortoise populations experiencing unnaturally high adult mortality due to multiple threats and stressors may require an increase in neonate/juvenile survival and recruitment to maintain the population long-term (Congdon et al. 1993). Desert tortoises are long-lived animals with delayed maturity, making for slow recovery potential when populations are thrown off-balance. Recruitment enhancement (head-starting) has been successfully used for other sensitive species of chelonians (Galapagos tortoises), perhaps averting extinctions (CSI Science Advisory Team 2006). This is accomplished by releasing juvenile tortoises that are large enough to avoid being depredated by natural and exotic tortoise predators (e.g., common ravens). Expert opinion indicates that due to the complexity and synergism of threats facing tortoise populations, head-starting may be needed to increase the likelihood that Nevada tortoise populations, including the Coyote Spring Valley population, persist in the wild until other conservation actions can be effectively implemented (CSI Science Advisory Team 2006). The use of enhanced-recruitment methods for management of tortoise populations should be regarded as a temporary conservation strategy allowing populations to persist until more effective management strategies can be established. A comprehensive conservation plan needs to include both enhanced recruitment in the short-term and threat reduction and reduced tortoise mortality through effective management actions in the longer term (CSI Science Advisory Team 2006).

The CSI Science Advisory Team is working with CSI to determine fence locations along the perimeter of the development. Tortoise-proof barriers to prevent movement of tortoises into the project area will minimize impacts to individual tortoises, but will likely serve to fragment the landscape and further limit movement and genetic exchange already hampered by US 93 and SR 168. The Science Advisory Team is considering the use of culverts in key locations to facilitate the occasional movement of tortoises across the highways but around the development.

Information collected from the CSI project area during clearance surveys (e.g., location of all tortoises and tortoise sign; habitat characteristics; and physiognomy of the cleared areas) will be used to further tortoise conservation efforts in the Coyote Spring Valley and Mormon Mesa CHU by providing important data on local and regional tortoise distribution, density, and habitat associations. These data can be used to model tortoise presence/absence or density in relation to environmental factors. Additionally, the distribution of tortoises and tortoise sign relative to US 93 and SR 168 will aid in the understanding of how paved roads impact tortoise populations.

The quantification and mapping of tortoise sign in the project area could potentially be used to refine multivariate models predicting population densities from indicators in tortoise sign, testing the power of this approach in the Coyote Spring Valley. As available, funds may also contribute to an intensive survey effort of Mormon Mesa to map densities of tortoises, as well as assess sites for experimental head-starting of tortoises generated at the DTCC. CSI funds associated with this project may also contribute to research on the efficacy of weed-control measures and fire effects to tortoise habitat. As mentioned above, tortoises collected from the project area can be translocated and/or their progeny can be used for head-starting tortoises at sites in Coyote Spring Valley and/or Mormon Mesa in an effort to enhance recruitment. Thus, tortoises cleared from CSI lands (and/or their progeny) will eventually contribute to regional and rangewide, long-term recovery efforts. Additionally, research associated with the head starting program will increase our understanding of effective release methods; movement, growth, health, and survivorship in relation to habitat; and the effectiveness of head starting as a means to enhance desert tortoise populations.

CSI's agreement to the reconfiguration of private and BLM-leased land in Coyote Spring Valley, as well as the dedication of the Coyote Springs Resource Management Area east of Pahranagat Wash, will help preserve habitat connections between the Wash, alluvial fans, and the Meadow Valley Mountains, as well as linkages between the alluvial fans of the Meadow Valley Mountains and the Arrow Creek Range. This action, while not considered a conservation measure specific to the desert tortoise, will decrease the amount of fragmentation of Mojave desert scrub in the Valley versus what could have occurred under the previous land-ownership configuration.

Moapa Dace

The Moapa dace will not be directly affected by the physical construction of the proposed residential community; however, groundwater pumping associated with the development is an interrelated action that will likely affect the headwater spring discharges of the Muddy River, and therefore, the Moapa dace. The parent programmatic biological opinion considered the cumulative withdrawal of 16,100 afy by multiple parties (including CSI) from two hydrographic basins of the regional carbonate aquifer, and analyzed potential effects on spring discharges and Moapa dace habitat (refer to Appendix A, pages 44-60). However, that analysis was completed on a landscape level and not on a project-specific level. The tiered biological opinion for the proposed CSI residential development will concentrate on the specific effects to Moapa dace from actions associated with the withdrawal of 4,600 afy of water from the regional carbonate aquifer system as detailed in the *Description of the Proposed Action.*

CSI's withdrawal of 4,600 afy of groundwater is approximately 29 percent of the cumulative groundwater withdrawal evaluated in the programmatic biological opinion. We assume that the amount of Moapa dace habitat loss attributable to CSI's pumping will be directly related to the amount of water CSI withdraws from the carbonate aquifer relative to the total amount withdrawn by all parties to the MOA. As indicated in Table 4 of the programmatic biological opinion (Appendix A, page 51), the predicted effect to Moapa dace habitat resulting from the cumulative withdrawal of 16,100 afy was an approximate decrease in riffle and pool habitat from 1998 conditions of 22 percent and 16 percent, respectively (see Pedersen Unit-Downstream Site section of Table 4).Therefore, the project's proposed withdrawal of 4,600 afy would equate to a loss of riffle and pool habitat from 1998 conditions of 6 percent (29 percent x 22 percent) and 5 percent (29 percent x 16 percent), respectively.

Since the spring of 2005, CSI's pumping from CSI Well No. 1 and CSI Well No. 2 has been limited to approximately 240 acre-feet for pump testing and construction purposes, which is well below the 600 afy anticipated for the first pump year of the phased pumping approach described in the Environmental Assessment and herein. Given the small amount and limited period of CSI's current groundwater withdrawal, effects of this activity on Moapa dace or its habitat are extremely difficult to detect, especially given on-going Arrow Canyon pumping of 2,400 afy. Therefore, we believe that CSI's current pumping of 240 afy in Coyote Spring Valley will not cause significant impact to the Moapa dace or its habitat. It is unlikely that CSI will increase groundwater withdrawal to a level equal to its first-year allotment (600 afy) during the interim period between signing of the CSI biological opinion and signing of the Muddy River MOA. Nevertheless, we believe it will be difficult to detect impacts to Moapa dace or its habitat if CSI were to pump up to 600 afy during this interim period, again due to on-going pumping at the Arrow Canyon location and the presumed short-time period between the effective dates of the two documents. Once the Muddy River MOA is signed by all Parties and goes into effect, all Parties to the MOA, including CSI, will be subject to the conditions associated with the trigger (flow) levels specified in the MOA and analyzed in the programmatic biological opinion.

The Service does not anticipate take of Moapa dace from project-related activities other than those associated with groundwater pumping. It is likely infrequent that ephemeral waters flowing in Pahranagat Wash that originate adjacent or upgradient of the CSI site reach downstream sites along the Muddy River. Additionally, the applicant has committed to implementing conservation measures to minimize impacts of the CSI development on water quality and quantity entering Pahranagat Wash from on and off-site precipitation events. A long-term stormwater management and flood control plan has been developed, including a system of constructed retention/detention basins to slow and filter urban and stormwater runoff, pollutants, and sediment prior to release into Pahranagat Wash. Other measures include (1) preserving Pahranagat Wash and a minimum 100-foot protective buffer from edge of bank on the west side of the Wash, (2) preserving in situ the length of two of the more substantial and heavily-vegetated west-east running washes within the Project Development Area, including an approximate 100-foot buffer from edge of bank on each side of both washes; (3) preserving in situ the western-most 1,650 linear feet of a third wash, including an approximate 75-foot protective buffer, and (4) restoring three desert dry washes and protecting each with a 40 to 80 foot restored upland buffer on each side. CSI will include the length of the Pahranagat Wash adjacent to the development and its buffer zone in the Coyote Spring Resource Management Area, the 6,219-acre natural reserve site that includes CSI lease lands east of the Wash. Additionally, all preserved and restored desert dry washes within the Project Development Area and their respective protective upland buffers will be permanently protected with a Natural Wash Buffer Zone Perpetual Conservation Easement.

These measures will maintain Pahranagat Wash, both adjacent and directly downstream of the CSI development, as an ephemeral drainage subject to infrequent surface flows following large precipitation events. Because of the relatively small size of the Project Development Area relative to the Pahranagat Wash watershed, we do not anticipate significant changes to the Wash's hydrograph during large, regional storms following development of the CSI site. However, local attenuation of the stormwater hydrograph will likely be observable for localized thunderstorms. CSI's proposed flood-control measures will likely minimize impacts to the timing and natural levels of discharge into and from Pahranagat Wash that will result from the conversion of desert scrub vegetation to impervious, man-made surfaces. However, Pahranagat Wash will experience at least some alteration of streamflow and sediment transport, which could potentially result in alterations of channel morphology, including destabilization of the channel.

The State has listed the Muddy River under Clean Water Act 303(d) as an "Impaired Water Body" for select pollutants or stressors of concern. The Nevada Department of Environmental Protection collects water quality samples from the Muddy River at Glendale, which is below the confluence with the Meadow Valley Wash, on a quarterly basis. It is not expected that Pahranagat Wash ephemeral flows originating within or upgradient of the CSI project site will have a significant influence on the water quality database that resulted in the 303(d) listing (ENTRIX 2005).

Desert Tortoise Critical Habitat

Our analysis of effects to desert tortoise critical habitat will follow recent Service-issued guidance: *Application of the "Destruction or Adverse Modification" Standard under section 7(a)(2) of the Endangered Species Act* issued on December 9, 2004; and *Guidance on Conducting Endangered Species Act section 7 Consultations on the Desert Tortoise and Other Species* issued on February 15, 2005. These guidance documents indicate that critical habitat analyses should focus on the entire critical habitat area designated *unless* the final rule for the designation identifies another basis for the analysis, such as discrete units and/or groups of units that are necessary for different life cycle phases, units representing distinctive habitat characteristics or gene pools, or units fulfilling essential geographic distribution requirements- and that the analysis should focus on the function and conservation role of affected critical habitat unit(s) for the species.

The Desert Tortoise Recovery Plan proposed six Recovery Units for the Mojave population of the desert tortoise representing six potentially distinct population segments (Service 1994). Designation of Recovery Units was based on behavioral, ecological, genetic, morphological, and physiological differences in desert tortoises across their range, which likely mirrors biotic and abiotic variability in desert tortoise habitat. By conforming closely to DWMA boundaries proposed in the Draft Recovery Plan (Service 1993), CHUs are intended to provide for viable populations of desert tortoises representing this variation in traits (59 FR 5820). The final rule designating desert tortoise critical habitat indicates that the basis for critical habitat analysis will be at multiple levels: the individual unit (including the local area that will be affected), the recovery unit in which it resides, and the overall range of the listed species. Each unit has a specific function and role both locally and rangewide, and the loss of a single unit may significantly reduce the ability of critical habitat to contribute to conservation and recovery of the species.

As noted in the *Status of the Species* section of this biological opinion, the constituent elements of desert tortoise critical habitat include sufficient space to support viable populations within each recovery unit and to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and over-wintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality. The proposed residential development will result in the complete loss of 6,881 acres of designated critical habitat for the desert tortoise from within the Mormon Mesa CHU. To date, tortoise surveys indicate a patchy distribution of tortoises/sign in the project area, with density estimates based on triangular strip surveys ranging from very low (1-10 tortoises per square mile) to very high (>140 tortoises per square mile). Generally, tortoise densities are low near the paved highways that traverse the western and southern boundaries of the project area. Recent tortoise clearance surveys in the southwestern part of the project area have produced mostly old sign (carcasses, old burrows) and relatively little recent sign and/or live tortoises. Evidently, these areas have supported tortoises in the past, perhaps in higher densities than currently found. Densities may be depressed, at least in parts of the project area, from what occurred historically due to road effects (depression zones near highways as discussed above under *Indirect Effects*), including easy access for poaching of tortoises.

The patchy distribution of tortoises/sign within the project area likely mirrors abiotic variability in desert tortoise habitat. Portions of the project area have cobbly soils less suitable for burrow excavation; other areas have sandy, loamy soils and incised washes more suitable for digging burrows. Generally, the project area appears to have sufficient shrub cover (creosotebush, bursage, Mojave yucca, and others) to provide shelter from temperature extremes and predators, and at least at certain times of year, sufficient forage for tortoises, as observed during several site visits to the area during the fall of 2005. In parts of the project area, tortoise densities may be depressed from what occurred historically; but the project area in general contains the primary constituent elements of desert tortoise critical habitat and has potential for use in recovery efforts through translocation and head-starting of tortoises. Currently, the high volume and speed of vehicular travel on US 93 and SR 168 presents a source of mortality for desert tortoises inhabiting the project area, potentially depleting tortoise populations on the proposed development site. However, both roads will eventually be fenced with desert tortoise exclusion fencing with funds collected though Clark County's MSHCP. This action, in combination with the potential use of culverts in key locations to facilitate tortoise movement, could further the recovery potential of the area. Thus, the proposed action will result in the loss of 6,881 acres that could otherwise have been used to further the purposes of desert tortoise recovery in the region and rangewide.

The indirect effects of building a new city in an area currently removed from human habitation and relatively unmodified by anthropogenic disturbances will result in the degradation of primary constituent elements and the fragmentation of desert tortoise habitat within the Mormon Mesa CHU and on adjacent lands that are not designated critical habitat but are none-the-less important for tortoise conservation (Desert NWR, non-ACEC BLM land). The Desert NWR was not designated critical habitat for the desert tortoise because current management policies provide adequate protection against human activities that could alter tortoise habitat (59 FR 5820). However, the refuge is currently not fenced or signed and refuge law enforcement may be inadequate to deal with impacts associated with a new city in the Coyote Spring Valley. Recreation in neighboring desert tortoise habitat, particularly off-road vehicle travel, will likely increase and over time, may destroy or damage most of the shrubs on land adjacent to the developed area. Shrubs that are not killed may be substantially reduced in height and width, thus providing little or no shelter for desert tortoises inhabiting surrounding lands. OHV recreation may remove forage plants for the desert tortoise or cover plants with dust, thus affecting photosynthesis; and disturb soils and destroy soil crusts and cryptogams, thus accelerating the spread of invasive non-native plants. These non-native plants (such as *Bromus* and *Schismus*) out-compete the native plant species, replacing the native annual plants that the desert tortoise requires for nutrients and shelter and increasing the ability of the desert to carry wildfire (Lovich and Bainbridge 1999). As mentioned above, the increased presence of humans in this area will likely increase the incidence of fire by anthropogenic sources, potentially resulting in substantial loss of desert tortoise habitat and alteration of plant composition and structure in the CHU.

Tortoise burrows may be destroyed by over-land foot or vehicular travel. Tortoises may be crushed or trapped inside burrows or the shelters may be rendered unusable, consequently exposing tortoises to the elements and predators. Off-road vehicles may also compact soils (e.g., sandy loams), rendering it difficult for tortoises to construct burrows or nests. Compacted sediments are not easily penetrated by rain, thus increasing runoff and erosion potential. Additionally, native plants are slow to colonize areas where the soil has been compacted because their roots cannot penetrate the denser sediments (Perkins 2004).

At this point in time, we lack accurate measurements of areas within desert tortoise critical habitat that contain the constituent elements, making it difficult to assess how much actual tortoise habitat will be lost as a result of the proposed action. For this analysis, we have defined suitable tortoise habitat crudely as areas within the species' range that fall below 4,200 feet in elevation, excluding dry lakes (playas), permanent waters, urban areas (including paved roads), and agricultural lands. As mentioned earlier, the 6,881-acre project area falls entirely within the Mormon Mesa CHU for the desert tortoise. The entire project area will be converted to a human landscape, representing a loss of 1.6 percent of the Mormon Mesa CHU. The majority of both the project area (99.9%) and Mormon Mesa CHU (98.5%) is potentially suitable desert tortoise habitat as defined above (Table 7). Thus, the amount of potentially suitable desert tortoise habitat that will be completely lost as a result of the proposed action is approximately 1.5 percent of the potentially suitable tortoise habitat in the Mormon Mesa CHU and 0.6 percent of the potentially suitable tortoise habitat in the entirety of critical habitat within the Northeastern Mojave Recovery Unit. Additionally, the numerous fires of 2005, including the Southern Nevada Complex, burned approximately three percent of available tortoise habitat in the Mormon Mesa CHU and ten percent of available tortoise habitat in the entirety of critical habitat within the Northeastern Mojave Recovery Unit (Table 7). At this point in time, these numbers represent worst-case scenario: burned acreages are the total area inside fire perimeters, and are not broken out by unburned areas and burn severity class, as this information is currently not available.

Table 7. Potential desert tortoise habitat, Critical Habitat Units of the Northeastern Mojave Recovery Unit.

Area	Size (acres)	Potential Tortoise Habitat (acres)[1]	Potential Tortoise Habitat in 2005 Burn Perimeters (acres)[2]
CSI Project Area	6,881	6,874	0
Mormon Mesa CHU	427,900	421,631	14,517
All CHUs in the Northeastern Mojave Recovery Unit[3]	1,194,517	1,172,646	120,146

[1] Defined as areas <4,200 feet in elevation minus playas, permanent waters, urban and agricultural/cultivated lands. Source: GIS analysis conducted by Portland Fish and Wildlife Service Office.
[2] Numbers represent total acreage for 56 fires (including the Southern Nevada Complex) that occurred in the Northeastern Mojave Recovery Unit in 2005. This total likely includes unburned areas and low, moderate, and high severity burned areas; accurate numbers for these burn severity classes are currently unavailable.
[3] Includes the entirety of the Mormon Mesa, Beaver Dam Slope, and Gold Butte-Pakoon CHUs and a small portion of the Piute-Eldorado CHU.

Additionally, critical habitat and constituent elements will be indirectly impacted by increased human presence in the Valley, primarily due to recreation (including OHV) and landscape changes brought on by increased extent/volume of non-native plants and incidence of fire. It is not possible to accurately determine the extent of these impacts. BLM anticipates that there will be high demand for OHV use and recreational trails in areas adjacent to the proposed CSI development (D Barajas, BLM, pers. comm.). As mentioned above, the Mormon Mesa CHU currently has an extensive network of unimproved roads and trails; which of these will be used and to what extent is largely unknown, though it can be assumed that if a road exists, it will get at least casual use. Impacts will likely be largest adjacent to the development and will attenuate to some unknown distance, with effects potentially occurring to a distance three times that of the development (D. Barajas, pers. comm.). Currently there is no formal trail/OHV system on BLM land in the CHU and there have been no organized, permitted recreation events to date in the immediate area of the proposed CSI development. BLM is currently inventorying roads on ACEC land within the Mormon Mesa CHU as part of their route designation and transportation planning process. However, the transportation plan, which will be legally enforceable, is only being developed for ACEC land. Thus, it is anticipated that much of the impact associated with the proposed CSI development will be felt on nearby BLM land that is not included in a designated ACEC (M. Maynard, BLM, pers. comm.). To date, BLM's road inventory is incomplete and has not undergone quality control checks. Therefore, no decisions have been made regarding which roads to close and which to maintain (C. Ronning, BLM, pers. comm.).

The Desert Tortoise Recovery Plan (Proposed DWMAs for Recovery of the Mojave Population of the Desert Tortoise) (Service 1994) characterizes the proposed Mormon Mesa DWMA as incurring much habitat degradation, thus necessitating a large DWMA to achieve a sustainable tortoise population size. CSI's proposed project will result in the direct loss of 1.6 percent of the critical habitat unit and will contribute to the degradation of constituent elements on surrounding land, though the geographic extent and severity of this effect is largely unknown at this point in time. This means there will be less land available for recovery of the tortoise in the Mormon Mesa CHU, and higher numbers of tortoises will need to be achieved on less land in order to reach delisting criteria. The Desert Tortoise Recovery Plan Assessment (Tracy et al. 2004) indicates that the number of threats in the Mormon Mesa area has increased since the original recovery plan was developed. One of the most significant threats to the Mormon Mesa CHU stems from urbanization and the resulting loss, fragmentation, and degradation of tortoise habitat. Allowable human uses of adjacent public or reserve lands will need to be appropriate and compatible with the purpose of their designation, i.e., conservation of desert tortoises or other sensitive wildlife species and protection of designated desert tortoise critical habitat.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local government, or private activities that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

CSI owns or leases approximately 29,000 acres in Lincoln County just north of the project area and proposed reserve lands in Clark County, and development of these lands is currently under consideration. CSI's original development proposal included lands in both counties. In 2001, CSI entered into an MOA with the Service and BLM to develop an MSHCP (CSI MSHCP) for the desert tortoise and other species of concern on all of its private lands in Clark and Lincoln counties. Since then, it was determined that the Clark County portion would be a stand-alone project with incidental take of the desert tortoise covered under the section 10(a)(1)(B) permit for the Clark County MSHCP, and the scope for the CSI MSHCP was reduced to CSI lands in Lincoln County. Discussions with the Service regarding the CSI MSHCP are on-going, and CSI continues to move forward on developing an MSHCP for their Lincoln County lands. However, the Service has not received a permit application and there have been no commitments on the part of any Party. Therefore, at this point in time, development of CSI's lands in Lincoln County is not considered reasonably certain to occur, as it is contingent on both the development and approval of an MSHCP and the issuance of a section 10(a)(1)(B) permit for incidental take of listed species on Lincoln County lands.

Other matters need resolution before CSI can develop their lands in Lincoln County, including securing needed resources (electrical power, gas, water) and/or Federal permits. Nevada State Engineer Order No. 1169 (March 8, 2002) held in abeyance the appropriation of additional waters from the Coyote Spring Valley and neighboring hydrographic basins until completion of a pump test that would determine impacts to flows of the Muddy River Springs. The pump test requires at least half of the existing permitted water in the basin be pumped for two consecutive years during a minimum five-year study period using a "staged development" (phased pumping) approach. Groundwater rights held in abeyance by this decision include 108,600 afy and 27,500 afy from Coyote Spring Valley hydrographic basin applied for by CSI and LVVWD, respectively. However, CSI has secured, through an affiliate, water rights in northern Lincoln County (Lake Valley basin); and in October 2005, CSI agreed to buy Kane Springs Valley water from Lincoln County and Vidler Water Company, pending appropriation by the Nevada State Engineer. State Engineer hearings on the Lincoln County/Vidler applications for approximately 17,375 afy from Kane Springs Valley are set for April, 2006. ROW corridors that could be used to transport water from Kane Springs Valley and/or Lake Valley to CSI were designated in the LCCRDA. However, exporting water to Coyote Spring Valley for use therein will require securing ROW permits from the Federal government for building a pipeline, necessitating environmental review and the Act and NEPA compliance prior to permit issuance. Therefore, not only is the development of CSI's lands in Lincoln County not reasonably certain to occur at this point in time, it will also likely be subject to future Federal actions that require consultation with the Service under section 7 of the Act [e.g., issuance of ROW permits across BLM land for water delivery; issuance of a Clean Water Act section 404 permit for filling WOUS, such as is the matter of this biological opinion; as well as intra-Service consultation on the issuance of a section 10(a)(1)(B) permit for an HCP].

However, it is reasonably certain that development on non-Federal lands in Clark County will continue to occur, as Clark County, Nevada, is one of the fastest growing counties in the United States. The population of Clark County has more than doubled between 1990 and 2003, increasing from 770,000 to 1.62 million, and the population is expected to grow to 2.75 million people by 2024 (Nevada State Demographer's Office 2004a, 2004b) or potentially higher (>3 million by 2025 as forecast by The Center for Business and Economic Research at University of Nevada, Las Vegas). For fiscal years 2001 through 2005, Clark County has recorded between 7,855 and 10,584 acres of land disturbance annually under its 10(a)(1)(B) permit for the MSHCP, with the amount of land disturbance increasing each year (R. Mrowka, Environmental Planning Division, Clark County, pers. comm.). This rate of development is expected to continue or increase in the future. Outside Las Vegas proper, North Las Vegas, Mesquite, and Henderson represent some of the fastest growing areas in the County. The Moapa and Moapa Valley area, which are located near the boundary of the project action area along the Muddy River, are also growing rapidly, with the combined population increasing from approximately 5,000 in 1996 to approximately 7,750 in 2004 (Nevada State Demographer's Office 2004a). BLM (1998) has identified approximately 41,000 acres for disposal near the towns of Moapa and Glendale that could allow for possible expansion of these communities. Each new development project within or near the action area will result in increased impacts to the environment, including potential impacts to endangered species and their habitat and increased demands on limited surface water and groundwater resources. More people will pursue recreational activities on Federal lands surrounding development areas, which will result in impacts to the environment across an area larger than just the acreage of the development itself.

As the human population continues to grow in Clark County and surrounding areas, additional resources (water, energy, etc.) will be needed to meet the needs of residents and visitors to the area. Development of these resources on non-Federal lands in the action area may occur, but most likely will require ROWs across Federal lands, thus falling under purview of section 7 of the Act. Non-Federal actions within the action area over the next 25 years will fall under the purview of the 10(a)(1)(B) permit for the Clark County MSHCP, which exempts incidental take of the desert tortoise on up to 145,000 acres of non-Federal land in Clark County. Non-Federal actions within the action area that could result in take of Moapa dace, southwestern willow flycatcher, and/or Yuma clapper rail (as well as other listed species not currently covered under the Clark County MSHCP) will require a Service-approved HCP and section10(a)(1)(B) permit and, where a Federal nexus occurs, consultation under section 7 of the Act.

Future demand for groundwater will continue to threaten spring flows and surface water important for aquatic species such as the Moapa dace. In the Muddy Springs area, MVWD's existing permit would allow more groundwater to be pumped from the Arrow Canyon Well, located within the Muddy River Springs Area hydrographic basin and 2.3 miles west of the Moapa Valley NWR, in the future. The maximum permitted pumping rate at the Arrow Canyon Well is 7,200 afy or 10.0 cfs, as compared with the annual average of 2,400 afy or 3.3 cfs pumped currently. Depending on the outcome of the five-year study mandated in the State Engineer Order 1169 and subsequent ruling by the State Engineer, additional groundwater could potentially be pumped in Coyote Spring Valley. While the Muddy River MOA includes the removal of 13,600 afy in Coyote Spring Valley, the total volume of permitted water rights in Coyote Spring Valley is 16,100 afy. Any of the remaining permitted water rights (2,500 afy) could be developed. The maximum volume that could be removed from the Coyote Spring/Warm Springs Area under existing groundwater permits is 23,300 afy. This represents almost a ten-fold increase from current withdrawals in the system.

In addition to the existing permitted water rights, there are pending applications for a far greater volume of groundwater than that already permitted in the Coyote Spring Valley (>200,000 afy pending) and Muddy River Springs Area (22,000 afy pending) hydrographic basins. The State Engineer, through Order 1169, held these pending applications in abeyance until the completion of the two-year pump test and evaluated results. Additionally, there are pending applications totaling more than 17,000 afy in Kane Springs Valley hydrographic basin (Basin 206), located northeast of Coyote Spring Valley. Coyote Spring Valley, Muddy River Springs Area, and Kane Springs Valley basins are part of the White River Flow System, and pumping in any of these basins could potentially affect groundwater levels and spring discharge in the Warm Springs Area. If these applications are granted, it is uncertain which ones would require a future Federal action in order to develop the rights upon approval.

Any future groundwater pumping by private parties above and beyond that analyzed in the parent, programmatic biological opinion that is determined to affect or take Moapa dace could only legally occur under the authorization of an HCP and a Service-issued incidental take permit. The Service's action of issuing such a permit would involve an internal consultation to affirm that section 7(a)(2) of the Act would not be violated. Additionally, any future well exploration on private lands that may result in the take of desert tortoises could only legally occur under the authorization of an HCP and a Service-issued incidental take permit.

Conclusion

The Service's signing of the Muddy River MOA, the action analyzed in the parent programmatic biological opinion (Attachment A), does not waive any of the statutory duties or authorities of the Service or the United States, nor relieve the participants of the MOA from complying with any Federal laws, including but not limited to, NEPA, Endangered Species Act, National Wildlife Refuge System Improvement Act of 1997, and Federal Land Policy and Management Act of 1976, and any and all rules and regulations there under. The biological opinion for CSI's proposed action tiers to the programmatic document and represents the Service's project-specific analysis of: 1) the effects of CSI's withdrawal of 4,600 afy of state-appropriated water rights from the Coyote Spring Valley basin on the endangered Moapa dace; and 2) the effects of CSI's proposed action on other listed (i.e., the desert tortoise) and/or candidate species not considered within the context of the programmatic document.

Desert Tortoise

After reviewing the current status of the desert tortoise (Mojave population) and its designated critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed and analyzed, is not likely to jeopardize the continued existence of the desert tortoise and is not likely to adversely modify its critical habitat. The action area falls within the coverage area and acreage calculation of the Clark County MSHCP, and the Corps intends to minimize the effects of the proposed action on the desert tortoise by requiring the applicant to comply with the terms and conditions of the section 10(a)(1)(B) incidental take permit under the Act for the MSHCP. Additionally, CSI has committed to implement minimization and conservation measures above those required under the Clark County MSHCP, including surveying and clearing the Project Development Area prior to ground disturbance, fencing the northern and eastern boundary of the Project Development Area with tortoise-proof barriers, and providing $750,000 to be used as directed by the Service and CSI Science Advisory Team for desert tortoise research and conservation activities within the Coyote Spring Valley and Mormon Mesa area, as recommended by the CSI Science Advisory Team.

The Service determined that the activities under the Clark County MSHCP would not jeopardize the continued existence of the desert tortoise because the minimization, mitigation, and monitoring measures under the MSHCP would contribute to the conservation and recovery of the covered species. However, the Service's analysis for the MSHCP biological opinion was specifically limited to a lower level of use in Coyote Spring Valley than what is currently proposed by CSI. The Service has herein analyzed the effects of CSI's proposal to develop a residential community on 6,881 acres within the Coyote Spring Valley, Clark County, Nevada, and this biological opinion serves to amend the Service's opinion for the MSHCP for the desert tortoise and its critical habitat. While the proposed project will result in the permanent loss of 6,881 acres of designated critical habitat for the desert tortoise, this represents a small percentage of the designated critical habitat within the Mormon Mesa CHU, and thus rangewide. It is the Service's opinion that critical habitat and the affected CHU (Mormon Mesa) will continue to function as intended by providing reserve quality habitat and functional corridors for conservation of the desert tortoise. Additionally, it is the Service's opinion that the action as proposed will not jeopardize the continued existence of the desert tortoise because (1) the number of tortoises that would be killed or injured should be extremely small due to commitments by CSI to survey and clear the Project Development Area of tortoises prior to ground-disturbing activities, (2) tortoises removed from the site will likely be used for translocation and/or a head starting program in the Coyote Spring Valley or areas of historic occupancy, (3) the applicant has committed to conservation measures (e.g., fencing of the northern and eastern perimeter) that will help minimize impacts of the development on the local desert tortoise population, and (4) research stemming from funds contributed by the applicant will greatly aid in our understanding of tortoise conservation, threat abatement, and the use of head starting for conservation purposes. Our finding is based on full implementation of the applicant's conservation and minimization measures as directed by the CSI Science Advisory Team and the Service, which is intended to further desert tortoise conservation efforts in the Coyote Spring Valley and Mormon Mesa area; as well as the Corps' intention to require compliance to the terms and conditions of the section 10(a)(1)(B) incidental take permit for the Clark County MSHCP.

Moapa dace

After reviewing the current status of and environmental baseline for the Moapa dace; the effects associated with the cumulative groundwater withdrawal by multiple parties analyzed in the Muddy River MOA biological opinion; the project-specific effects associated with CSI's proposed action; and the cumulative effects; it is the Service's biological opinion that the action, as proposed and analyzed, is not likely to jeopardize the continued existence of the endangered Moapa dace. Our finding is based on implementation of the project's conservation actions within the range of the Moapa dace prior to the initiation of groundwater pumping. These conservation actions are an effort to increase the species population and expand its range from current levels and distribution in order to assure its long-term survival. Additionally, our finding is based on the assumption that the groundwater pumping proposed in the MOA and the associated effects of such pumping occur as analyzed in the programmatic and tiered biological opinions.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act, as amended, prohibits take (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. "Harm" is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering (50 CFR § 17.3). "Harass" is defined as actions that create the likelihood of injury to listed species by annoying them to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant. Under the terms of sections 7(b)(4) and 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Incidental Take Exemptions- Desert Tortoise

Applicant

CSI's proposed residential development is an interdependent activity with respect to the Corps' action and will result in the incidental take of the desert tortoise as described below. The applicant's proposed action falls within the scope and coverage of the 10(a)(1)(B) permit issued to Clark County for its MSHCP, and an exemption for the anticipated take of the desert tortoise is provided to the applicant via the incidental take permit for Clark County's MSHCP. The Service's biological opinion for the Clark County MSHCP stated that covered activities may result in the loss of up to 145,000 acres of Mojave desert scrub habitat (4 percent of total desert tortoise habitat within Clark County) and take of all desert tortoises therein. The loss of 6,881 acres of tortoise habitat for CSI's residential development will be applied toward the 145,000-acre incidental take area for the MSHCP. Thus, the total number of acres of disturbance and the associated take of desert tortoises permitted under Clark County's incidental take permit will remain at 145,000 acres, and this will include the 6,881-acre CSI Project Development Area.

Federal Action Agency

Incidental take of covered species due to mortality or habitat loss within Corps jurisdictional wetlands is not authorized by the section 10(a)(1)(B) incidental take permit for the Clark County MSHCP, thus necessitating section 7 consultation for the proposed action. Incidental take of covered species for the Corps' proposed issuance of a Clean Water Act section 404 permit to CSI for the discharge of dredged and fill material to jurisdictional waters is being authorized through the CSI biological opinion. An exemption for the anticipated incidental take of the desert tortoise as described below is provided to the Corps via this *Incidental Take Statement*.

Amount or Extent of Take Anticipated

Desert Tortoise

Based on the analysis of impacts provided above, the Service anticipates that all desert tortoises that occur on the 6,881 acres of Mojave desert scrub on the project area will be taken through harm, harass, kill, wound, capture or collect as a result of the proposed action. Based on prior surveys of the project site, we believe that take will amount to no more than 645 desert tortoises. Because tortoise clearance surveys will be conducted prior to ground-disturbance activities, we anticipate that a majority of the take of adult and sub-adult tortoises will be in the form of collect, i.e., capture with subsequent removal to the DTCC. However, some tortoises will undoubtedly be missed during clearance surveys, especially juveniles which are more difficult to detect, and/or others may wander unnoticed onto the construction site subsequent to surveys, resulting in injury or death. Thus, we anticipate that some number of tortoises will be accidentally injured or killed as a result of project-related activities within or adjacent to the project area, but that this number is not quantifiable and depends largely on clearance survey methodology (e.g., single versus multiple clearance surveys) and the use of measures (e.g., temporary tortoise-exclusion fencing) to prevent and/or detect tortoises re-entering previously surveyed areas. Additionally, an unknown number of desert tortoise eggs and non-emerged hatchlings may be incidentally destroyed or excavated and moved to the DTCC as a result of project activities. The number of eggs that a female desert tortoise can produce in a season is dependent on a variety of factors including environment, habitat, availability of forage and drinking water, and physiological condition (Henen 1997; McLuckie and Fridell 2002). Without detailed information on the Coyote Spring Valley tortoise population and habitat conditions, it is impossible to quantify potential take of eggs and non-emergent hatchlings.

An unknown number of desert tortoises may be taken indirectly in the form of harm and harass through increased noise and ground vibrations associated with the use of heavy equipment, as well as other construction-related activities. Based on strip transect surveys (BLM, K&LA), which generally indicate low to moderate tortoise densities on land adjacent to the CSI project site and an overall patchy distribution of tortoises, the Service estimates that only a few desert tortoises inhabiting land adjacent to the proposed project site would be adversely affected by noise and vibrations associated with construction activities. An unknown number of desert tortoises may also be taken in the form of mortality through predation by ravens attracted to construction-related trash in the project area. Additionally, tortoises adjacent to the development area may be taken indirectly in the form of harass, harm, pursue, hunt, shoot, wound, kill, capture or collect due to increased human access and use of surrounding lands once the development is completed. The degree and extent of this indirect take is not quantifiable and is not authorized through this biological opinion.

The CSI project will result in the permanent loss of 6,881 acres of desert tortoise habitat. The Service's biological opinion for the Clark County MSHCP stated that covered activities may result in the loss of up to 145,000 acres of Mojave desert scrub habitat (4 percent of total desert tortoise habitat within Clark County) and take of all desert tortoises therein. The Corps will require CSI, through enforceable conditions tied to the section 404 permit, to comply with the terms and conditions of the section 10(a)(1)(B) incidental take permit for the Clark County MSHCP. The loss of 6,881 acres of tortoise habitat associated with this project will be applied toward the 145,000-acre incidental take area for the MSHCP.

Moapa Dace

The Service anticipates that incidental take of Moapa dace through harm (i.e., habitat modification or degradation that results in death or injury) will occur, but the actual death or injury of fish will be difficult to detect for the following reasons: the species has a small body size and finding a dead or impaired specimen is unlikely in a flowing stream environment. On the other hand, significant habitat modification or degradation that could result in take of Moapa dace will be detectable and measurable. Therefore, we are expressing take of Moapa dace in terms of habitat loss resulting from changes in habitat characteristics, such as water temperature or chemistry and water flows. Although the extent of effects to the species as a result of the proposed action is not yet known, future and on-going biological/hydrological studies will assist us in determining how flow reductions and thermal load losses will affect Moapa dace habitat, food availability, reproduction, and fecundity.

Perhaps the most significant impact to Moapa dace habitat that could result from implementation of the proposed action, as a result of decreased discharge and subsequent wetted area, is the reduction of overall volume of water that would be available to the species within the channel, thereby limiting the chance for long-term survival. Larger water volumes provide the habitat necessary for increased food production and subsequently larger fish, thus greater fecundity. Hence, more numerous, larger eggs provide a better opportunity for species long-term survival.

We have estimated that CSI's proposed action will result in the incidental take of Moapa dace associated with the loss of 6 percent riffle habitat and 5 percent pool habitat, consequent to the withdrawal of 4,600 afy from the Coyote Spring Valley hydrographic basin. However, there are factors which complicate the evaluation and establishment of habitat loss and associated incidental take of Moapa dace specific to CSI's proposed action, such as the potential for multiple parties to be simultaneously withdrawing groundwater from different locations within the same carbonate aquifer. Given this, the most accurate way to establish habitat loss and associated incidental take of Moapa dace is by evaluating the impacts to Moapa dace habitat on a landscape level, as was done in the programmatic biological opinion. In that parent document, the cumulative withdrawal of 16,100 afy by the parties associated with the MOA predicted a loss of approximately 22 percent riffle and 16 percent pool habitat (as measured at the Warm Springs West gage downstream from the Pedersen Unit) *when the flows reach 2.78 cfs* (see Appendix A, Table 4, pg. 51). Therefore, while incidental take is not authorized under the programmatic opinion but deferred to project-specific (tiered) opinions, the total amount of incidental take of Moapa dace anticipated for the cumulative actions of parties to the MOA is that which is associated with 22 percent loss in riffle habitat and 16 percent loss in pool habitat. Should flows at the Warm Springs West gage decline to a flow below 2.78 cfs, the amount of incidental take for any project-specific action under the MOA would be exceeded for the Moapa dace.

Effect of the Take

In the CSI biological opinion, the Service determined that the above-mentioned levels of anticipated take are not likely to jeopardize the continued existence of the desert tortoise or Moapa dace. These determinations are based in part on the implementation of conservation measures detailed in the CSI biological opinion- *Description of the Proposed Action* section, and the programmatic opinion for the Muddy River MOA (Appendix A).

Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of desert tortoise and/or Moapa dace that may result from the CSI residential development in Clark County, as described. These measures, and the subsequent terms and conditions, are intended to clarify or supplement the protective measures that are part of the proposed action. The Service's evaluation of the effects of the proposed action includes consideration of the conservation measures developed by the Corps and the applicant to minimize adverse effects of the proposed action on the desert tortoise and Moapa dace. These conservation measures were detailed in the CSI biological opinion *Description of the Proposed Action* section, and include the Corps' requirement that CSI comply with the terms and conditions of the section 10(a)(1)(B) incidental take permit for the Clark County MSHCP. Any subsequent changes to the conservation measures proposed by the Corps and applicant may constitute a modification of the proposed action and may warrant re-initiation of formal consultation, as specified at 50 CFR § 402.16.

1. The Corps shall implement measures to ensure compliance with the conservation measures, reasonable and prudent measures, terms and conditions, reporting requirements, and re-initiation requirements contained in this biological opinion and incidental take statement.

2. The Corps shall implement measures to minimize injury and mortality of desert tortoises due to CSI construction activities and operation of heavy equipment.

3. The Corps shall implement measures to minimize entrapment of desert tortoises in open excavations or pipe during construction of the CSI residential development.

4. The Corps shall implement measures to minimize predation on tortoises by ravens and other potential desert tortoise predators drawn to the project area during construction.

5. The Corps shall implement measures to minimize destruction of desert tortoise habitat (soil compaction, erosion, or crushed vegetation) on adjacent lands due to CSI construction activities.

6. The Corps shall implement measures to minimize the likelihood of tortoises entering the Project Development Area.

7. The Corps shall implement measures to minimize potential impacts to Moapa dace that may result from groundwater pumping associated with CSI's construction and development of a residential community in Coyote Spring Valley.

8. The Corps shall implement measures to minimize injury and mortality to desert tortoises and Moapa dace from hazardous waste leaks, spills, or releases associated with construction-related activities.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must fully comply with the following terms and conditions, which implement the reasonable and prudent measures described above.

1. To implement Reasonable and Prudent Measure Number 1, the Corps shall ensure implementation of the following measures to ensure compliance with the reasonable and prudent measures, terms and conditions, reporting requirements, and re-initiation requirements contained in this biological opinion:

    a. The project proponent shall designate a field contact representative (FCR) who is responsible for coordinating with the Federal agencies and overseeing the conservation measures, reasonable and prudent measures, and terms and conditions of this biological opinion and incidental take statement. The FCR shall have authority to halt all activities that are in violation of the permits required for this project. The FCR shall have a copy of all appropriate stipulations when work is conducted at the site. The FCR may be a contract biologist, or a person designated by the agencies. This individual(s) must be approved by the Service and be independent of the project proponent.

b. The FCR/biological monitor(s) shall be responsible for determining compliance with measures as defined in the CSI biological opinion or other agreements between the project proponent and the Federal agencies. Biological monitors shall have the authority to briefly halt non-emergency construction activities that are not in compliance with these measures. Actions shall be halted long enough to remedy the immediate situation and shall apply only for the equipment and parties involved in the situation. All actions of non-compliance or conditions that threaten a federally-listed species shall be recorded and reported to the project proponent, and the Federal agency, or Federal agency representatives immediately.

c. Qualified biologists shall act as biological monitors and be present on-site during construction and project-related activities for the protection of desert tortoises and other listed species. All biological monitors shall be approved by the Service to handle desert tortoises and other threatened or endangered species. The number of biological monitors required will be determined in consultation with the Service and the CSI Science Advisory Team.

d. The Corps shall obtain confirmation that CSI has complied with the terms and conditions of the section 10(a)(1)(B) incidental take permit for the Clark County MSHCP and retain such proof of adherence in the project file.

e. The Corps shall notify the Service if project changes result in additional effects to federally-listed species not previously discussed in the Biological Assessment, Environmental Assessment, and/or section 404 permit application and supplemental materials, and formal consultation shall be re-initiated.

f. Reporting requirements for groundwater elevations in monitoring wells and surface water measurement sites will be in accordance with the Monitoring, Management, and Mitigation Plan, as established by the stipulated agreement.

2. To implement Reasonable and Prudent Measure Number 2, the Corps shall ensure implementation of the following measures to minimize injury and mortality of desert tortoises due to CSI construction activities and operation of heavy equipment:

a. Only qualified and Service-authorized biologists will survey for and handle desert tortoises during pre-construction tortoise clearance surveys. The Service, in conjunction with the CSI Science Advisory Team, shall choose the surveyors used for this effort.

b. A desert tortoise education program shall be developed and presented to all personnel who will be on-site, including surveyors, construction engineers, proponent employees, contractors, contractor's employees, supervisors, inspectors, and all visitors. The program shall include information on the biology of the desert tortoise and their occurrence in the project area; measures being implemented for the protection of the tortoise and its habitats during project activities; and means by which individual employees can facilitate this process. The program shall be developed by the project proponent and approved by the Service at least 15 days prior to its initial presentation. The program will be presented by a biologist familiar with the issues relating to CSI and the desert tortoise. Wallet-size cards signifying completion of training will be provided to employees.

The program shall cover the following topics at a minimum relative to the desert tortoise: occurrence and distribution within the project area, general behavior and ecology; sensitivity to human activities; legal protection and penalties for violation of State and Federal laws; reporting requirements; project minimization (conservation) measures; and project terms and conditions per the incidental take statement.

c. Project personnel shall be notified that they are not authorized to handle or otherwise move federally-listed species encountered on the site. Instead, project personnel shall immediately inform the FCR or an on-site biological monitor whenever a desert tortoise is observed on or near the construction site, *whether or not the tortoise is in the path of construction activities*. The biological monitor will inform project personnel on how to proceed and/or will move the desert tortoise out of harm's way.

d. Observations of federally-listed species and their sign during activities shall be conveyed to the FCR and/or authorized biological monitor. This includes all observations of desert tortoises, tortoise sign, and mortalities.

e. All employees shall be instructed that their activities shall be confined to locations within areas previously cleared of tortoises to the maximum extent practicable. Travel routes within the project area should be established, cleared of desert tortoises, and clearly marked prior to construction in any particular area. In areas not cleared of desert tortoises and enclosed with tortoise exclusion fencing, cross-country vehicular travel (including that of survey crews) shall only occur after the route has been cleared by a qualified biologist/biological monitor.

f. Existing routes of travel shall be used whenever possible. To the extent possible, previously disturbed sites within the project area shall be used for the stockpiling of excavated materials, storage of equipment, digging of borrow pits, parking of vehicles, and any other surface-disturbing activity. Any routes of travel on site that require construction or modification and have not been cleared of tortoises shall have a qualified biologist(s) survey the area for tortoises prior to modification or construction of route.

g. During construction, a speed limit of 15 mph shall be maintained in areas not cleared of tortoises and fenced with desert tortoise exclusion fencing. In areas cleared of tortoises and fenced, the speed limit can be increased to 25 mph. This requirement should reduce dust and allow a safe speed at which personnel can observe desert tortoises in the road. Speed limit signs and caution signs indicating the presence of desert tortoises shall be posted at the beginning of any access road within areas not cleared of tortoises and enclosed with desert tortoise exclusion fencing.

h. Any time a vehicle is parked in an area not enclosed with desert tortoise exclusion fencing, whether the engine is engaged or not, the ground around and under the vehicle shall be inspected for desert tortoises. If one is observed, an authorized biologist shall be contacted for instructions on how to proceed.

i. Project activities that may endanger a tortoise shall cease if a tortoise is found in harm's way. Project personnel shall contract the on-site biological monitor for instructions on how to proceed. Project activities shall resume after a qualified biologist/biological monitor removes the tortoise from danger or after the tortoise has moved to a safe area.

3. To implement Reasonable and Prudent Measure Number 3, the Corps shall ensure implementation of the following measures to minimize entrapment of desert tortoises in open excavations or pipe during construction of the CSI residential development:

   a. In areas not cleared of desert tortoises and enclosed by tortoise exclusion fencing, any construction pipe, culverts or similar structures with a diameter of 3 to 24 inches that are stored on the construction site for one or more nights, shall be inspected for tortoises before the material is moved, buried, or capped. As an alternative, all such structures may be capped before being stored on the construction site.

   b. In areas not cleared of desert tortoises and enclosed by tortoise exclusion fencing, and during periods when desert tortoises are considered active, any open pits, trenches, or other excavations shall be covered at the close of each working day. If covering is not possible, tortoise escape ramps (of at least 3:1 slope) shall be installed at least every 1/4-mile. Or as an alternative, any trench segment left open may be covered with tortoise-proof fencing. All fences and coverings shall have zero ground clearance. A qualified biological monitor shall routinely inspect escape ramps, including following periods of substantial rainfall, to ensure their integrity.

c. All open pits or other excavations shall be inspected for tortoises and other entrapped animals by a qualified biological monitor on a routine basis and prior to backfilling. Entrapped tortoises shall be removed only by a qualified biological monitor. Whenever possible, open trenches or pits shall be backfilled within 72 hours.

d. If temporary tortoise exclusion fencing is used, whether for tortoise-clearance surveys or other purposes, the fencing shall be inspected regularly and following major precipitation events. Temporary fencing materials, construction, and maintenance shall follow the recommendations of the Service and CSI Science Advisory Team, which will likely be based on the August 2005, or most-recent version of the *Recommended Specifications for Desert Tortoise Exclusion Fencing*. All fence damage shall be repaired in a timely manner to prevent tortoises from moving through damaged sections.

4. To implement Reasonable and Prudent Measure Number 4, the Corps shall ensure implementation of the following measures to minimize predation on tortoises by ravens and other desert tortoise predators drawn to the project area during construction:

a. During construction, trash and food items shall be disposed of properly in predator-proof containers with re-sealing lids and removed daily to reduce attractiveness to opportunistic predators such as ravens, coyotes, and feral dogs. This trash will be disposed of properly in an approved landfill. Trash includes but is not limited to, cigarettes, cigars, gum wrappers, tissue, cans, paper, and bags. Upon project completion, all construction refuse, including, but not limited to, broken equipment parts, wrapping material, cords, cables, wire, rope, strapping, twine, buckets, metal or plastic containers, and boxes, shall be removed from the site and disposed of properly.

b. Domestic dogs, other than those that may be approved by the Service and used for tortoise clearance surveys, shall be prohibited from the project site during construction.

5. To implement Reasonable and Prudent Measure Number 5, the Corps shall ensure implementation of the following measures to minimize destruction of desert tortoise habitat (soil compaction, erosion, or crushed vegetation) on adjacent lands due to CSI construction activities:

a. The area of disturbance associated with the development of the CSI residential community shall be confined to the project/development area described in this biological opinion. This includes the location of stockpiles, staging and storage areas, turnaround sites, maintenance areas, and all pre-construction activities such as surveys and flagging of work areas.

b. Cross country vehicular travel (i.e., off established roads) shall not be allowed on neighboring Federal land, reserve lands, or adjacent CSI lands in Lincoln County, and should occur only in areas cleared of tortoises.

c. If unforeseen circumstances require expansion of activities onto adjacent Federal land or private/leased land not included within the project area description for this biological opinion, written approval must be obtained from the Service and/or BLM prior to such disturbance, including appropriate consultation under section 7 or section 10 of the Act.

d. CSI shall prepare and implement a BLM-approved weed-control plan. Heavy equipment will be cleaned of soil with high-pressure air or water prior to arrival at the project area to minimize the potential introduction of alien plant seeds. All imported materials will be certified weed-free.

6. The Corps shall implement measures to minimize the likelihood of tortoises entering the Project Development Area.

a. Permanent tortoise exclusion fencing (or other tortoise proof barriers as approved by the Service and CSI Science Advisory Team) shall be inspected at least quarterly and after major precipitation events. Fencing materials and construction shall follow the August 2005 or most-recent version of the *Recommended Specifications for Desert Tortoise Exclusion Fencing* available from the Service, or other guidance provided by the Service and CSI Science Advisory Team. All fence damage shall be repaired in a timely manner and according to guidelines in the *Recommended Specifications for Desert Tortoise Exclusion Fencing* to prevent tortoises from moving through damaged sections.

b. Stormwater detention basins on the west side of US 93 will be designed to prevent entrapment of tortoises and/or will be safeguarded against tortoise entrapment. CSI shall work with the Service and the CSI Science Advisory Team to determine if there are particular tortoise safety concerns at this location and the appropriate measures to be taken.

7. To implement Reasonable and Prudent Measure Number 6, the Corps shall ensure implementation of the following measures to minimize impacts to Moapa dace that may result from groundwater pumping associated with CSI's construction and development of a residential community:

a. CSI shall not pump more than what they need for construction purposes and at most, no more than their first-year groundwater allotment as detailed in the Final Environmental Assessment for the Coyote Springs Project, until the Muddy River MOA has been signed by all Parties. CSI will provide the Service with a monthly summary of well data for CSI Well No. 1 and CSI Well No. 2. Once the Muddy River MOA is signed, CSI may begin to pump up to their State-appropriated water right of 4,600 afy in the phased approached described within this biological opinion and the programmatic biological opinion (Attachment A; File No. 1-5-05-FW-536).

b. CSI shall implement all conservation measures outlined in the Muddy River MOA that are specific to the project applicant, as well as those measures to be carried out in conjunction with other Parties to the MOA. The specific measures applicable to CSI are detailed in the CSI biological opinion, *Conservation Measures Specific to the Moapa Dace and Other Imperiled Aquatic Fauna.*

8. To implement Reasonable and Prudent Measure Number 7, the Corps shall ensure implementation of the following measures to minimize injury and mortality to desert tortoises and Moapa dace from hazardous waste leaks, spills, or releases associated with construction-related activities:

a. No equipment or construction materials shall be stored, and no equipment or vehicles shall be refueled, within 100-feet of a water body or wash system whose runoff has the potential to enter Pahranagat Wash and from there, the Muddy River.

b. Any fuel, transmission, or brake fluid leaks or hazardous waste leaks, spills, or releases will be reported immediately to the designated FCR, and all leaks and spills shall be stopped and repaired immediately and cleaned up at the time of occurrence. All heavy equipment and vehicles shall carry a bucket and pads to absorb leaks or spills. Contaminated soil shall be removed and disposed of at an appropriate off-site facility. If spills occur in a maintenance yard, they shall be cleaned up as directed by the FCR.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take or loss of habitat identified is exceeded, such incidental take and habitat loss represents new information requiring re-initiation of consultation and review of the reasonable and prudent measures provided. The Corps must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Reporting Requirements

Upon locating a dead or injured endangered or threatened species, initial notification must be made to the Service in Las Vegas, Nevada, at (702) 515-5230. All incidences of take of desert tortoises, whether associated with project activities or not, will be summarized in an annual report and submitted to the Service's Nevada Fish and Wildlife Office by March 1 of the following year. The first annual report would be due **March 1, 2007**.

Desert Tortoise

The following actions should be taken for injured or dead tortoises if directed by the Service's Division of Law Enforcement:

1. If a desert tortoise is killed or injured due to construction-related activities, the Service's Southern Nevada Field Office shall be notified within 24 hours of finding the dead or injured tortoise. The Corps must provide an explanation of the causes of the taking and review with the Service the need for possible modification of the protective measures.

2. Injured desert tortoises shall be delivered to a qualified veterinarian for appropriate treatment or euthanasia, as appropriate.

3. Dead desert tortoises may be buried away from the project area or cremated, upon authorization by the Service.

4. Should injured desert tortoises be treated by a veterinarian and survive, they may be transferred as directed by the Service.

Moapa Dace

The following action should be taken for injured or dead dace if directed by the Service's Division of Law Enforcement:

1. Dead Moapa dace suitable for preparation as museum specimens shall be frozen immediately and provided to the Southern Nevada Field Office in Las Vegas, Nevada.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Desert Tortoise

The following conservation recommendations are aimed at minimizing the indirect effects of developing a residential community in Coyote Spring Valley to adjacent Federal and reserve lands:

1. Community Design

   a. Provide a buffer between residential development and adjacent Federal/reserve land by locating low-density housing (that which incorporates a significant proportion of natural area to developed area per lot) at the periphery of the development, with higher density housing and commercial centers located in the center of the development or toward US 93 and SR 168.

   b. Situate commercial development so as to promote and facilitate low-impact modes of transportation (i.e., foot and bicycle) that limit local traffic and air pollution.

   c. Direct development lighting inward so as to minimize impacts to the night sky over adjacent Federal/reserve lands; and to minimize impacts on nocturnal wildlife that use drainages and adjacent lands as movement corridors.

   d. Preserve as much natural desert within the footprint of the project area as possible and/or use only native (including salvaged) plants to landscape the project area to limit the impacts of development on local biotic communities.

   e. Limit the amount of impervious surfaces within the development as much as reasonably possible to promote natural recharge and prevent excessive runoff and erosion.

2. Infrastructure Location and Design

   a. Design wastewater treatment ponds to provide wildlife habitat (wetlands) and wildlife-viewing and educational opportunities, drying out ponds on a rotational schedule to prevent or minimize establishment of non-native species.

   b. Provide underground utilities (e.g., power lines) to the maximum extent practicable so as to decrease the amount of artificial perch and nest sites provided for ravens.

   c. Replace and, where necessary, construct new culverts at select areas of SR 168 and US 93 that will facilitate wildlife movement, including that of tortoises, across these barriers and around the development, and include these as part of the reserve design. Monitor the effectiveness of these culverts in terms of wildlife movement and adapt design and location as needed.

d. Provide *temporary* tortoise exclusion fencing along the western and southern boundary of the Project Development Area if NDOT's fencing of US 93 and SR 168 is not completed in a timely manner relative to the CSI project. The need for this action shall be coordinated with the Service, CSI Science Advisory Team, and the Clark County fencing workgroup. Temporary tortoise exclusion fencing materials and construction shall be approved by the Service and CSI Science Advisory Team and shall be inspected regularly and following major precipitation events and repaired in a timely manner, as advised by the Service and Science Advisory Team.

3. Recreation

a. Provide ample trails and parks within the proposed development area so as to promote on-site recreation and reduce recreational pressure on surrounding Federal/reserve lands. Design and maintain these facilities so as to invite frequent use.

b. Design golf courses in an environmentally-friendly manner to incorporate the natural environment, minimize water use, improve water quality, and limit pesticide use. Design golf courses to meet certification standards of the Audubon Cooperative Sanctuary Program for Golf.

c. Situate ponds developed in association with golf courses away from drainages that empty into Pahranagat Wash and do not stock ponds with non-native, aquatic wildlife. Provide signage to educate residents about the importance of not dumping aquarium fish and vegetation into ponds.

d. Work with the Service, BLM, CSI Science Advisory Team, and others to minimize and monitor recreation impacts and the proliferation and use of roads and social trails on adjacent Federal/reserve land. In cooperation with the Federal agencies, implement measures to focus recreational activities on adjacent BLM land so as to minimize impacts on desert tortoises. Measures used may include, but are not limited to: providing designated, clearly marked trails that concentrate activity in areas less valuable in terms of desert tortoise conservation efforts; installing signage at public use areas (e.g., trailheads) informing recreationists about the rules and regulations in place; requiring dogs to be on-leash; and closing specific areas to recreational use and/or motorized use. Consider closing and rehabilitating old Highway 93 and the jeep trail west of Pahranagat Wash. Alternatively, close these roads to motorized use or make them available for administrative use and foot traffic only. In cooperation with Federal agencies, consider blocking roads that access adjacent lands to discourage off-road vehicle travel and trash dumping.

4. Community Regulations

Restrictions required to minimize impacts to surrounding desert tortoise habitat and tortoises should be applied through Covenants, Conditions, and Restrictions (CC&Rs) enforced through Homeowners' Associations. Such restrictions include, but are not limited to:

a. Requiring domestic pets (dogs, cats) to be kept indoors, confined to a yard, or on leash.

b. Prohibiting exotic tortoises or desert tortoises to be kept as pets.

c. Prohibiting the intentional feeding of wildlife and not allowing pet food to be left outside.

d. Requiring trash containers to be sealed and predator proofed, and requiring residential trash to be put outside only on days that trash is picked up.

e. Encouraging residents to use xeric and native landscaping and water recycling/conservation techniques.

5. Education

a. Provide kiosks and/or an education center to educate the public about the desert environment, its inhabitants (specifically the desert tortoise), conservation needs, and ways to minimize impacts to the Mojave Desert and its wildlife. Signage should include information on the status of the desert tortoise (including its protected status) and suggestions on how the public can contribute to desert tortoise conservation. Recreationists and residents should be instructed to stay on designated trails, keep pets on leashes, not dump trash or litter, and avoid contact with desert tortoises.

b. Consider establishing a non-profit organization with locally-stationed staff specifically dedicated to working with residents to protect the natural resources of Coyote Spring Valley and the Mormon Mesa area. This program could be modeled after the Rincon Institute in the Rincon Valley, Arizona, which was established due to the pending development of Rocking K Ranch bordering Saguaro National Park. The non-profit organization could be involved with local outreach, environmental education, ecological restoration, and possibly research as directed by the CSI Science Advisory Team, and can serve as the local contact for volunteers interested in natural resource management and protection.

6. Monitoring and Mitigating Impacts on Adjacent (Federal/Reserve) land

   a. Rehabilitate degraded areas in the Coyote Springs Resource Management Area and assist Federal agencies with rehabilitation of degraded areas on adjacent ACECs. Degraded areas include but are not limited to: the SR 168 turnout where old US 93 is accessed; old Highway 93 and the jeep trail west of Pahranagat Wash and within the Coyote Springs Resource Management Area; social trails and unauthorized roads; and any open space areas within the project/development area that may be temporarily disturbed during construction activities. Restoration techniques shall be approved by BLM and the Service.

   b. Monitor effectiveness of any rehabilitation efforts using monitoring protocols approved by the Service, CSI Science Advisory Team, and BLM.

   c. Implement a control and monitoring plan for invasive and non-native species within the development and at development boundary areas. Establish baseline conditions on both sides of the proposed development boundaries before barrier construction and at select locations (e.g., along roads and washes, in open space within development).

   d. Initiate regular trash patrols along the periphery of the development and on adjacent public lands, as long as lawful access to federally-managed lands is gained.

   e. Work with the Service, BLM, and CSI Science Advisory Team to monitor the extent and intensity of impacts to desert tortoises and tortoise habitat on Federal/reserve lands adjacent to the CSI development, including effects associated with recreation and the proliferation of social trails.

Moapa Dace

As stated in the programmatic biological opinion (Appendix A, page 63), the following conservation recommendations should be considered in cooperation with other Parties to the MOA:

1. Acquire Moapa dace habitat and/or water rights that are currently privately owned and secure the management of these rights for the long-term benefit of the Moapa dace in perpetuity;

2. Restore and enhance additional Moapa dace habitat. This includes funding restoration actions at Baldwin Spring, Cardy Lamb, and/or Muddy Spring or other areas identified by the Muddy River Recovery Implementation Team;

3. Provide funding for pre- and post-construction monitoring of water quality and quantity throughout the range of the species; and

5. Assist with the development and implementation of a Moapa dace habitat restoration plan.

In order for the Service to be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Reinitiation Notice

This concludes formal consultation on the actions outlined in your request dated June 23, 2005. As required by 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over an action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not considered in the parent programmatic biological opinion or this tiered biological opinion; (4) a new species is listed or critical habitat designated that may be affected by the action; (5) there is failure to meet any of the measures or stipulations in the Muddy River MOA; and (6) assumptions used for the programmatic biological opinion's analysis have not been met or become invalid. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If we can be of any further assistance, please contact me at (775) 861-6300 or Cynthia Martinez in the Southern Nevada Field Office at (702) 515-5230.

Sincerely,

Robert D. Williams
Field Supervisor

Enclosures

cc:

President, Coyote Springs Investment, LLC, Sparks, Nevada
ROBCYN, LLC, Las Vegas, Nevada (Attn: Mike Ford)
Senior Consultant, ENTRIX Environmental Consultants, Las Vegas, Nevada (Attn: Leo Lentsch)
Administrator, Desert Conservation Program, Clark County Department of Air Quality and Environmental Management, Las Vegas, Nevada (Attn: Marci Henson)
Chief, Planning Division, Department of Army, Los Angeles District Corps of Engineers Office, Los Angeles, California
Supervisor, Wetlands Regulatory Office, Environmental Protection Agency Southwest Region, San Francisco, California (Attn: Tim Vendlinski)
Field Manager, Las Vegas Field Office, Bureau of Land Management, Las Vegas, Nevada
Deputy General Manager, Engineering Operations, Southern Nevada Water Authority, Las Vegas, Nevada
General Manager, Moapa Valley Water District, Moapa, Nevada
Chairman, Moapa Band of Paiutes, Moapa, Nevada
Acting Project Leader, Desert National Wildlife Refuge Complex, Las Vegas, Nevada
Refuge Manager, Moapa Valley National Wildlife Refuge, Moapa Valley, Nevada
Assistant Manager, Ecological Services, CNO, Fish and Wildlife Service, Sacramento, California (Attn: Vicki Campbell)
Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Portland, Oregon (electronic copy only)
Senior Resident Agent, Division of Law Enforcement, Fish and Wildlife Service, Boise, Idaho

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APPENDIX A

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

January 30, 2006
File No. 1-5-05-FW-536

Memorandum

To: Manager, California/Nevada Operations, Fish and Wildlife Service, Sacramento, California

From: Field Supervisor, Nevada Fish and Wildlife Office, Fish and Wildlife Service, Reno, Nevada

Subject: Intra-Service Programmatic Biological Opinion for the Proposed Muddy River Memorandum of Agreement Regarding the Groundwater Withdrawal of 16,100 Acre-Feet per Year from the Regional Carbonate Aquifer in Coyote Spring Valley and California Wash Basins, and Establish Conservation Measures for the Moapa Dace, Clark County, Nevada

This document transmits the Fish and Wildlife Service's (Service) programmatic biological opinion for the proposed Memorandum of Agreement (MOA) among the Southern Nevada Water Authority (SNWA), Moapa Valley Water District (MVWD), Coyote Springs Investment, LLC (CSI), Moapa Band of Paiutes (Tribe), and the Service. The Service has determined that the proposed action is likely to adversely affect the endangered Moapa dace (*Moapa coriacea*). No critical habitat has been designated for the Moapa dace; therefore, none will be affected and thus no further analysis is required. This biological opinion is being submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*). We have assigned 1-5-05-FW-536 to this programmatic consultation; please reference this number in future correspondence. Future actions pursuant to the MOA that may adversely affect Moapa dace will be tiered to this programmatic biological opinion.

This biological opinion evaluates, as the proposed action, the execution of the MOA by the Service. None of the activities included in the MOA will be implemented absent project or activity specific consultations. Since the MOA contemplates future groundwater development up to 16,100 acre-feet per year (afy), this total withdrawal and the potential effects to the Moapa dace are evaluated in this biological opinion. As part of the proposed action, the following biological opinion will evaluate the effects of the cumulative groundwater withdrawal of 16,100 afy from two basins within the regional carbonate aquifer to the federally listed as endangered Moapa dace at a programmatic level in light of the conservation measures proposed in the MOA. The groundwater is proposed to be withdrawn from the White River Groundwater

Flow System at the MX-5, RW-2 wells, CSI Well #1, and CSI Well #2 (SNWA 9,000 afy), and CSI Well #1 (Permit 70430) and CSI Well #2 (Permit 70429), and other wells (CSI 4,600 afy) in the Coyote Spring Valley (Basin 210), and from a well-field located in the southwestern third of the Moapa Reservation (2,500 afy) in the California Wash (Basin 218). Species not evaluated in this biological opinion but may be evaluated in the future as proposed actions are submitted in accordance with section 7 of the Act include, but are not limited to the following endangered species: (1) the Mojave population of desert tortoise (*Gopherus agassizii*) and its designated critical habitat; (2) southwestern willow flycatcher (*Empidonax traillii extimus*); and (3) the Yuma clapper rail (*Rallus longirostris yumanensis*); as well as, (4) the western U.S. distinct population segment of the Federal candidate yellow-billed cuckoo (*Coccyzus americanus*) (67 FR 40666).

This biological opinion is based on the following information: (1) the January 27, 2006, proposed MOA (Attachment A) and attached Exhibit (Attachment B); (2) the proposed final Water Supply Agreement among the Tribe, SNWA, MVWD, Las Vegas Valley Water District (LVVWD), and Muddy Valley Irrigation Company (MVIC) received on January 26, 2006, (Attachment C); (3) Bureau of Land Management's (BLM) July 8, 2003, Biological Assessment of the Coyote Spring Valley area (BLM 2003); (4) numerous meetings and discussions among MOA signatories; (5) discussions with species experts familiar with the ecology of the species; and (6) other sources of available information available in our files and cited herein. The Service has prepared this biological opinion in the absence of site-specific and spatially explicit information on future site-specific actions that would be tiered to this programmatic biological opinion. In the absence of this information, this biological opinion reflects the ecologically and hydrogeologically most conservative estimate of effects for the Moapa dace and its habitat. A complete administrative record for this consultation is on file at the Service's Southern Nevada Field Office.

PROGRAMMATIC CONSULTATION

This biological opinion was prepared in accordance with the July 16, 2003, guidance for programmatic-level consultations (Service 2003). Such consultations can provide the benefit of streamlining the consultation process while leading to a more landscape-based approach to consultations that can minimize the potential "piecemeal" effects that can occur when evaluating individual projects out of the context of a complete agency program. Some of the benefits of programmatic consultations include: (1) better and more cost effective integration of ecosystem/recovery planning activities with agency activities; (2) streamlined consultation processes; (3) added predictability for all signatories of the MOA; (4) minimization of the potential "piecemeal" effects that can occur when evaluating individual projects out of the context of a complete agency program; and (5) the opportunity to better and more efficiently integrate the action agency's 7(a)(1) responsibilities at the program level.

Due to the number of impending actions by different entities included in the proposed action, a tiered-programmatic approach has been taken by the Service in an attempt to analyze the effects of the proposed action. This approach does not cover future site-specific actions resulting from implementation of the proposed action, nor does it authorize any incidental take for programmatic impacts associated with the activities included in the MOA. The tiered approach is a two-stage consultation process with the two stages fulfilling the same purposes. The first stage biological opinion or concurrence, as appropriate, evaluates the landscape-level effects. The second stage results in the completion of project-specific documentation that addresses the specific effects of each individual project. Under the tiered approach, two complete biological opinions are completed for each proposed action, with the second-stage documents "tiering" to the first-stage document by incorporating portions of it by reference. Thus each action has its own individual consultation document that is supported by the programmatic document.

Project-level Consultation under the Tiered Programmatic Consultation Approach

As individual projects are proposed under the tiered programmatic consultation approach, project-specific information will be provided that: (1) describes each proposed action and the specific areas to be affected; (2) identifies the species and critical habitat that may be affected; (3) describes the manner in which the proposed action may affect listed species; (4) describes the anticipated effects; (5) specifies the *anticipated effects from the proposed project are consistent with those analyzed in the programmatic biological opinion*; (6) describes proposed measures to minimize potential effects of the action; and (7) describes any additional effects, if any, not considered in the programmatic consultation. The Service reviews this information and then completes a tiered biological opinion with a project-specific incidental take statement. This document, while meeting the basic requirements of biological opinions as specified at 50 CFR 402.14(h), generally requires less effort to complete because it references back, or tiers, to the program-level biological opinion.

The following assumptions regarding future consultation (second stage) are incorporated into this programmatic biological opinion:

1. Analysis for site-specific actions proposed under the "umbrella" of this proposed MOA will be submitted to the Service pursuant to section 7 or section 10 of the Act, as appropriate.

2. Specific actions that the Federal permitting agency or the Service determines may affect listed species will undergo consultation according to section 7(a) (2). These actions will be assessed on their own merits and be evaluated relative to the jeopardy and adverse modification criteria of the Act, as appropriate.

3. Specific actions that do not have a Federal nexus but may result in take of a listed species will require a section 10 incidental take permit. These actions will be assessed on their own merits and be evaluated relative to the jeopardy and adverse modification criteria and section 10 issuance criteria of the Act, as appropriate.

4. The Service will provide guidance on future site-specific actions in order to ensure that the project description is consistent with our biological opinion, such that our determination remains valid.

The effects of actions resulting from the proposed action will require future programmatic and/or site-specific section 7 consultations for the listed species covered in this biological opinion. This biological opinion does not issue exemption for any incidental take resulting from any action undertaken by Federal agencies or applicants.

Consultation History

On July 30, 2004, a meeting was held among SNWA, MVWD, and the Service to discuss conservation measures that would be identified and incorporated into an ongoing consultation for a proposed pipeline that would be necessary to comply with Nevada State Engineer Order 1169. It was determined that a Memorandum of Agreement was the appropriate mechanism to effectuate these commitments. The MOA would then become part of the project proposal and thus incorporated into the Description of the Proposed Action in the biological opinion.

On August 6, 2004, a meeting was held among SNWA, MVWD, and the Service to discuss, clarify, and continue development on the MOA.

On August 30, 2004, a meeting was held among SNWA, MVWD, and the Service to discuss, clarify, and continue development on the MOA.

On September 20, 2004, a meeting was held among SNWA, MVWD and the Service to negotiate average flow levels that would be necessary to protect in-stream flows that may be affected by the proposed project. These flow levels would then be incorporated into the MOA.

On October 5, 2004, the Office of the Solicitor sent a letter to the Tribe outlining technical and legal concerns with a Proposed Water Settlement Agreement that the Tribe had negotiated with other entities regarding water issues in the California Wash Basin.

On October 7, 2004, the MOA was revised to include CSI due to the potential effects to the Moapa dace from pumping their existing permitted water rights in Coyote Spring Valley for their proposed development in Clark County.

November 19, 2004, the National Park Service (NPS) and the Service met with the Tribe to discuss the technical concerns identified in the October 5, 2004, letter.

On December 15, 2004, the Service sent the Tribe a letter outlining technical concerns and suggesting that the Tribe participate in a Recovery Implementation Program to address species related groundwater issues consistent with that was developed in the MOA with SNWA, MVWD, and CSI.

On January 25, 2005, a meeting was held among the Tribe, NPS, and the Service to discuss the concerns identified in the December 15, 2005 letter. In addition, the Service discussed the MOA that was negotiated with SNWA, MVWD, and CSI and explained that this MOA did not bind or affect the Tribe or their resources in any way, but rather that the MOA may prove beneficial to the Tribe.

On March 7, 2005, a memorandum from the Office of the Solicitor was sent to the Acting Assistant Secretary for Water and Science recommending that bureau coordination of the two actions [(1) Tribal Water Settlement Agreement and (2) MOA] and to develop a recommendation on future water development in southern Nevada.

On March 17, 2005, a letter from SNWA was sent to the Office of the Solicitor requesting resolution of both actions before April 22, 2005, or they would pursue other options for development of their water rights.

On March 23, 2005, the Nevada BLM State Director (designated Liaison between DOI and SNWA) conducted a meeting with DOE Regional Managers and a separate meeting on the same day with SNWA to initiate discussions in an effort to resolve the two groundwater issues [(1) Tribal Water Settlement Agreement and (2) MOA].

On April 6, 2005, a meeting was held among the Tribe, SNWA, NPS, BLM, Bureau of Reclamation, Bureau of Indian Affairs, the Deputy Assistant Secretary for Fish, Wildlife, and Parks, and the Service to discuss including the Tribe into the MOA. Following this meeting, the Service made a decision to include the Tribe and formally conduct section 7 consultation on the MOA.

On June 6, 2005, a meeting was held among the Tribe, SNWA, and the Service to discuss, clarify, and continue inclusion of the Tribe into the MOA.

On June 27, 2005, a meeting was held among the Tribe, SNWA, and the Service to discuss, clarify, and continue inclusion of the Tribe into the MOA.

On July 14, 2005, a MOA was agreed to by the Tribe, SNWA, MVWD, CSI, and the Service to ensure that conservation actions were in place prior to potential impacts associated with the project's groundwater pumping. Also agreed to by MVWD and the Service was the Jones Spring Agreement which is an Exhibit to the MOA.

On July 14, 2005, a Water Supply Agreement was agreed to by the Tribe, SNWA, MVWD, LVVWD, and MVIC. Among other features under this Water Supply Agreement, the Tribe will receive the State groundwater permit and State groundwater applications which are to be provided to the Tribe by LVVWD under the Water Supply Agreement, and a lease of Muddy River water rights which in certain respects will be functionally similar to the federally-reserved Muddy River rights to be secured to the Tribe under the Water Supply Agreement.

On July 19, 2005, the Service determined that given the complexity of various entities, withdrawing groundwater from the regional carbonate aquifer system, a tiered programmatic approach for those actions included in the MOA would be the most effective approach to evaluate those effects, including proposed conservation measures to minimize the effects to the endangered Moapa dace. Other species may potentially be affected as a result of actions associated with the use of the groundwater withdrawals; however those proposed actions will be evaluated in subsequent biological opinions (tiered) as appropriate.

On October 5, 2005, the Service requested review of the draft Intra-Service Programmatic Biological Opinion for the Proposed Muddy River Memorandum of Agreement Regarding the

Groundwater Withdrawal of 16,100 afy from the Regional Carbonate Aquifer in Coyote Spring Valley and California Wash Basins, and Establish Conservation Measures for the Moapa Dace, Clark County, Nevada (File No. 1-5-05-FW-536) by the Parties of the MOA.

On October 18, 2005, a meeting was held among the Parties of the MOA, including the Service to discuss comments on the draft programmatic biological opinion (File No. 1-5-05-FW-536). It was determined at the meeting that the Parties of the MOA would provide a set of substantial written comments to the Service by November 10, 2005.

On October 27, 2005, the Service received preliminary written comments on the October 5, 2005, draft programmatic biological opinion (File No. 1-5-05-FW-536) from CSI.

On November 15, 2005, the Service received written comments on the October 5, 2005, draft programmatic biological opinion (File No. 1-5-05-FW-536) from SNWA, MVWD, and CSI, collectively.

On November 22, 2005, the Service received written comments on the October 5, 2005, draft programmatic biological opinion (File No. 1-5-05-FW-536) from the Tribe via their consultants Ziontz, Chestnut, Varnell, Berley & Slonim.

On November 29, 2005, the Service received written comments on the October 5, 2005, draft programmatic biological opinion (File No. 1-5-05-FW-536) from the Tribe via their consultants Mifflin & Associates, Inc.

On December 12, 2005, a meeting was held among the Parties of the MOA to discuss the Parties comments relative to the Service's representation of available information.

On January 11, 2006, the final draft programmatic biological opinion (File No. 1-5-05-FW-536) was emailed to the Parties of the MOA.

On January 27, 2006, the final MOA was agreed to by the Tribe, SNWA, MVWD, CSI, and the Service to ensure that conservation actions were in place prior to potential impacts associated with the project's groundwater pumping.

BIOLOGICAL OPINION

Description of the Proposed Action

The proposed action involves the cumulative withdrawal of 16,100 afy of groundwater by the SNWA (9,000 afy), MVWD, CSI (4,600 afy), and Tribe (2,500 afy) from two separate basins (Coyote Spring Valley and California Wash basins) within the White River Groundwater Flow System (Figure 1), which is part of a larger carbonate aquifer system. The White River Groundwater Flow System encompasses many smaller basins throughout several counties within the State of Nevada. These basins include Long Valley (175), Jakes Valley (174), White River Valley (207), Cave Valley (180), Garden Valley (172), Coal Valley (171), Pahroc Valley (208), Pahranagat Valley (209), Delamar Valley (182), Kane Springs Valley (206), Coyote Spring

Valley (210), Muddy River Springs Area (219), Hidden Valley (217), Lower Moapa Valley (220), California Wash (218), Garnet Valley (216), and Black Mountains Area (215).

The breakdown of proposed groundwater withdrawals associated with this action and evaluated in this programmatic biological opinion include: 1) SNWA's withdrawal of 9,000 afy from Coyote Spring Valley at the MX-5, RW-2, CSI Wells #1 and #2; 2) CSI's withdrawal of 4,600 afy from Coyote Spring Valley at CSI Well #1 (Permit 70430) and CSI Well #2 (Permit 70429) and other wells in Coyote Spring Valley; and 3) the Tribe's withdrawal of 2,500 afy from California Wash from a well-field located in the southwestern third of the Moapa Reservation. These proposed projects would require actions by other Federal agencies; however, their actions are only administrative in nature and would not change the scope of the projects or the effects analyzed in this biological opinion. Therefore, as long as the Federal action does not change the effects analysis, then future section 7 consultations for each Federal action could be tiered to this biological opinion as described above. Moapa Valley Water District is responsible for supplying the municipal water needs of Upper and Lower Moapa Valley in Clark County, Nevada, and owns several water rights including surface rights to spring flows in the Warm Springs Area and groundwater rights. Signatories to the MOA have proposed various minimization/conservation actions to offset effects to the Moapa dace.

State Engineer Rulings and Existing Groundwater Permits in Coyote Spring Valley (210), Muddy River Springs Area (219), and California Wash (218) Basins

There are three primary Nevada State Engineer rulings that affect the withdrawal of groundwater associated with the proposed action. In these ruling the Nevada State Engineer has employed a "staged development" approach that outlines an incremental approach for phasing in development of the carbonate aquifer with adequate monitoring in cooperation with other parties in order to assist in assessing affects. This approach was adopted by the Nevada State Engineer"...in order to predict, through the use of a calibrated model, the effects of continued or increased development with a higher degree of confidence." Two of these rulings (Order 1169 and Ruling 5115) held rights and applications in abeyance while allowing small projects to go forward "...that are possibly augmented gradually if conditions and confidence warrant. This approach allows the effects of development to be observed and analyzed continually, so that the benefits and adverse effects of development can be judged, and the effects reversed or mitigated if they prove to be detrimental to existing rights and the environment." These rulings are summarized below along with the existing permitted groundwater rights in the three hydrographic basins associated with the proposed action, as well as in Table 1.

Coyote Spring Valley (210)

In Order 1169 the Nevada State Engineer held in abeyance applications for new groundwater rights in certain groundwater basins (Table 1), and mandated that all water right holders (SNWA, LVVWD, MVWD, CSI and Nevada Power Company) conduct a regional groundwater study including the pumping of at least 50 percent of the permitted water rights within the Coyote Spring Valley hydrographic basin for a period of at least two consecutive years. Order 1169 is designed to evaluate how groundwater pumping activities in Coyote Spring Valley will impact water rights and the environment within the Warm Springs Area, including the Muddy River ecosystem. In an effort to meet the requirements of Order 1169, the SNWA is proposing to remove the 9,000 afy of groundwater rights they currently own from the Coyote Spring Valley basin at the MX-5 and RW-2 wells. However, SNWA may propose to redistribute development of their existing groundwater rights from other wells within the Coyote Spring Valley. Data obtained from the study will be used to evaluate groundwater development activities within the regional carbonate groundwater system. SNWA is cooperating with MVWD, which will accommodate the 9,000 afy of Coyote Spring Valley groundwater pump test for the Order 1169 study through a new SNWA pipeline and existing MVWD pipelines and facilities, terminating at the Bowman Reservoir. Flows in excess of the capacity of the Bowman Reservoir would ultimately enter the lower Muddy River.

As of 2002, the Nevada State Engineer had granted 16,300 afy of groundwater right permits in Coyote Spring Valley (Table 1). To date, there has been almost no pumping of the permitted rights in the basin.

Muddy River Springs Area (219) (Warm Springs Area)

In Ruling 4243 the Nevada State Engineer granted permits to MVWD for 5,800 afy, but with pumping phased in over a ten-year period while monitoring surface water flows and groundwater levels in order to assess potential effects to wells and springs. Annual volume pumped is limited to annual demand, up to the maximum permitted. Annual pumping has consistently been less than the amount allowed in the ruling.

As of 2002, the Nevada State Engineer had granted a total of approximately 14,800 afy of groundwater permits for the alluvial aquifer or the carbonate aquifer in the Muddy River Springs Area Basin or Warm Springs Area (Table 1). Included in these are the MVWD permits for the Arrow Canyon Well totaling 10 cubic feet per second (cfs) or 7,240 afy (1,440 afy prior to Ruling 4243 plus 5,800 afy from Ruling 4243). To date, the actual pumping from the Arrow Canyon Well (carbonate aquifer pumping) has been far less than the permitted volume. Approximately 2,400 afy has been pumped on average from 1998 to 2003. Nevada Power Company holds groundwater rights in the Warm Springs Area as well, but their groundwater pumping has been historically limited to the alluvial aquifer only.

California Wash (218)

In Ruling 5115 the Nevada State Engineer granted Application Number 54075, filed by the LVVWD on October 17, 1989, for a total duty of 2,500 afy with a diversion rate of 5.0 cfs within the California Wash hydrographic basin (Permit Number 54075). By separate agreement, the LVVWD will transfer ownership of Permit Number 54075 to the Tribe (Attachment C). The Tribe plans to divert and utilize groundwater under Permit Number 54075.

As of 2002, the Nevada State Engineer had granted 3,067 afy of permitted groundwater rights in California Wash Basin (Table 1). It is not known how much of the permitted groundwater rights are being pumped.

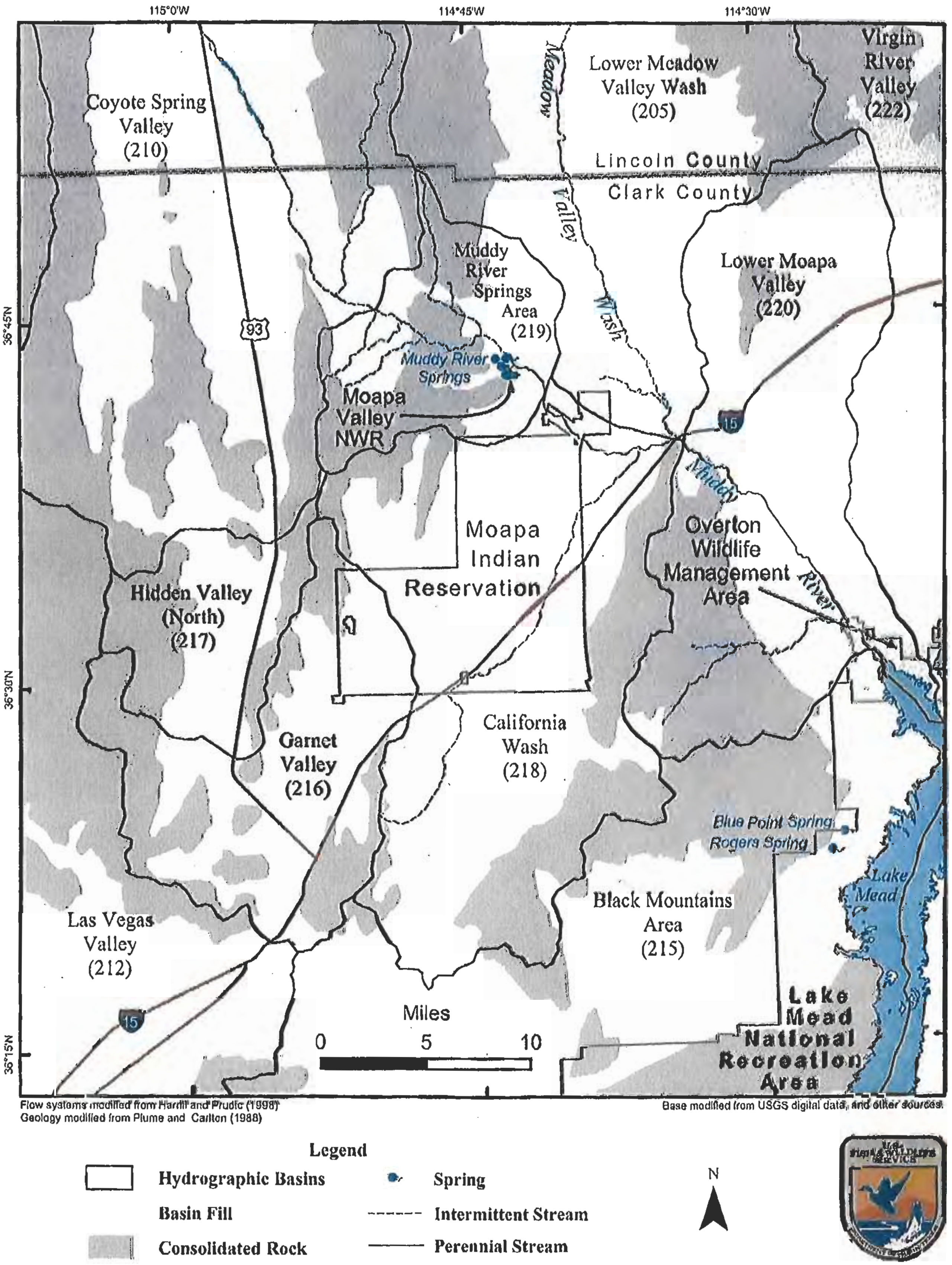


Figure 1.--Location of the Moapa Valley National Wildlife Refuge (NWR) and vicinity.

Table 1. Primary Nevada State Engineer's Rulings in the White River Groundwater Flow System 1995 to 2005

STATE ENGINEER'S DECISION	DATE OF DECISION	HYDROGRAPHIC AREA	APPLICANT	RIGHTS PERMITTED BY DECISION (afy)	RIGHTS HELD IN ABEYANCE BY DECISION (afy)	TOTAL GROUNDWATER RIGHTS PERMITTED IN BASIN AND MAJOR PERMIT HOLDERS (afy)	TOTAL GROUNDWATER RIGHTS PENDING IN BASIN AND MAJOR APPLICATION HOLDERS (afy)*
Ruling 4243	Oct 1995	Muddy River Springs Area	MVWD	5,800	0	~14,800 (MVWD and NPC)	22,000 (MVWD, Silver State Water Co)
Significant Points Of Ruling 4243:	1) State Engineer granted permits to MVWD but with pumping phased in incrementally over a ten-year period while monitoring to assess effects to wells and springs. A "staged development" approach. The ruling requires monitoring for impacts to resources or other water rights. The consequences of impacts are handled somewhat vaguely in the ruling. 2) Annual volume is limited to annual demand, up to the maximum permitted. Annual pumping has consistently been less than what is allowed in the ruling. 3) Monitoring to be conducted by applicant in cooperation with other parties (NPS, FWS, NPC, US Geological Survey (USGS), SNWA)						
Order 1169	March 2002	Coyote Spring Valley	LVVWD and CSI	0	27,500 (LVVWD) 108,600 (CSI)	16,300 (LVVWD/SNWA, CSI, NPC)	>200,000 (LVVWD/SNWA, CSI, Dry Lake Water Co.)
Significant Points of Order 1169:	1) State Engineer ordered that at least half of the existing permits be pumped for two consecutive years during a minimum five-year study period, continuing the "staged development" approach. A report on pumping-related impacts to groundwater and surface water resources is due to the State Engineer following the study. 2) Pending and any new water right applications in Coyote Spring Valley, Black Mtns Area, Garnet Valley, Hidden Valley, Upper Moapa Valley, and Lower Moapa Valley are held in abeyance until the pump test is completed. 3) Monitoring is to be conducted by applicants in cooperation with other parties (MVWD, NPC, FWS, NPS)						
Ruling 5115	April 2002	California Wash	LVVWD and Moapa Paiutes	2,500	7,200	~3,000 (LVVWD/Moapa Paiutes)	29,000 (LVVWD/Moapa Paiutes, Dry Lake Water Co., NPC, Oxford Power)
Significant Points of Ruling 5115:	1) State Engineer continued the "staged development" approach by granting a portion of one application and holding the other in abeyance until the development occurs and effects can be assessed. 2) Granted only the volume of water needed for an air-cooled power plant, stating that it was not prudent "..to use substantial quantities of newly appropriated groundwater for water-cooled power plants in one of the driest places in the nation, particularly with the uncertainty as to what quantity of water is available…" 3) State Engineer noted in the Ruling that SNWA intends to transfer the permits to the Moapa Band of Paiutes.						

*Estimates of pending groundwater rights should be viewed as approximate and subject to change.

Acronyms: CSI (Coyote Springs Investment), FWS (U.S. Fish and Wildlife Service), LVVWD (Las Vegas Valley Water District), SNWA (Southern Nevada Water Authority), MVWD (Moapa Valley Water District), NPC (Nevada Power Company), NPS (National Park Service), USGS

Proposed Groundwater Withdrawals Associated with the MOA

On July 14, 2005, an MOA was agreed to by the signatories to outline specific conservation actions that each party would complete in order to minimize potential impacts to the Moapa dace should water levels decline in the Muddy River system as a result of the cumulative withdrawal of 16,100 afy of groundwater from two basins within the regional carbonate aquifer system. The following descriptions summarize the signatories intended water withdrawals and conservation actions that would be implemented in order to offset potential impacts to the Moapa dace. Each of these proposed groundwater withdrawals will be the subject of a future tiered biological opinion prior to any such withdrawal occurring.

Southern Nevada Water Authority and Moapa Valley Water District

As part of Nevada State Engineer Order 1169, a minimum of half the existing permitted groundwater rights in Coyote Spring Valley are to be pumped consecutively for two years as part of a five-year study to monitor the effects of the pumping. The SNWA and LVVWD have existing water right permits for approximately 9,000 afy of groundwater in Coyote Spring Valley. SNWA has indicated that they will pump 9,000 afy to meet the minimum pumping requirement in Order 1169. MVWD shall have the right during the pump test to use the Arrow Canyon Well only in the event and to the extent SNWA is unable to supply MVWD with "all necessary municipal and domestic water supplies." In conjunction with the MVWD, SNWA will pump this water from Coyote Spring Valley to water users in Moapa Valley via a pipeline, which would be analyzed in a future project-specific tiered biological opinion. Any excess water that is not utilized by SNWA and MVWD will be sent to the Bowman Reservoir. If the capacity of the reservoir is reached, then the water will be discharged into the lower Muddy River. It is anticipated that construction of the pipeline would take two years upon issuance of a right-of-way permit, thus pumping of this 9,000 afy would not occur until construction of the pipeline was completed. SNWA and the LVVWD have begun implementing the study in cooperation with other water right holders and Federal agencies (Service, NPS, and BLM) by expanding existing monitoring efforts, and drilling eight additional monitoring wells in Coyote Spring Valley and the Warm Springs Area. Following the study period, it is assumed that the transmission system will continue to be utilized by SNWA and/or MVWD to convey the 9,000 afy of permitted water rights. It is anticipated that the permitted water right will ultimately be used as a resource option for MVWD and/or SNWA.

Coyote Springs Investment, LLC

CSI has initiated development of a residential community in the Coyote Spring Valley basin in Clark County. In order to meet the water demands of that community, CSI proposes to withdraw their State appropriated groundwater right of 4,600 afy from the basin at CSI Well #1 (Permit 70430) and CSI Well #2 (Permit 70429) well locations or other well locations approved by the Nevada State Engineer as production locations for CSI's water right in Coyote Spring Valley. However, CSI has anticipated a phased in approach over five years, for the production of the full water rights as follows: 1) first year, 600 afy, 2) second year, 1,600 afy, 3) third year, 3,600 afy, 4) fourth year, 3,600 afy, and 5) fifth year, 4,600 afy. Incidental take has been exempted for desert tortoise in Clark County under section 10(a)(1)(B) of the Act pursuant to the approved

Clark County Multiple Species Habitat Conservation Plan (MSHCP); however the Moapa dace is not included in the MSHCP, nor the associated incidental take statement. Utilization of the CSI water right and its affect to Moapa dace would be analyzed in a future project-specific tiered biological opinion.

Moapa Band of Paiutes

Through a Water Supply Agreement with LVVWD (Attachment C), the LVVWD will transfer to the Tribe, 2,500 afy groundwater water rights in the California Wash Basin. Although no proposal has been submitted for any specific action regarding groundwater withdrawals, the Tribe has indicated the potential use of 500 afy of that 2,500 afy right for commercial development within the next two years. Utilization of the Tribe's water right and its affect to Moapa dace would be analyzed in a future project-specific tiered biological opinion, as will any other future projects up to the maximum 2,500 afy right analyzed in this programmatic opinion.

Proposed Conservation Measures

In order to minimize effects to the Moapa dace, conservation actions have been identified by the signatories of the MOA that propose to withdraw groundwater from the regional carbonate groundwater system. In order to be considered a benefit to the species, it is assumed that the proposed conservation measures will be initiated or fully implemented prior to the proposed groundwater withdrawal of 16,100 afy associated with the proposed action. Since development of the 16,100 afy requires the construction of facilities, as identified above, there would be a two to five year timeframe in which to implement many of these actions prior to the pumping of the full amount of water analyzed in this biological opinion. However, as indicated above, CSI would utilize a small portion of their water right in Coyote Spring Valley prior to full implementation of all of the conservation measures. While the contribution of funding is crucial to any conservation action, the completed, on-the-ground activity that results from the funding is the action that will be the evaluated benefit to the species. The true benefit to the species will occur with the implementation of the intended conservation action. Each of these actions, either separately or in combination, will be the subject of a future tiered biological opinion prior to their implementation. The action items are identified in the MOA (Attachment A); the following is a summary of those actions:

1. Implement restoration of Moapa dace habitat on the Service's Apcar Unit of the Moapa Valley National Wildlife Refuge (MVNWR);

2. Develop a Recovery Implementation Program (Recovery Program), which will be used to effectuate the goals of the MOA by implementing measures necessary to accomplish the protection and promote the recovery of the Moapa dace, as well as, outline the development of regional water facilities and include additional parties as appropriate. The Recovery Program will be developed for the purposes of continuing to identify the key conservation actions that, when implemented, would continue to contribute to offset any pumping impacts that may result from groundwater pumping;

3. Assist in developing an ecological study designed specifically to determine effects of groundwater pumping on the Moapa dace and other aquatic dependent species in the Muddy River system;

4. Construct fish barriers in order to prevent additional non-native fishes from migrating into Moapa dace habitat;

5. Eradicate non-native fish, such as tilapia from the historic range of Moapa dace;

6. Restore Moapa dace habitat outside the boundary of the MVNWR;

7. Provide the use of the Tribal greenhouse to cultivate native plants for restoration actions in the Muddy River area;

8. Provide access to Tribal lands for the construction and maintenance of at least one fish barrier;

9. Dedication of an existing 1.0 cfs Jones Spring water right (MVWD) towards establishing and maintaining in-stream flows in the Apcar tributary system that empties into the Muddy River as outlined in Attachment B; and

10. Dedication of 460 afy of water rights (portion of CSI appropriated water rights) to the survival and recovery of the Moapa dace, in perpetuity.

In addition, minimum in-stream flow levels were also established in the MOA that trigger various conservation actions should those predetermined levels be reached. The flow levels will be measured at the Warm Springs West Flume located on MVNWR. These automatic actions are identified in the MOA (Attachment A) and are summarized below:

1. Should the water flows reach 3.2 cfs, the signatories will meet to discuss the issue and compare/evaluate hydrology data;

2. Should the water flows reach 3.0 cfs, during the pendency of the pump test, the Arrow Canyon well will shut down and SNWA will provide the MVWD with the sufficient water quantity necessary to meet their municipal demands. In addition, SNWA and CSI will take necessary actions to geographically redistribute groundwater pumping in Coyote Springs Valley if flows levels continue to decline;

3. Should the water flows reach 3.0 cfs or less but greater than 2.9 cfs, SNWA and CSI will restrict groundwater pumping from MX-5 and RW-2 wells, and CSI Well #1 (Permit 70430) and CSI Well #2 (Permit 70429) and CSI's pumping from other wells in Coyote Spring Valley, in combination, to 8,050 afy;

4. Should the water flows reach 2.9 cfs or less but greater than 2.8 cfs, SNWA and CSI will restrict groundwater pumping from MX-5 and RW-2 wells, and CSI Well #1 (Permit 70430) and CSI Well #2 (Permit 70429) and CSI's pumping from other wells in Coyote

Spring Valley, in combination, to 6,000 afy, and the Tribe will restrict their pumping (under permit number 54075) in the California Wash basin to 2,000 afy;

5. Should the water flows reach 2.8 cfs or less but greater than 2.7 cfs, SNWA and CSI will restrict groundwater pumping from MX-5 and RW-2 wells, and CSI Well #1 (Permit 70430) and CSI Well #2 (Permit 70429) and CSI's pumping from other wells in Coyote Spring Valley, in combination, to 4,000 afy, and the Tribe will restrict their pumping (under permit number 54075) in the California Wash basin to 1,700 afy;

6. Should the water flows reach 2.7 cfs or less, SNWA and CSI will restrict groundwater pumping from MX-5 and RW-2 wells, and CSI Well #1 (Permit 70430) and CSI Well #2 (Permit 70429) and CSI's pumping from other wells in Coyote Spring Valley, in combination, to 724 afy, and the Tribe will restrict their pumping (under permit number 54075) in the California Wash basin to 1,250 afy.

Action Area

The Action Area is defined as the hydrogeomorphic basins which have hydrologic connectivity to the Muddy River ecosystem. Although the entire White River Groundwater Flow System is hydrogeologically connected, only the basins that include the area of the proposed groundwater development and location of the Moapa dace and its habitat are included in the action area. These basins include the Coyote Spring Valley (Basin 210), Muddy River Springs Area (Basin 219) and California Wash (Basin 218).

Status of the Species

Moapa Dace

The Moapa dace was federally-listed as endangered under the Endangered Species Preservation Act of 1966 on March 11, 1967 (32 FR 4001), and has been protected under the Act since its inception in 1973. Critical habitat has not been designated for the Moapa dace. The Service assigned the Moapa dace the highest recovery priority because: (1) it is the only species within the genus *Moapa*; (2) the high degree of threat to its continued existence; and (3) the high potential for its recovery (Service 1996). A final recovery plan was approved by the Service in 1996 (Service 1996).

The Moapa dace was first collected in 1938 and was described by Hubbs and Miller (1948). Key identification characteristics are a black spot at the base of the tail and small, embedded scales, which create a smooth leathery appearance. Coloration is olive-yellow above with indistinct blotches on the sides, with a white belly. A diffuse, golden-brown stripe may also be present. Maximum size is approximately 4.7 inches fork length. The oldest known specimen on record is over four-years old (Scoppettone et al. 1992).

The Moapa dace is a member of the North American minnow family, *Cyprinidae*. The genus *Moapa* is regarded as being most closely related to the dace genera *Rhinichthys* (speckled dace) and *Agosia* (longfin dace) (Coburn and Cavender 1992). These three dace genera, along with the genera *Gila* (chub), *Lepidomeda* (spinedace), *Meda* (spikedace), and *Plagopterus* (woundfin), developed from a single ancestral type (monophletic) and are only associated with the Colorado River Basin (Service 1996).

The Moapa dace is thermophilic and endemic to the headwaters of the Warm Springs Area, typically occurring in waters ranging from 78.8 to 89.6° F (Hubbs and Miller 1948); however, one individual was collected in water temperatures of 67.1°F (Ono et al. 1983). Although, Rinne and Minckley (1991) rarely found the species below 86° F. Deacon and Bradley (1972) indicated that the species reaches its greatest abundance at warmer temperatures between 82.4 and 86.0° F. Reproduction occurs year-round and is confined to the upper, spring-fed tributaries (Scoppettone et al. 1992) where the water temperatures vary from 84.2 to 89.9° F and dissolved oxygen concentrations vary between 4.1 and 6.2 parts per million (Scoppettone et al. 1993). Juveniles are found almost exclusively in the spring-fed tributaries, whereas adults are also found in the mainstem of the Muddy River (Scoppettone et al. 1992). Adults show the greatest tolerance to cooler water temperatures, which appears to be 78.8° F (Scoppettone et al 1993). Given the species temperature tolerances and cooling pattern of the river (in a downstream direction), its range appears to be restricted to the warmer waters of the upper springs and tributaries of the Warm Springs Area (Deacon and Bradley 1972, Cross 1976, Scoppettone et al. 1992, Scoppettone et al. 1993).

In 1983, the Service prepared a recovery plan for Moapa dace which was updated in 1996, and identified various tasks to guide Recovery (Service 1996). The plan also addresses the current status, threats, and recovery needs of seven other endemic aquatic species. These include three fishes: the Virgin River chub (*Gila seminuda*) [this species is currently listed as endangered in the Virgin River and is under review for listing in the Muddy River], Moapa speckled dace (*Rhinichthys osculus moapae*), and the Moapa White River springfish (*Crenichthys baileyi moapae*); two snails: the Moapa pebblesnail (*Fluminicola avernalis*), and the grated tyronia (*Tryonia clathrata*); and two invertebrates: the Moapa Warm Springs riffle beetle (*Stenelmis moapa*) and the Amargosa naucorid (*Pelocoris shoshone shoshone*) that co-exist with the Moapa dace in the Muddy River ecosystem.

Threats to Moapa dace habitat include introductions of non-native fishes (e.g. tilapia and mollies), and parasites; habitat loss from water diversions and impoundments; increased threat of fire due to encroachment of non-native plant species such as palm trees, and reductions to surface spring-flows resulting from groundwater development which reduces spawning, and nursery habitats and the food base for the species. The Moapa dace is more vulnerable to catastrophic events due to their limited distribution in conjunction with these threats.

Hydrogeologic Setting

To understand the factors influencing the distribution and abundance of the Moapa dace, it is important to understand the unique hydrogeologic setting of Moapa dace habitat in the Warm Springs Area. The following description is based on past reports, monitoring information, and discussions with hydrology experts from the SNWA, NPS, USGS, Service, other agencies and organizations. We acknowledge that there are other interpretations of the hydrogeology and existing hydrologic data and the effects of current groundwater pumping that have been expressed by Parties of the MOA (refer to the Journal of Nevada Water Resources Association, Volume 1, pg. 14 and pg [40], Johnson and Mifflin, 2003 and 2005). While these interpretations are plausible and differ from ours, the goal of the pump test as identified in Order 1169 is to gain a better understanding of the effects of groundwater pumping on existing rights and the environment, which will further our understanding of the hydrogeology of the area.

The Warm Springs Area is a groundwater discharge area consisting of about 20 regional springs, with numerous seeps and wetlands (Figure 2). This area is part of the White River Groundwater Flow System, a regional groundwater flow system located in Southern Nevada (Eakin 1966, Harrill et al. 1988, Prudic et al. 1993). As originally defined by Eakin (1966), the flow system encompasses 13 topographic basins, extending over 400 km and terminating at the Warm Springs Area. The flow system consists of numerous local basin fill aquifers underlain by a large regional carbonate aquifer that transmits groundwater from basin to basin, beneath topographic divides. This regional carbonate aquifer varies considerably in thickness, saturated zones ranging from 4,000 to 17,000 feet thick (Dettinger et al. 1995). The identification of the regional groundwater flow system was based on: (1) the hydrologic properties of the rocks in the area; (2) the movement of groundwater inferred from hydraulic gradients; (3) the relative distribution and quantities of estimated recharge and discharge in the system; (4) the relative uniformity of the discharge of the principal springs; and (5) the chemical composition and warm temperature of the discharge from the principal springs (Eakin 1966).

Groundwater inflow or recharge to the regional carbonate aquifer is primarily through precipitation. Nevada is the most arid State in the United States, and precipitation is strongly dependent on elevation. Most precipitation recharging the flow system occurs as snow in the higher elevation areas of the northern part of the flow system. The regional groundwater flow is inter-basin and is generally south and southeast through the system. Outflow or discharge from the system occurs primarily through spring discharge in three areas: (1) the White River Valley; (2) Pahranagat Valley and; (3) the Warm Springs Area.

The terminal discharge of the regional flow system is most likely to be the Warm Springs Area in the Upper Moapa Valley. However, there has been some speculation that a portion of the regional flow reaches the Colorado River. Eakin (1966) estimated that approximately 37,000 afy or 51 cfs of discharge occurs here annually from about 20 springs, as well as subsurface seepage, although the river discharge at the Moapa gage has decreased significantly since that time (LVVWD 2001). The springs are warm (thermal), discharging at a nearly constant temperature of 89.6° F (Scoppettone et al. 1992), and occur within a 2-km radius and form the headwaters of the Muddy River. Historically, this river was a major tributary to the Virgin River, which then joined the Colorado River; however, after the construction of the Hoover Dam, it now flows into Lake Mead at the Overton Arm.

The source water supporting spring discharge in the Warm Springs Area is primarily groundwater flowing beneath Coyote Spring Valley, with a small contribution possibly from Lower Meadow Valley Wash to the northeast (Eakin 1966, Prudic et al. 1993, Thomas et al. 1996, Bassett 2003). The average age of spring discharge water is approximately 6,100 years, based on carbon-14 dating (Thomas et al. 1996). Coyote Spring Valley is also the location of the groundwater pumping described in the proposed action. The two wells, MX-5 and RW-2, in

Coyote Spring Valley that have been identified as the withdrawal points for Order 1169 are located about 10 to 12 miles northwest of the Warm Springs Area.

Groundwater flow from Coyote Spring Valley to the Warm Springs Area appears to be through a zone of high permeability. Estimates of groundwater transmissivity, based on measurements from MX-5 in Coyote Spring Valley and the Arrow Canyon Well in the Warm Springs Area, range from 230,000 to 360,000 ft^2/day (Van Liew et al. 2004). Such high permeability zones are commonly observed upgradient of areas of regional spring discharge. Dettinger et al. (1995) analyzed 39 well tests in southern Nevada and determined that the aquifer transmissivity measured at wells located within 10 miles upgradient from regional springs is about 10-20 times more transmissive, on average, than that portion of the aquifer located further away. However, other measurements indicate the zone of high transmissivity may be spotty and localized. The transmissivity of Arrow Canyon Well No. 2, adjacent to the Arrow Canyon well, is 92,000 ft^2/day. Downgradient of the Warm Springs Area, a normal fault juxtaposes low permeability rock of the Muddy Spring Formation against the carbonate aquifer, forming a barrier of sorts to regional subsurface flow. This low permeability barrier is responsible for the location of the springs.

Carbonate potentiometric heads at MX-4 and MX-5 in Coyote Spring Valley are about 4 feet (ft) greater than carbonate potentiometric heads at EH-4 and EH-5B wells, which are located in the Warm Springs Area about 12 miles to the southeast (Figure 2) (SNWA 2003). The resulting hydraulic gradient of 6.3×10^{-5} is very low. The high transmissivities and low hydraulic gradients suggest the presence of a zone of well-developed hydraulic continuity and high flow rates extending from Coyote Spring Valley to the Warm Springs Area (Figure 1). Pumping stresses imposed at any point in this zone are expected to be readily propagated to all areas in the high transmissivity zone. Johnson and Mifflin (2003) essentially came to the same conclusion. They state that "Extractions from the "northern" flow field, which extends northwestward from the Muddy River springs and includes Coyote Spring Valley, will impact Muddy River flows on essentially a one-to-one basis."

The other area of potential groundwater development included in the MOA is the California Wash hydrographic basin (Basin 218). This basin is located to the south of the Warm Springs Area and includes the Moapa Indian Reservation. There is less information on the hydrologic properties of the carbonate aquifer underlying the basin. Some areas within the California Wash basin appear to be highly transmissive and the potentiometric surface is generally quite flat, with a small east-southeast gradient (Johnson et al. 2001). The hydraulic connectivity of the California Wash basin to the Warm Springs Area is unknown although there are some indications that the area is connected with the Warm Springs Area based on monitoring well data that was shared with the Service in July 2004. However, Johnson and Mifflin (2003, 2005) suggest that there is a hydraulic barrier that will prevent pumping in the southern part of California Wash from impacting the Warm Springs Area.

Moapa Valley National Wildlife Refuge

The MVNWR is a 106-acre area of springs and wetlands located in the Warm Springs Area of the Upper Moapa Valley (Figure 3). The MVNWR was established in 1979 for the protection of the endangered Moapa dace. The thermal headwaters of the springs on the MVNWR are some of the most productive spawning habitat in the area. The MVNWR consists of three units encompassing the major spring groups: the Pedersen Unit, Plummer Unit, and Apcar Unit (upper Apcar). The MVNWR also provides protection for the Moapa White River springfish and other aquatic fauna including endemic snails and other aquatic invertebrates native to the Warm Springs Area.

Pedersen Unit

The Pedersen Unit was the first parcel acquired for the MVNWR and is one of the important strongholds for the Moapa dace reproduction. The Pedersen Unit contains five major springs or spring groups: Pedersen Spring; the East Pedersen Spring group; the Spring 13 group; the Spring 12 group; and Spring 11. Pedersen Spring, at an elevation of 1,810 ft (Mayer 2004), is the highest elevation spring in the Warm Springs Area. The other major spring groups range in elevation from 1,792 to 1,807 ft (Mayer 2004). As discussed later, spring elevation is significant if and when groundwater levels in the regional carbonate aquifer decline due to groundwater development. Therefore, higher elevations springs will be impacted first and with a relative reduction in flow than lower elevation springs.

The Service holds a State-appropriative water right for spring discharge on the Pedersen Unit with a priority date of 1991. The water right is for 3.5 cfs as measured at the Warm Springs West gage, which is located near the downstream boundary of the MVNWR and discharges into the Refuge Stream.

The USGS monitors the total spring discharge from the Pedersen Unit of the MVNWR through a one-ft Parshall flume at the Warm Springs West Gaging Station (USGS Station Number 09415920). The site has been monitored continuously since 1985, except for a data gap from October 1994 through May 1996, due to a lack of funding. Until January 1998, there was an un-metered irrigation diversion upstream of the Warm Springs West flume. The diversion was set up such that water in excess of the irrigation needs could be returned to the stream channel, but downstream of the flume. Water was probably not diverted continuously; however, there is no record of when the diversion was open or closed or how much water was diverted. The flow that was diverted for irrigation was not accounted for in the flume measurements, resulting in an underestimate of the total spring discharge from the MVNWR. For this reason, the period of record prior to January 1998 does not adequately represent the total volume of water emanating from the springs on the Pedersen Unit. The diversion was metered by MVWD beginning in February 1998. The farmer ceased irrigating through this diversion after May 1999, and no water has been diverted since that time. The February 2001, seepage run reported a flow of 3.82 cfs at this site (USGS 2001) although flows have decreased since then (Mayer 2004).

Figure 2

Warm Springs Area

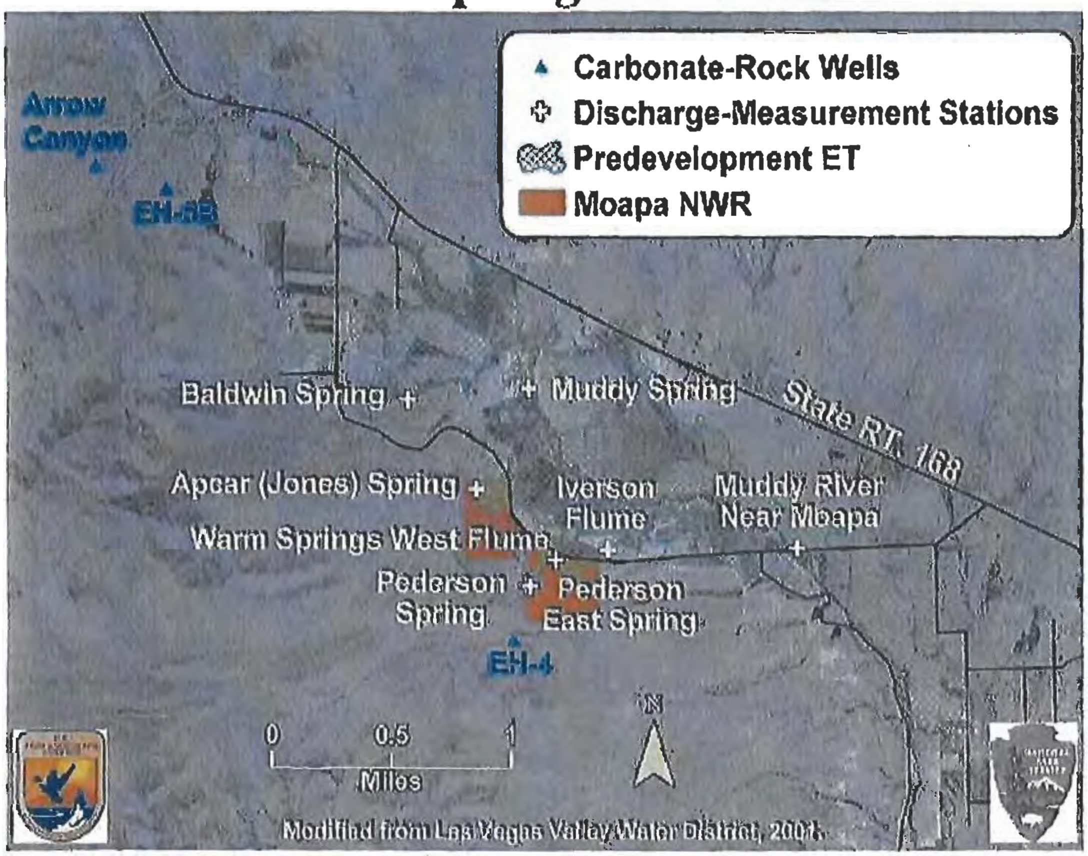


Figure 3
Moapa Valley National Wildlife Refuge

Plummer Unit

The Plummer Unit is the second parcel acquired for the MVNWR and is located just east of the Pedersen Unit. It contains three major springs or spring groups: Plummer West; Plummer Central; and Plummer East. The elevations of all three of the spring groups are about 1,755 to 1,760 ft, which is lower than the springs on the Pedersen Unit. The total spring discharge from the Plummer Unit, as measured at Plummer Main, averages about 2.5 cfs, based on periodic measurements by the Service and the USGS. The February 2001, seepage run reported a flow of 2.39 cfs at Plummer Main (USGS 2001).

The discharge from the Plummer and Pedersen units combines to become the Refuge Stream, downstream of the MVNWR boundary. The Iverson flume (USGS Station Number 9415927) on the Refuge Stream measures the flow leaving the MVNWR, plus any additional losses or gains between the MVNWR boundary and the gaging station. The February 2001, seepage run reported a flow of 8.00 cfs at the flume with an additional 1.13 cfs being diverted upstream of the flume, for a combined total of 9.13 cfs (USGS 2001). The combined total at the Iverson Flume was about 150 percent of the sum of the two flows measured upstream on the same day at Warm Springs West gage and Plummer Stream (USGS 2001). The additional flow measured at the downstream site is assumed to result from subsurface seepage gain into the channel along this reach.

Apcar Unit

The Apcar Unit is the third and most recent parcel acquired for the MVNWR. There is just one spring emanating in this area, the Apcar or Jones Spring. The elevation of the spring orifice is reported to be 1,788 ft although the orifice is buried and the elevation may be difficult to determine accurately. Flows from Apcar Spring are reported by MVWD and have averaged about 1.5 to 1.6 cfs since January 2001. MVWD currently diverts 1.0 cfs of the total flow from Apcar Springs continuously for municipal use (Water Right Certificate Number 10060). The undiverted portion of the spring discharge flows east into Apcar Stream. The February 2001, seepage run reported a flow of 2.54 cfs downstream of Apcar Stream at the Pipeline Jones flume and 3.86 cfs just above the confluence with the Refuge Stream. MVWD reported an average daily flow of 1.55 cfs during February 2001, (flow measurements for specific days were not available, only an average daily flow based on a monthly total). Presumably, 1.0 cfs of this 1.55 cfs was being diverted by MVWD, leaving 0.55 cfs in the channel. The additional flow measured during the seepage run at the two measurement sites downstream of the Apcar Unit is assumed to result from un-metered springs on private property and subsurface seepage gain into the channel along the entire stream.

Historic Distribution and Abundance of the Moapa dace

Between 1933 and 1950, Moapa dace was abundant in the Muddy River and was estimated to inhabit as many as 25 individual springs and up to 10 miles of stream habitat (Ono et al. 1983). La Rivers (1962) considered the species "common" until at least 1950. However, by 1983, the species only occurred in springs and 2 miles of spring outflows (Ono et al.1983). The species appears to have declined since 1938, when Hubbs and Miller considered the species "rather common" in all warm water habitats in the headwaters of the Moapa River (Muddy River), including spring pools, small creeks and the mainstem.

During 1984-87, the Service's Seattle National Fisheries Research Center, now part of the USGS-Biological Resources Division (BRD), extensively surveyed Moapa dace habitats and estimated the adult Moapa dace population to be between 2,600 and 2,800 individuals (Scoppettone et al. 1992). These areas were re-surveyed by USGS-BRD in August 1994, when approximately 3,841 Moapa dace were recorded (Scoppettone et al. 1996). There was a substantial reduction in the number of individuals counted in 1997, with less than 1,600 adult Moapa dace observed, which was believed to be a result of the introduction of tilapia (Scoppettone et al. 1998). In January 2001, a total of 934 Moapa dace were recorded by a consortium of agencies, including the Nevada Department of Wildlife, USGS-BRD, SNWA, and the Service. In February 2002 and 2003, annual surveys enumerated approximately 1,085 and 907 individuals, respectively (Table 2).

Table 2. Moapa dace survey results [a]

Stream Survey Segment	1994	1997	Feb 1999	Feb 2000	Jan 2001	Feb 2002	Feb 2003	Feb 2005
Muddy River Mainstem	2,088*	260*						
– NP to REF	N/A	N/A	X	X	X	8	0	X due to turbidity
– REF to N/S forks	N/A	N/A	X	X	34	49	19	49
Apcar (off MVNWR)	407*	528*						
– Lower			X	43	85	55	30	157
South Fork	355	28	13	9	18	24	14	10
North Fork	426	106	77	73	46	37	33	9
Muddy Spring	236	28	14	X	5	2	0	0
Apcar-Upper (MVNWR)			5	X	87	86	40	6
Plummer (MVNWR)	0	20	113	X	59	53	60	177
Pedersen (MVNWR)			185	163	184	172	204	174
Refuge Stream	313*	595*						
– Warm Springs Road to A/R	N/A	N/A	566	643	416	599	507	652
– A/R to Gabion Structure	N/A	N/A	X	X	X	X	X	62
TOTALS	3841	1565	973	931	934	1085	907	1,296

[a]2004 surveys not completed throughout the species entire range and not used for comparison

A/R = just above confluence of Refuge and Apcar Streams; N/S = confluence of North and South Forks; NP = Nevada Power diversion; MVNWR = spring heads to Warm Springs Road; REF = confluence of Refuge Stream and Muddy River; X= stream reach not surveyed.

* entire reach surveyed, not broken into segments. 2005 population surveys were broken into distinct reach segments and did include juveniles in the Refuge Stream and Plummer Unit on the MVNWR

Current Distribution and Abundance of the Moapa Dace

The Moapa dace currently occupies a variety of habitats in the Warm Springs Area, including spring pools, tributaries (spring outflows), and the upper 2.48 miles of the 24.8 mile-long mainstem Muddy River (post-Hoover Dam). Habitat use varies among larval, juvenile, and adult life stages. Larval dace are observed only in the upper-warmest reaches of tributaries and occur most frequently in slack water, suggesting that spawning only occurs near the spring heads in the extreme upper end of the Muddy River headwaters. Juveniles occur throughout tributaries and occupy habitats with increasing flow velocities as they grow (Service 1996). Adults inhabit both tributaries and the mainstem of the Muddy River, but are most often seen in the mainstem except during spawning when they are in the upper end of the thermal tributaries (Scoppettone et al. 1987, 1992). Larger adults are typically associated with higher velocity flows of 2.6 to 3.0 ft per second (fps) (Cross 1976), with the largest occurring in the Muddy River (Scoppettone et al. 1987). In the Warm Springs Area, water emerges at 89.6° F, cools and increases in turbidity as it travels downstream (Scoppettone et al. 1992). Cooler water temperatures in the lower Muddy River likely form a natural barrier to downstream movement of the Moapa dace (La Rivers 1962).

Moapa dace surveys continue to be conducted annually on both public and private lands throughout the upper Muddy River system. The 2005, survey data indicate that there are approximately 1,300 fish in the population that occur throughout 5.6 miles of habitat in the upper Muddy River system. Approximately 95 percent of the total population occurs within one major tributary that includes 1.78 miles of spring complexes that emanate from the Pedersen, Plummer, and Apcar (a.k.a. Jones) spring complexes on the MVNWR and their tributaries(upstream of the gabion barrio Figure 4). Approximately 28 percent of the population was located on the MVNWR and 55 percent occupied the Refuge Stream supplied by the spring complexes emanating from the MVNWR (Table 3 and Figure 4). This Refuge Stream reach accounts for the highest density of Moapa dace, with the 2nd and 3rd highest densities occurring on the MVNWR's Plummer and Pedersen units, respectively (Table 3 and Figure 4).

Although the stream segment downstream from the convergence of the Refuge Stream and the mainstem Muddy River to the USGS Gaging station (Survey Reach Number 11) (Figure 4) was not surveyed in 2005, due to lack of visibility, available information indicate that no Moapa dace have been present in this portion of the Muddy River since 2002, when only eight dace were reported (Table 2). This loss is likely the result of competition with and predation by non-native tilapia. Since the Moapa dace is a thermally restricted species, water temperatures that drop below the preference range would not provide sufficient habitat for spawning, foraging, or shelter. The species shows varying water temperature tolerances for different life stages; however, the adult stage shows a lower tolerance of approximately 79° F (Scoppettone et al. 1993); therefore, any temperature cooler than 79° F would not provide long-term habitat for the species, thereby creating a thermal barrier for species. While the species has always had a natural thermal barrier due to the warm spring water cooling as it travels downstream, the tail of the temperature threshold can fluctuate due to reduced flows in the system (as explained later in the thermal loads section). Thermal losses can occur as a result of decreasing flows from warm

Figure 4

2005 Fish Population Survey

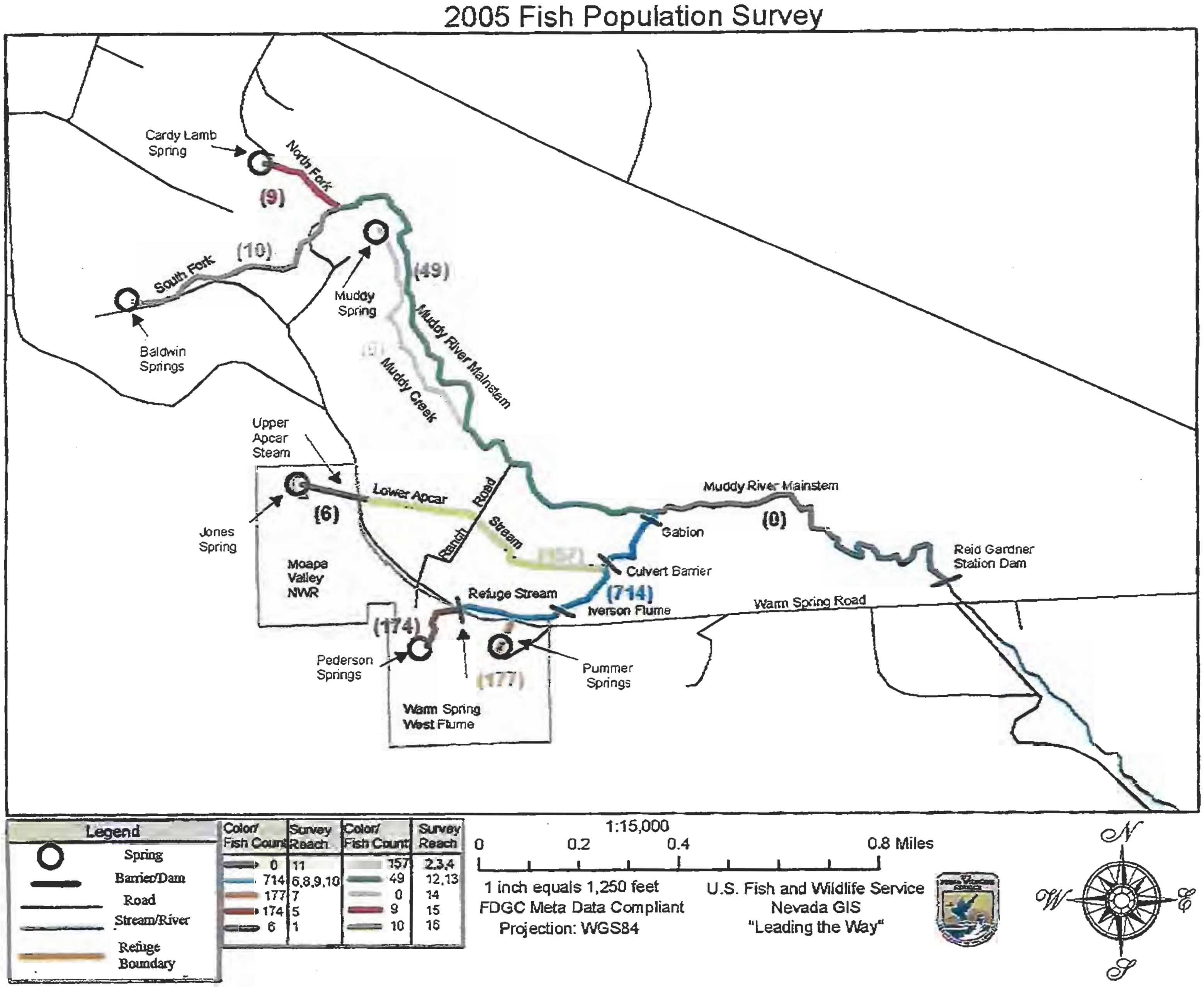


Table 3. Moapa dace density and population estimates for 2005

Stream Segment	Available Habitat *	Fish Density (# fish/10 Ft)	Fish Density	Total Number of Fish (2005 Survey)
Muddy River Mainstem (N/S forks convergence to WSR Bridge)	11,743 ft or 2.22 mi	0.04	1 fish/239 ft	49
Apcar – Lower (off MVNWR)	3,145 ft or 0.60 mi	0.50	1 fish/20 ft	157
South Fork	3,085 ft or 0.58 mi	0.03	1 fish/309 ft	10
North Fork	2,640 ft or 0.50 mi	0.03	1 fish/293 ft	9
Muddy Spring	2,743 ft or 0.52 mi	0	0	0
Apcar -Upper (MVNWR)	733 ft or 0.14 mi	0.08	1 fish/122 ft	6
Plummer (MVNWR)	860 ft or 0.16 mi	2.06	1 fish/5 ft	177
Pedersen (MVNWR, includes all springs and tributaries)	1,839 ft or 0.35 mi	0.95	1 fish/11ft	174
Refuge Stream (off Pedersen Unit of MVNWR-Warm Springs Road to confluence with the mainstem of the Muddy River)	2,849 ft or 0.53 mi	2.51	1 fish/4 ft	714
Totals	29,637 ft or 5.6 mi	--	--	1,296

* Stream segment lengths are approximations derived from digitized aerial photos (USGS In Draft see Lit. Cited).
Note: shaded areas indicate the 3 stream segments with the highest Moapa dace densities.

water springs, water diversion structures, and/or surface sheet flow (water that flows freely out of stream banks across the land) and result in an overall reduction in the species' distribution potential. With the potential loss of these warmer waters contributing to the overall decrease in thermal load in the system, the Muddy River cools more rapidly, thus decreasing the distribution potential for the species.

Reproduction

Moapa dace larvae have been observed year-round, indicating year-round reproduction; however, peak spawning activity likely occurs in the spring, with lesser activity in autumn, probably linked to food availability (Scoppettone et al. 1992). Sexual maturity occurs at one year of age, at approximately 1.6 to 1.8 inches fork length (Hubbs and Miller 1948, Scoppettone et al. 1987, 1992). Fecundity is related to fish size; egg counts range from 60 eggs in a 1.77-inch fork length dace to 772 eggs in a 3.5-inch fork length dace (Scoppettone et al. 1992).

Reproduction of Moapa dace is believed to occur within a very narrow temperature range of 86° to 89.6 °F (Scoppettone et al. 1992) and is likely isolated with the warmer springs (headwaters) of the Muddy River. Although Moapa dace have never been observed spawning, Scoppettone et al. (1992) observed recently emerged larvae within 492 ft of the warm water spring discharge, over sandy silt bottoms in temperatures ranging from 86° to 89.6 °F, and dissolved oxygen levels of 3.8 to 7.3 ppm. Sexually mature Moapa dace must migrate upstream from the Muddy River into thermal tributaries to spawn successfully (Scoppettone et al. 1987). Several depressions in the sand were similar to "redds" described by Minckley and Willard (1971) for longfin dace (*Agosia chrysogaster*). Depth and velocity at the suspected redds were representative of the outflow channel and similar to other suspected spawning areas in the Warm Springs (Scoppettone et al. 1992). Redds were in sandy-silt substrate at depths of 5.9 to 7.5 inches, water velocities near the nesting redds ranged from 0.12 to 0.24 fps, and mean water column velocities from 0.5 to 0.6 fps (Scoppettone et al. 1992).

The duration of egg incubation is unknown, but is likely relatively short due to the high water temperatures (Service 1996). Emigration of young-of-the-year Moapa dace from the Refuge Stream is believed to peak in May (Scoppettone et al. 1987), and dispersal is likely similar in other tributaries with comparable water temperatures. Mortality rates for Moapa dace have been estimated to be 68 percent for the first year (juveniles) and 65 percent in the second year (adults) (Scoppettone et al. 1987).

Visual observations of Moapa dace have revealed that they are omnivores, feeding primarily on drift items, but adults forage from the substrate as well. Larval dace feed on plankton in the upper water column, in areas with little or no current, and juveniles feed at mid-water (Service 1996). Schools of 30 or more Moapa dace have been observed congregating at drift stations to feed (Scoppettone et al. 1987). They often use sites where cover is provided by overhanging vegetation (Service 1996). Drift stations are also located in reaches of low to moderate water velocity adjacent to depressions in the substrate. These depressions may be located downstream of a pebble riffle, thus creating turbulent flows. Moapa dace actively feed 24 hours a day, but peak feeding occurs around dawn and dusk (Scoppettone et al. 1987).

Threats

Moapa dace are thermophilic and endemic to the headwaters of the Muddy River (Figure 5). The Muddy River originates from spring discharges in the Warm Springs Area. When it was described by Eakin (1964), the Muddy River at the Moapa gage had an average annual discharge of 46.5 cfs and temperatures ranging from 87.8 to 89.6°F at its sources. Flows have declined over the last 40 years to about 35 cfs due to a combination of surface water diversions and groundwater pumping (LVVWD 2001). The Muddy River is a unique system due to the fact that its headwaters emanate from warm water springs. Given the warm sources, the water does not get warmer as it travels downstream like most riverine systems but rather cools as it travels downstream. Although the flow in the headwaters is nearly constant seasonally, flow in the mainstem of the Muddy River varies with precipitation events, seasonal water diversions, groundwater recharge, vegetation transpiration, evaporation, and irrigation return flows. Before reaching Lake Mead, nearly 75 percent of the annual inflow is lost to diversions, evaporation, and transpiration (Soil Conservation Service 1993).

Physical alteration of Moapa dace habitats in the Warm Springs Area, initially for irrigation purposes, began even before the species was discovered in 1938 (Scrugham 1920). These habitats have since been developed for recreational, industrial, and municipal uses. Spring orifices and outflow streams have been dug out, lined with concrete and/or gravel, mechanically and/or chemically treated to eliminate aquatic vegetation, and chlorinated to create private and public swimming pools. Several springs are capped and piped directly from the orifices for municipal use, desiccating associated outflow streams. Chlorination and agricultural activities in the Warm Springs have decreased in recent years, but some spring outflow streams continue to flow through culverts and/or dirt and cement irrigation ditches. Historically, irrigation return flows and runoff from pasture land and alfalfa fields carried significant quantities of sediment into the upper Muddy River. Encroachment of non-native vegetation [i.e., palm trees *(Washingtonia filifera)*, and tamarisk *(Tamarix ramosissima)*] within and along stream channels has also modified habitat. The root system of palm trees has modified stream morphology by obstructing the stream channel and/or lining the channel bed.

The upper Muddy River has also been subjected to various physical perturbations. In 1944, the Bureau of Reclamation constructed a 10-ft-high Cipoletti weir gaging station at the Warm Springs Road Bridge. The USGS took ownership of the gage in 1948, and continues to measure flows at this gaging station. This concrete dam impounds approximately 150 ft of riverine habitat. Although the structure serves as a barrier to fish migration upstream during normal flows, it also hinders movement of Moapa dace from accessing the upstream spawning tributaries or escaping turbid river conditions. The structure also cools the river water as it cascades over the structure to a temperature below that preferred by Moapa dace (Deacon and Bradley 1972).

It is believed that the first non-native, mosquito fish (*Gambusia affinis*) became established in the Muddy River by 1938 (Hubs and Miller 1948). A decline in the abundance of Moapa dace was first noted in the 1960s, shortly after the introduction of non-native shortfin mollies (*Poecilia mexicana*) (Deacon and Bradley 1972, Cross 1976). The concurrent decline in the abundance of Moapa dace was likely related in part to interactions between these two species. Habitat use by mollies is similar to that of larval and juvenile Moapa dace (Deacon and Bradley 1972, Scoppettone et al. 1987), and laboratory experiments have demonstrated that shortfin mollies are predators of fish larvae (Scoppettone 1993). Together, these species have introduced fish parasites into the ecosystem, including tapeworms (*Bothriocephalus acheilognathi*), nematodes (*Contracaecum* spp.), and anchor worms (*Lernaea* spp.), which have negatively impacted native fishes of the Muddy River, including Moapa dace (Wilson et al. 1966, Heckman 1988).

The blue tilapia (*Oreochromis aurea*) is the only non-native fish to become established in the Warm Springs Area since the introduction of the shortfin molly (Scoppettone et al. 1998). With the exception of waters on the MVNWR, Apcar and Refuge streams, tilapia occur in the Warm Springs' tributaries and have had devastating effects on Moapa dace and other native fish populations. The Moapa dace population has declined dramatically since the invasion of tilapia. The tilapia is detrimental to native fish species in a number of ways. Shortly after the invasion of tilapia into the Warm Springs Area, most of the aquatic vegetation disappeared. This vegetation provided habitat for invertebrates that Moapa dace rely upon as a food resource. Analysis of tilapia stomach contents revealed the presence of Moapa dace and Moapa White River springfish, indicating that tilapia further degrade native fish populations through predation (Scoppettone et al. 1998). Additionally, tilapia significantly altered the stream bed through the creation of nesting areas.

The introduction and establishment of tilapia in 1997 and other non-native fishes have been a major factor in the deterioration of the Muddy River as habitat for native fishes (Deacon and Bradley 1972). Currently, the springs and streams on the MVNWR, and Apcar and Refuge streams are the only Muddy River tributaries free of tilapia; therefore, making them more vulnerable to catastrophic events. The occurrence of tilapia is likely the primary cause for reductions in Moapa dace populations in the South Fork, North Fork, and Muddy River tributaries (Scoppettone et al. 1998). Deacon and Bradley (1972) stated, "The marked decrease in abundance of native fishes that follows establishment of a non-native species could conceivably carry a native species to the point of extinction."

A threat in recent years to the Moapa dace is the increased occurrence of fire, primarily due to the encroachment of non-native vegetation. In June of 1994, a flash fire swept through the upper Refuge Stream that either killed or displaced individual Moapa dace that were occupying affected stream reaches. Surveys conducted post-fire in 1994, indicated that only 34 Moapa dace survived on the MVNWR (Scoppettone et al. 1998), and subsequent surveys indicated an overall decline in the total population of Moapa dace (Table 2). Given the restricted range of the species, and the associated mortality from the fire, it is apparent that the species is vulnerable to stochastic and catastrophic events.

Figure 5

2005 Moapa Dace Existing/Historic Range

Environmental Baseline

Groundwater Elevation/Spring Discharge Relationships

It is well established that the spring discharge in the Warm Springs Area emanates from the regional carbonate aquifer (Eakin 1966, Prudic et al. 1993, Thomas et al. 1996). The regional carbonate aquifer underlying the area is confined and the potentiometric surface of the carbonate aquifer is greater than the land surface elevation of the springs. This hydraulic head differential causes groundwater in the carbonate aquifer to rise to the land surface through cracks and fissures, manifesting itself as spring discharge. Darcy's Law states that flow through a porous medium is proportional to the hydraulic head differential or hydraulic gradient (Fetter 1994). The law is valid for groundwater flow in any direction. In the case of spring discharge, the greater the hydraulic head differential between the elevation of the spring orifice and the hydraulic head of the aquifer, the greater the spring discharge, all other things being equal.

Groundwater development activities in the Coyote Spring Valley or Warm Springs Area will lead to the development of a drawdown cone around the pumping center. We assume that if the drawdown cone extends to the area underlying the springs, then the hydraulic head differential at the springs will be reduced. Darcy's Law states that a reduction in the hydraulic head differential will result in a proportional decrease in flow. For example, if the head differential at a spring is initially 10 ft but groundwater pumping lowers the potentiometric surface of the aquifer by 2 ft, then the head differential will only be 8 ft, a 20 percent decrease. The proportionality relationship in Darcy's Law implies that the spring discharge will also be decreased by a similar amount, or 20 percent.

The elevations of spring pool orifices in the Warm Springs vary by more than 60 ft (SNWA 2003). Considering the head/discharge relationship described above, it becomes evident that for a given decline in the potentiometric surface of the aquifer, the springs in a system with the smallest head differential, the highest elevation springs, will be the most susceptible to groundwater pumping impacts. Figures 6 and 7 illustrate this concept with two hypothetical springs of different elevations. Following a decrease of 5 ft in the groundwater elevations, the hydraulic head at the higher elevation spring is reduced by 50 percent. The discharge at the spring is expected to be reduced proportionately (Figures 6 and 7). By contrast, the same 5 ft decrease in groundwater elevations only reduces the hydraulic head at the lower elevation spring by 25 percent. The spring discharge would be reduced by a much smaller percentage (25 percent) compared to the higher elevation spring. The underlying assumption in this example is that the drawdown is uniform at both springs, a reasonable assumption in a highly transmissive system with a shallow, extensive drawdown cone. In such a system, the springs that will be most susceptible will be the highest elevation springs and not necessarily the springs that are closest to the pumping center.

Figure 6

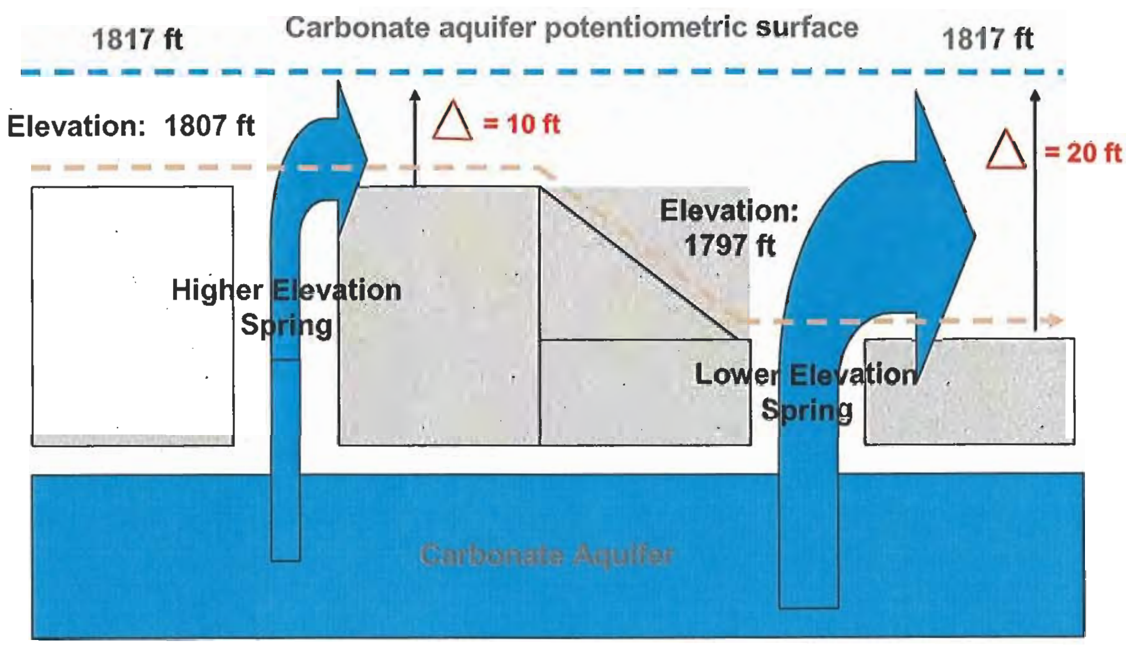
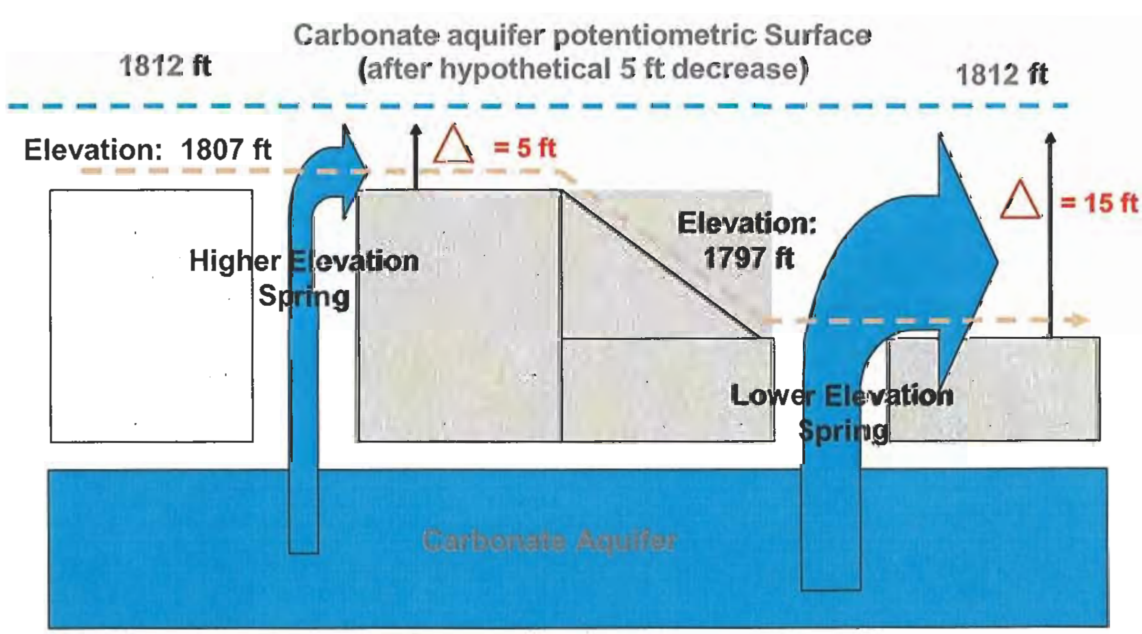


Figure 7



Current groundwater pumping at the Arrow Canyon Well and impacts

In the following discussion, the groundwater/spring discharge relationships described above have been used to base our current analysis of impacts from current pumping and to project the impacts of future groundwater development on the springs. It is anticipated that upon completion of the pump test required in Order 1169, that additional hydrogeologic information will be available to assist in a better understanding of this relationship. In the interim, the Service recognizes that there are different interpretations and opinions regarding the timing and causes of recent groundwater level declines in the flow system than that discussed in this programmatic biological opinion (Buqo 2004, Johnson and Mifflin 2003 and 2005).

In 1990 and 1992, MVWD applied for water rights of an additional 3.0 and 5.0 cfs, respectively, of groundwater for municipal purposes from the carbonate aquifer in the Warm Springs Area. The point of diversion is the Arrow Canyon Well, located about 2.3 miles west of the MVNWR. The MVWD had existing water rights in the area, including a right for 2.0 cfs from the Arrow Canyon Well. MVWD forecasts of growth in the Moapa area indicated the need for additional water. The water right applications were formally protested by the Service, NPS, and Nevada Power Company, primarily due to concerns about Moapa dace and injury to senior water rights, including the Service's water right for the Pedersen Unit of the MVNWR. In 1995, the Nevada State Engineer overruled the protests but ordered (in Ruling 4243) that pumping be phased in incrementally from 1996 through 2004, with monitoring to evaluate any impacts to springs or groundwater levels (Nevada State Engineer 1995).

Growth in demand was less than forecasted by the MVWD and groundwater pumping from the Arrow Canyon Well has lagged behind the incremental pumping rate ordered by the State Engineer in Ruling 4243. Pumping was stepped up to 2.7 cfs in 1998, in part at the request of the Federal agencies to allow collection of data related to the effects of groundwater production from the carbonate aquifer, and has averaged 3.3 cfs or 2,400 acre-ft annually since that year (Mayer 2004). Concurrent with the increased pumping, groundwater levels and spring discharge in the Warm Springs Area have been consistently decreasing since 1998. Water levels in the two carbonate monitoring wells, EH-4 and EH-5B, have decreased by 0.38 ft/yr or a little more than 2 ft over the six-year period (Figures 2 and 8). Over the same period, the total spring discharge from the Pedersen Unit, as measured at Warm Springs West, has decreased from 4.00 cfs to 3.55 cfs. The rate of decrease is about 0.08 cfs/year, representing an 11 percent decrease over the period (Figure 9). The discussion in Mayer (2004) shows that the observed decreases in spring discharge are consistent with expected decreases based on the two-foot decline in groundwater levels observed in the carbonate monitoring wells in the Warm Springs Area. The relationship between groundwater levels and spring discharge at Warm Springs West was used to predict a 13 percent decrease in spring flows over the period from 1998 to 2003, in response to the 2-ft drawdown that has occurred (Table 4). The actual measured decrease of 11 percent is in close agreement with the predicted value.

Figure 8

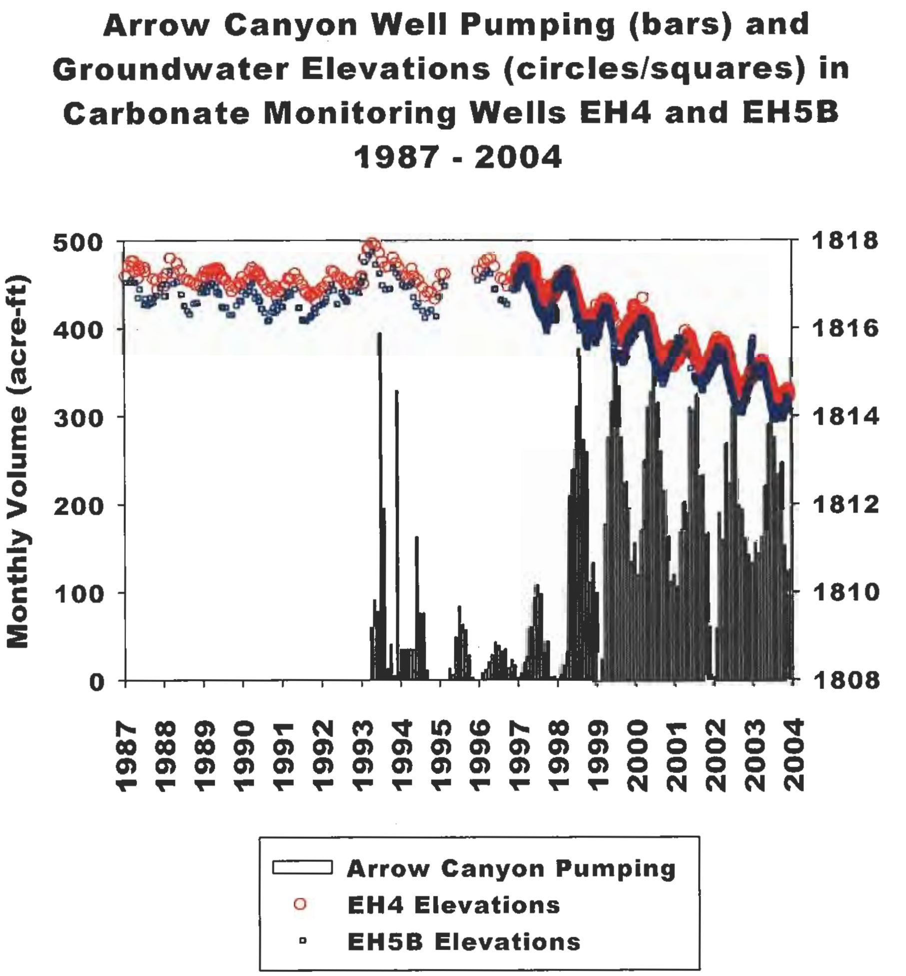


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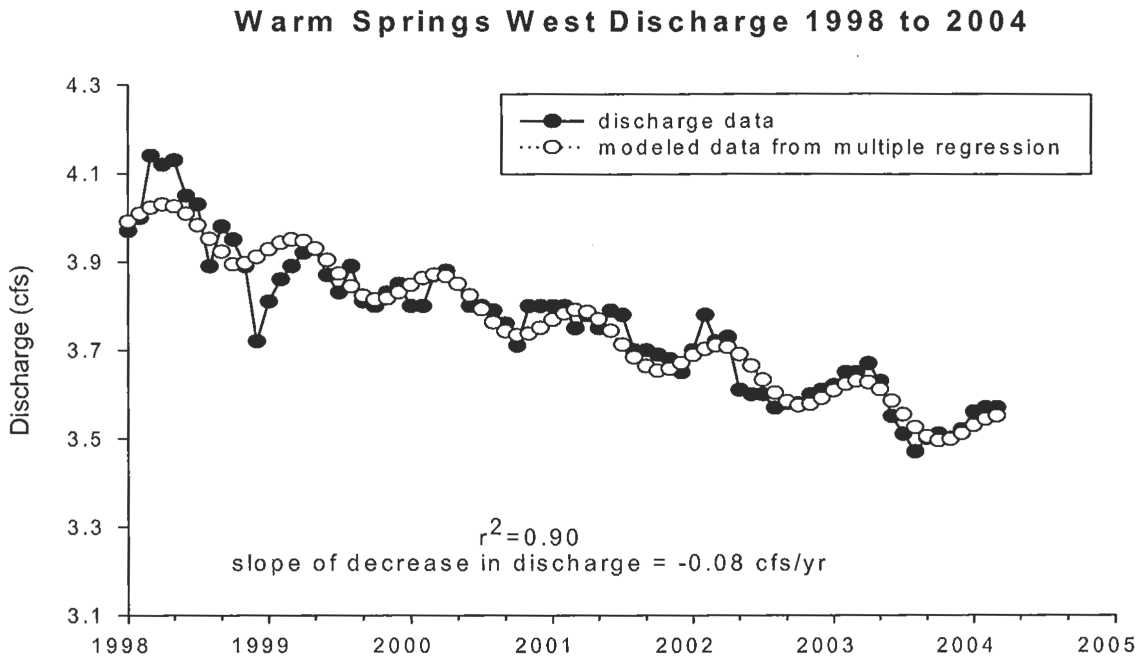
Figure 9



The exact timing of the groundwater level decline is important because if the actual decline precedes in time any action or event suspected of causing the decline (such as increased pumping or drought), then this is strong evidence that there are other factors causing the decline. We have attempted to analyze the timing of the decline here.

Figure 10 is a plot of the periodic water level readings in EH-5B. Also shown is a lowess smooth of the data. Lowess (locally weighted scatterplot smoothing) is a smoothing technique used to emphasize trends in xy data (ex. water levels with time). The lowess says nothing about the statistics of a trend, it is simply a method of ascertaining any trend. The lowess of the EH-5B data shows that while there was variability prior to 1998 (possibly due to climatic impacts, seismic activity, barometric changes, earth tides, existing pumping), the slope of the decline clearly became more negative starting in this year. In other words, the rate of decline increased from 1998 through 2004. Looking at similar data from EH-4, Mayer (2004) showed through multiple regression analysis that the slope of the decline changed from -0.06 ft/yr in the period 1989 to 1993, to -0.38 ft/yr in the period 1998 to 2003, and that this change in slope was statistically significant. The magnitude and extent of the decline is unlike anything observed in the earlier record. This rate and magnitude of the 1998 to 2004 decrease is what is of concern to the Service. The start of the decline coincides with MVWD's increased pumping from the carbonate aquifer (see Figure 8). It also coincides with a very wet year (see Figure 11), which has implications for likelihood of drought or climatic impacts causing this decline, as discussed below.

Figure 10

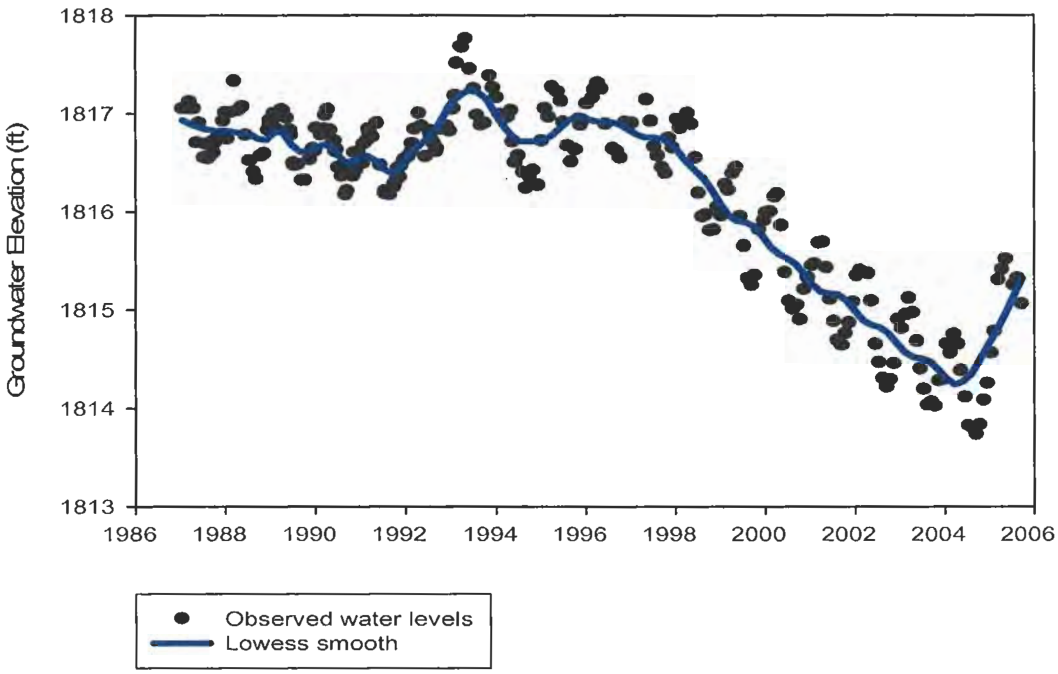
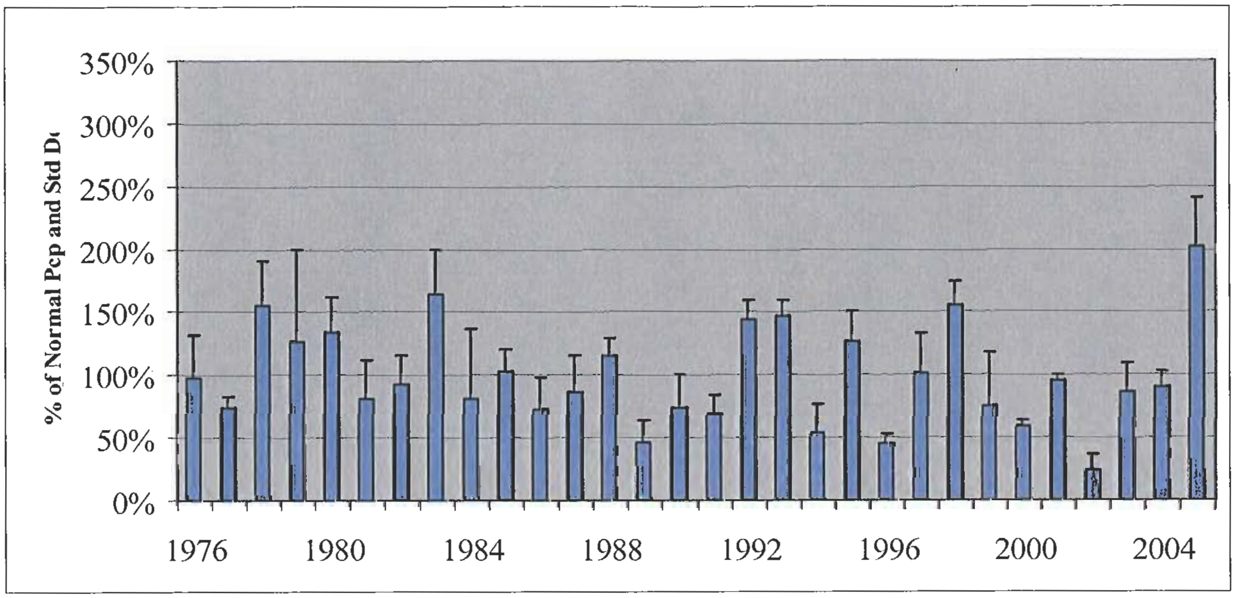


Figure 10. Periodic Measurements of Water Level Elevations in EH-5B for the period 1987 to 2005. Lowess smooth added as discussed in text.

In order to address the possibility that drought caused the groundwater level declines, we compiled precipitation records from a number of stations in the southeastern Nevada area. Four of these stations (Desert Game Range, Las Vegas Weather Service Office (WSO) airport, Valley of Fire, St George Utah) have precipitation records of 30 years or more. A fifth station (Red Rock Canyon) has a 27-year period of record. We averaged the precipitation from these five stations for a measure of local precipitation (Figure 11). In addition, we compiled the Palmer Drought Severity Index (PDSI) and the Palmer Hydrological Drought Index (PHDI) for a 30-year period of record for both Region 4 (southeastern Nevada) and Region 3 (Central Nevada). Our analysis shows that the decline from 1998 to 2004 was not likely to be drought-related for the following reasons.

Figure 11



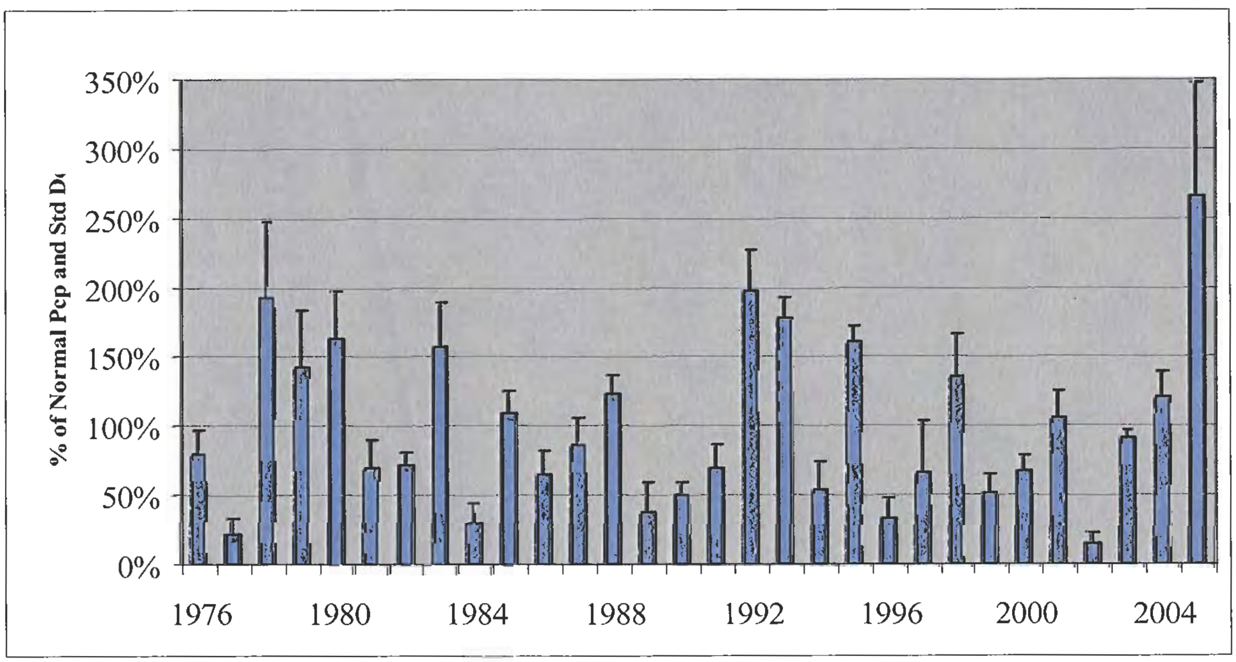


Figure 11. Percent of normal precipitation for the water year (top) and Nov-Apr period (bottom) averaged at five precipitation stations in or near southeastern Nevada. Station locations are discussed in the text.

Figure 11 shows the percent of normal precipitation from the five precipitation stations for the winter and water year. 2002 was an exceptionally dry year (24 percent of normal water year) but the other years were not unexpectedly dry and were not much different from earlier periods in the preceding decade (Figure 11). 1998 was a fairly wet year (156 percent of normal for the water year and 134 percent of normal for the winter), yet the groundwater level decline started in 1998. 1999 and 2000 were dry years (75 percent and 59 percent, respectively of the normal water year), but 2001 was close to average (95 percent of normal for the water year and 106 percent of normal for the winter), yet the groundwater level decline continued through this year.

The PHDI for southeastern Nevada indicates similar trends, a period of mild drought from 1999 through 2000, a recovery in 2001, followed by a period of severe or extreme drought from 2002 to 2003 (Fig 12). There were periods of severe drought observed from 1989 to 1991 and 1996 to 1997 without groundwater level declines of similar magnitude. Furthermore, the average precipitation for the four year period from 1998 to 2001 was 96 percent. There were two other periods in the 1990s that were significantly drier than this. From 1989 to 1991, the average precipitation was 67 percent of normal. From 1996 and 1997, the average precipitation was 76 percent of normal. There is a slight decline in water levels corresponding to the 1989 to 1991 dry period, but it is nothing of the magnitude of the decline from 1998 to 2004. Finally, overlaying the plots of EH-5B water levels and PHDI on the same time series suggests that while climate likely has some effect on groundwater levels in the area, the decline from 1998 to 2004 does not seem to be related to a change in the PHDI. (Figure 13)

With respect to the increase in water levels in 2005, it should be noted that both the local precipitation stations and the PHDI and PDSI show this to be an extraordinarily wet year. The average water year precipitation for the five local stations was 200 percent of normal. Thus, this increase in precipitation has resulted in groundwater level increases. However, the long-term effect of the extremely wet year is unknown and not likely to influence the downward trend in groundwater levels. Understanding the factors responsible for influencing trends and variability in the groundwater level record will become more apparent as more data and information is collected.

The declines observed since 1998, have occurred not only locally in the Warm Springs Area, but have also occurred in monitoring wells 12 miles upgradient in Coyote Spring Valley and 15 miles south to monitoring wells in California Wash, based on USGS monitoring well data and monitoring well data shared with the Service in July 2004, respectively. Both of these locations are areas of potential groundwater development under the terms of the MOA.

The flow from the Pedersen Unit of the MVNWR, as measured at the Warm Springs West gage, has declined at an annual rate of 0.08 cfs/yr since 1998. If the current decline continues unabated, the flow will reach a monthly minimum of 2.7 cfs by 2014. It is not certain that the current rate of decrease will continue as it has for the past six years. While the system could begin to equilibrate and the rate of decrease could slow, there is no evidence to suggest that this could occur. On the other hand, if the rate of groundwater pumping increases then the rate of decline could increase.

Figure 12

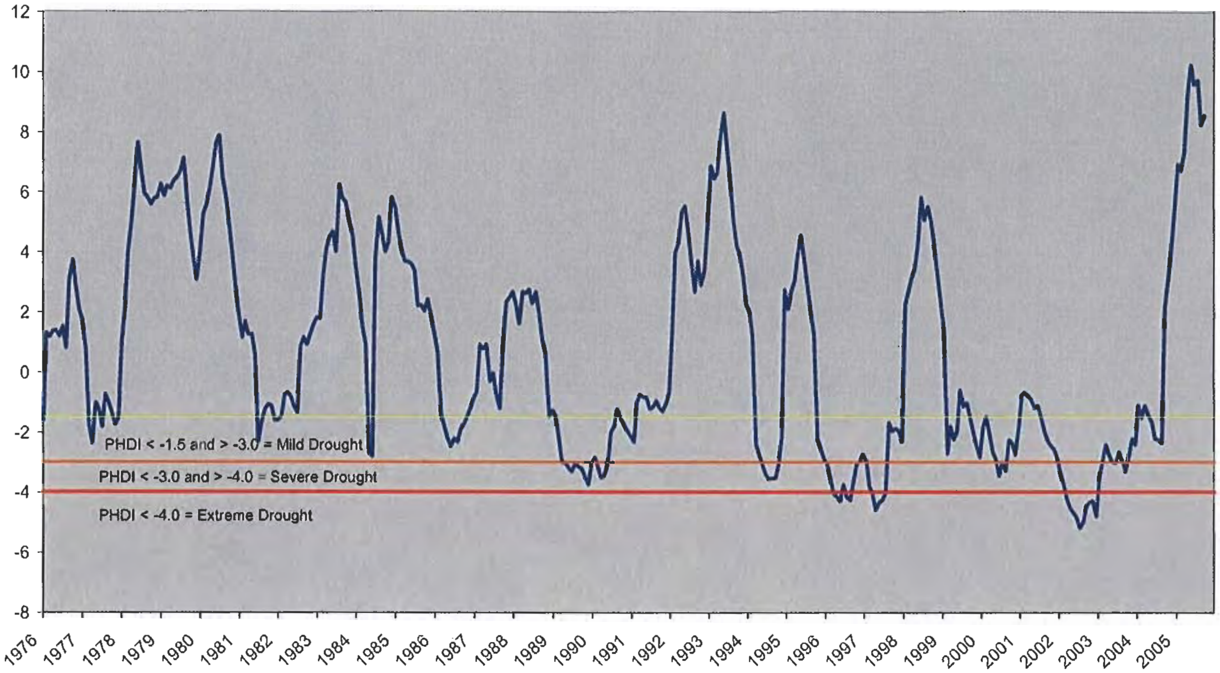


Figure 12. Palmer Hydrological Drought Index for U.S. Climate Division, Nevada Region 4, southeastern Nevada (positive values indicated wetter years, negative values indicate drier years)

Figure 13

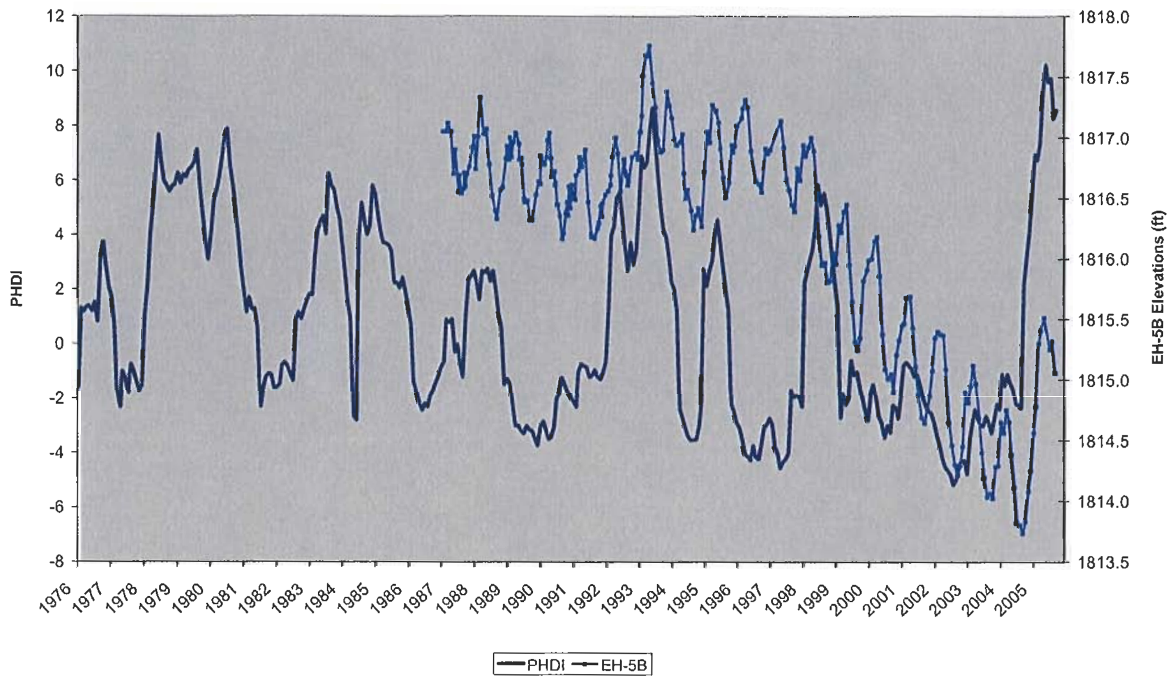


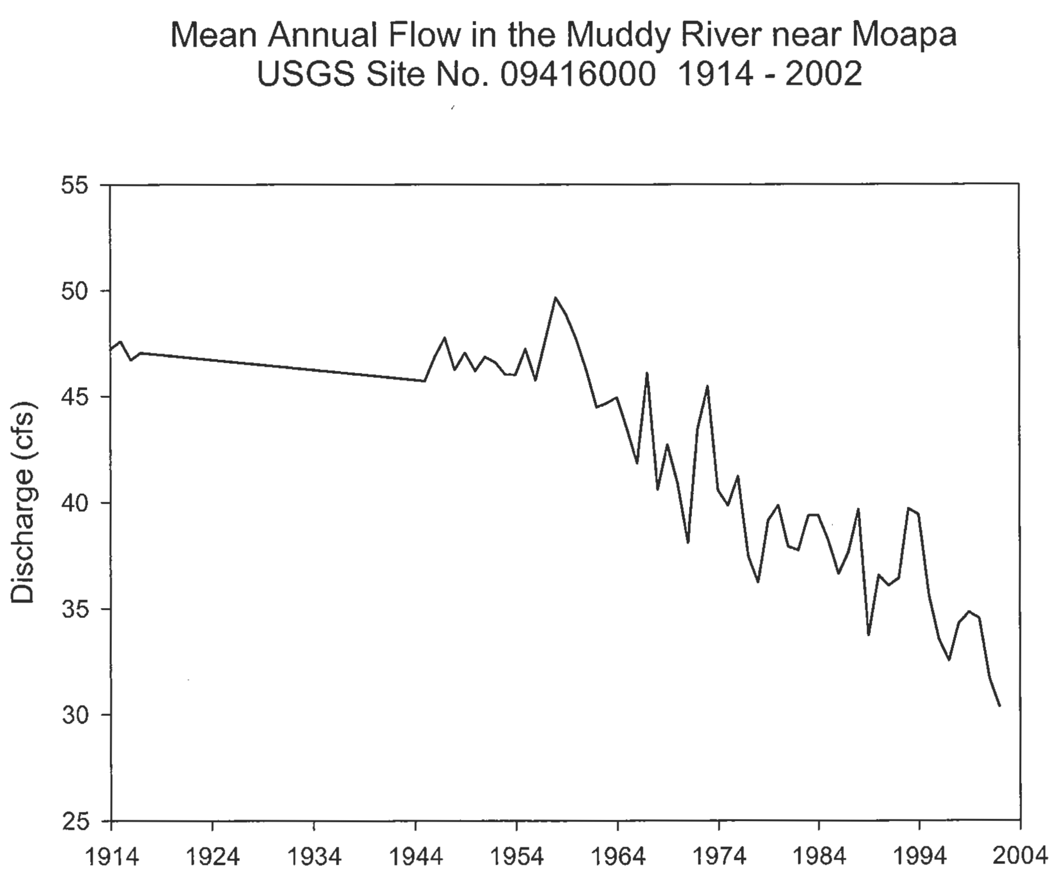
Figure 13. Relationship of Palmer Hydrological Drought Index (NV Region 4) and EH-5B Water Level Elevations

The current pumping rate and volume and associated groundwater declines are not affecting all springs in the Warm Springs Area to the same degree as those on the Pedersen Unit, despite the fact that the water level decline in the carbonate aquifer is believed to be uniformly distributed throughout the area. As discussed above, those springs at lower elevation are less susceptible to the current groundwater declines. The springs on the Plummer Unit of the MVNWR range in elevation from 1,755 to 1,760 ft, much lower than the springs on the Pedersen Unit. These springs have shown very little change in flow in the last six years although the measurements from Plummer Unit are less frequent and the period of record is not as long as Warm Springs West. The lack of decline in flow at these springs is consistent with the estimated change in the hydraulic head differential at the springs over the last six years.

The Apcar Spring, at 1,788 ft, is intermediate between the spring elevations on the Pedersen Unit and the Plummer Unit. According to the annual reports from MVWD, the flow at Apcar has decreased in the last six years from about 2 cfs to 1.5 cfs. A large decrease in flow occurred during 2000 (from an average of 1.9 cfs in 1999 to 1.6 cfs in 2001). The cause of this decline is not known.

The USGS has a continuous record of flow on the Muddy River at Moapa (USGS Station Number 9416000) from 1945 to the present, with discontinuous or periodic measurements as far back as 1913 (Figure 14). This is one of the longest periods of records for any measuring site in the area. The flow at this location in the river is much greater than the sum of all the spring discharge measurements (Eakin 1964, USGS 2001). About half of the flow measured at the gage is unaccounted for at the springs, and is believed to come from subsurface seepage gains into the river channel and its tributaries. The annual flow in the river changed little between 1913 and about 1960. The average flow during this period was 47 cfs. There is a steady significant decline in flow starting in the 1960s and continuing until the present. The decline is believed to be due to groundwater pumping from both the alluvial and carbonate aquifers, which has decreased subsurface seepage into the river, and to a lesser extent, from surface water diversions. The mean annual flow from 1960 to 1969 was 44 cfs. From 2000 to 2004, the flow has averaged 32 cfs. This equates to a decrease of approximately 0.4 cfs/yr or 28 percent over the 40-year period. At the present rate of decline, the mean annual flow in the river will decline to 28 cfs in another 10 years and 22 cfs in 25 years.

Figure 14



Completed or Ongoing Conservation Actions

- A piscicide called rotenone was used to successfully remove tilapia from waters on the MVNWR, Refuge Stream and the Apcar Stream to the gabion structure (just upstream of the Refuge Stream and Mainstem convergence);
- Various fish barriers (gabion and culvert) have been constructed in the Refuge Stream to prevent further encroachment of non-natives;
- The Pedersen and Pedersen East (a.k.a. Playboy pool) spring heads have been restored to make use of all available surface water and to maintain good flow records;
- Old concrete channels in portions of the Pedersen Unit have been removed to facilitate a more natural flow and recruitment of invertebrates (one food source for the dace);
- The development stage of restoring habitat on the Plummer Unit has been completed to provide more suitable habitat for and public viewing of the Moapa dace;
- Prevention of wild fire threats has continued through the removal of potential fire sources such as palm trees;
- Hydraulic geometry, water temperature, and groundwater flow models were developed to predict both existing and future conditions that may modify water quality and quantity that supply the warm water supply necessary for the Moapa dace and other aquatic species in the Warm Springs Area; and
- Multi-agency, annual Moapa dace surveys continue to be conducted throughout the range of the species (depending on access to private lands).

Conservation Needs of the Moapa Dace

- Placement of additional fish barriers in the lower reaches of the historic range of the Moapa dace in order to facilitate reestablishment in these areas;
- Eradication/control of remaining non-native invasive species including, but not limited to, fishes, bullfrogs, spiny softshell turtles, and non-native plant species such as palm trees, *Vallisneria*, Russian olive and salt cedar throughout the range of the dace;
- Continued fire maintenance activities to reduce the threat of wild fires;
- Minimization/elimination of surface water sheet flows that decrease the natural thermal load of water within dace habitat;
- Prevention of illegal water diversions that reduce or modify water quality and quantity in the Muddy River and its tributaries;
- Securing adequate water flows for Moapa dace recovery at the MVNWR and other spring sources, to provide long-term habitat for reproduction, nursery, forage, shelter, etc;

- Enhancement of existing occupied habitat [i.e. restoring stream dynamics, eradication of non-native fish and vegetation, removal of barriers to native fish migration in upper Muddy River and tributaries];
- Expansion of research efforts to gain additional knowledge about the biological needs/requirements of the species;
- Establishment of easements or acquisition of private lands within the range of the Moapa dace to address the threat of habitat loss as a result of residential/commercial development; and
- Continuation of the multi-agency, annual Moapa dace surveys throughout its range.

Major Activities Authorized Under Sections 7 and 10(a)(1)(A) of the Act in the Action Area

File No. 1-5-98-FW-177. On November 2, 1998, the Service issued a non-jeopardy biological opinion to the Nevada Fish and Wildlife Office for the implementation of eradication of non-native fish activities and installation of fish barriers in the Apcar Stream in the Warm Springs Area of the Muddy River. The Service concluded that the project was not likely to jeopardize the continued existence of the Moapa dace. Incidental take was authorized and Reasonable and Prudent Measures were identified to minimize take to the species.

File No. 1-5-01-F-463. On December 26, 2001, the Service issued a non-jeopardy biological opinion to the Bureau of Indian Affairs for approval of the Tribe's lease for reservation lands on the Reservation for construction and operation of the Moapa Paiute Energy Center. Calpine Corporation would lease the lands from the Tribe for the project. The proposed project would disturb 222 acres of desert tortoise habitat, and could result in take of 6 desert tortoises by death or injury, and 70 desert tortoises by harassment; and up to 7 percent of the total available spawning habitat for the Moapa dace. As of the date of this biological opinion, the proposed project has not moved forward and the Service is not aware of any plans in the near future to construct the project. Should a decision be made to implement the project, re-initiation of consultation would be required based on new information.

File No. 1-5-02-FW-463. On March 13, 2002, the Service issued a non-jeopardy biological opinion to the Desert National Wildlife Refuge Complex, Las Vegas, Nevada for the implementation of riparian and aquatic habitat restoration activities in the Pedersen Unit of the MVNWR. The Service concluded that the incidental take of less than 10 percent of the 180-200 individuals (18-20 individuals) that may be present in the project area would not likely jeopardize the continued existence of the Moapa dace. Reasonable and Prudent Measures were identified and implemented to minimize take of the species.

Effects of the Action

Moapa Dace

The Moapa dace will be directly affected by the proposed groundwater withdrawals since those actions are likely to affect the spring flows upon which the dace depends. The signatories of the MOA are proposing to cumulatively pump 16,100 afy of groundwater from the White River Groundwater Flow System at the MX-5, RW-2, Coyote Springs Wells #1 and #2, and other wells in the Coyote Spring Valley Basin (Basin 210) and from a well-field located in the southwestern third of the Moapa Reservation in the California Wash Basin (Basin 218). The purposes of these water withdrawals are: 1) part of a Nevada State Engineer Order (Order 1169) to test the carbonate systems response to groundwater withdrawals and continued use for residential and commercial purposes (9,000 afy); 2) municipal uses for a residential community in Coyote Spring Valley (4,600 afy); and 3) Tribal commercial developments (2,500 afy). For the purposes of this programmatic biological opinion, this consultation will only evaluate the effects of the MOA (cumulative groundwater withdrawal of 16,100 afy and their minimization measures) to the endangered Moapa dace. The specific actions associated with the uses of the groundwater will be evaluated in subsequent tiered biological opinions as applicants apply for Federal permits in the area.

The pump test to be undertaken pursuant to the MOA is expected to generate additional data to better understand and predict the effects of development of the carbonate-rock aquifer and to reduce or mitigate the effects of its development on the environment. In the interim, the Service recognizes that there are different interpretations regarding the causes of recent groundwater level declines in the flow system than that discussed in this programmatic biological opinion (Buqo 2004, Johnson and Mifflin 2003 and 2005). However, for the purposes of this programmatic biological opinion, the Service is utilizing the information and data presented above and analysis below. Groundwater extracted through a well, typically results in a decline in groundwater levels around the well. The technical term for this zone of lowered water levels is the "cone of depression" or the "drawdown cone." For a given aquifer, the drawdown cone increases in depth and extent with increasing time of pumping. Drawdown at any point and time is directly proportional to the pumping rate and inversely proportional to the transmissivity and storativity of the aquifer (Freeze and Cherry 1979). Aquifers of high transmissivity develop shallow drawdown cones of wide extent. As discussed earlier, the regional carbonate aquifer between Coyote Spring Valley and the Warm Springs Area is a zone of high transmissivity; the drawdown cone in this area is expected to be shallow and wide. This high transmissivity zone is one reason that the pumping at the Arrow Canyon Well is assumed to have caused the drawdown in well levels 12 miles upgradient in Coyote Spring Valley (Van Liew et al. 2004).

The hydraulic connectivity of the California Wash basin to the Warm Springs Area is uncertain although there are some indications that the area is connected with the Warm Springs Area based on monitoring well data that were shared with the Service in July 2004. These data from California Wash show a downward trend in groundwater levels. While there are various opinions as to cause of the decline, based on the very limited available data, the Service assumes that groundwater pumping in California Wash is likely to cause a decline in spring flow in the Warm Springs Area.

The proposed groundwater development in Coyote Spring Valley and California Wash is likely to cause further declines in groundwater levels in the carbonate aquifer within the area of the proposed pumping, and the Warm Springs Area. Our analysis predicts that a reduction in head at springs in the Warm Springs Area and decreases in spring discharge and groundwater seepage into streams is likely to occur, although the magnitude and timing of impacts from pumping in Coyote Spring Valley and California Wash are uncertain. Differences in boundary conditions relating to the areal extent of the aquifer, location of the pumping, transmissivity, and permeability, all influence the magnitude and timing of pumping impacts. Also, if the proposed pumping lowers carbonate water levels in the Warm Springs Area further, not all springs will be affected equally. The decrease in spring discharge will be proportional to the decrease in head elevation at each spring. Higher elevation springs have a lower head difference initially and are therefore more susceptible to decreases in groundwater levels. Therefore, the higher elevation springs will be affected proportionately more for a given decline in groundwater levels. This relationship has been observed in the Warm Springs Area as a result of a 2-ft drawdown in groundwater levels that has occurred since 1998 (Mayer 2004). The highest elevation springs, which are the most susceptible to impacts from groundwater pumping, occur on the Pedersen Unit of MVNWR, an area which also comprises some of the most important spawning habitat for dace in the system.

As discussed above, existing data indicates a decline in the regional carbonate aquifer levels locally and in the Coyote Spring Valley, and a decrease in spring discharge in the warm Springs Area from the current groundwater pumping of the Arrow Canyon Well (Mayer 2004). In addition, existing data has suggested that the same pumping has led to a decrease in carbonate aquifer levels in the California Wash Area as well. The average pumping rate at the Arrow Canyon Well for the last five years has been 3.3 cfs or 2,400 afy. The proposed action includes pumping of an additional 22.2 cfs or 16,100 afy from the same regional carbonate aquifer, which is almost seven times the existing withdrawal rate. Much of the pumping (13,600 afy) will be located along the same flow path that supplies the Warm Springs Area and is within the low-gradient, high-transmissivity zone that connects the Coyote Spring Valley and Warm Springs Area. The remainder of the pumping (2,500 afy) will be located downgradient in California Wash which has uncertain hydrologic connection to Warm Springs Area.

Under the terms of the MOA, if flows reach 2.7 cfs at the Warm Springs West gage, the pumping from Coyote Spring Valley will be reduced to 724 afy and the pumping from California Wash will be reduced to 1,250 afy. This 724 afy will replace the flows (1 cfs) that MVWD once used from the Jones Spring (on the MVNWR's Apcar Unit) to meet their water demands, which would be utilized for the Moapa dace on the MVNWR per the MOA. The 1,250 afy will be available for use by the Tribe. The following assumptions are used relative to groundwater pumping if the 2.7 cfs "Average Flow Level" as identified in the MOA is reached:

- The Arrow Canyon Well will be turned back on and will resume pumping at the current rate of 2,400 afy to meet MVWD's existing municipal water demands;
- 724 afy will be pumped from MX-5 and RW-2 wells in the Coyote Spring Valley by SNWA to replace MVWD's municipal commitment from the Jones Spring;
- No additional pumping in Coyote Spring Valley will occur; and
- Pumping in the California Wash is assumed to be limited to 1,250 afy of the existing permitted water rights held by the Tribe.

The exact magnitude and timing of the impacts from pumping groundwater from the carbonate aquifer in Coyote Spring Valley and California Wash are unknown at this time, as are the effects of reduced or cessation of groundwater pumping or whether there will be some equilibration of the aquifer to the proposed pumping. Two approaches were used to bracket the range of potential impacts to groundwater levels and spring discharge at the Warm Springs West gage: (1) an extrapolation of the current groundwater impacts and trends; and (2) numerical groundwater modeling.

Extrapolation of Current Groundwater Impacts and Trends

Using this approach, the groundwater system is assumed to respond proportionally to increased pumping; that is, increasing the pumping rate by some factor will increase the rate of decline in groundwater levels by a similar factor. The assumption is that because of the high transmissivity of the carbonate aquifer in this area, the decline in groundwater levels will be relatively small, but widespread. The location of pumping within these three basins doesn't matter under these assumptions. Thus, the decline in groundwater levels would be similar in magnitude and timing to the decline in the Warm Springs Area for pumping at the Arrow Canyon Well; at MX-5, RW-2, or other wells in Coyote Spring Valley; or for wells in California Wash. This assumption is simplified and may tend to overestimate the effects because of different boundary conditions in Coyote Spring Valley and California Wash, and because the pumping in Coyote Spring Valley and California Wash is further from the Warm Springs Area than the Arrow Canyon well. Therefore, this represents a worst-case scenario that can be used to bracket the lower end of the possible range of effects.

Under the above assumption, increasing the total pumping from the system sevenfold, from 2,400 afy to 16,100 afy, will increase the rate of water level decline in carbonate levels approximately sevenfold, from the current rate of 0.38 ft/yr to 2.55 ft/yr. The rate of decline of the spring discharge from the Pedersen Unit of the MVNWR, as measured at the Warm Springs West gage, would increase proportionately as well, from 0.08 to approximately 0.6 cfs/yr, using the groundwater spring discharge relationships described in Mayer (2004). Initial projections based on these extrapolated rates suggest that the flow at Warm Springs West gage will decline during the two-year pump test. A decrease of 1.2 cfs (two years multiplied by 0.6 cfs/yr) is predicted. However, under the terms of the MOA, as flows are reduced below 3.0 cfs at Warm Springs West, the pumping at Arrow Canyon Well will be stopped and the pumping from Coyote Spring Valley and California Wash will be reduced. While the response of the aquifer to a reduction or cessation of pumping is not known and has not been tested, it is assumed that reducing and ceasing the pumping will slow the decline in water levels. Furthermore, it is not likely that the entire 16,100 afy of groundwater will be withdrawn during the two-year pump test. CSI has proposed a five year incremental approach to utilizing their full water right of 4,600 afy and the Tribe has not identified a use for all of its 2,500 afy of potential groundwater pumping in California Wash. For the purposes of identifying the lower bound of the range of impacts, this analysis will assume that the total volume of water will be pumped and that the Warm Springs West gage will reach 2.7 cfs upon or before completion of the two-year pump test. Using the head/spring discharge relationships described in Mayer (2004), the groundwater levels are estimated to be about 5 ft below 1998 levels at a flow of 2.7 cfs. At this point, pumping would be adjusted to the levels stipulated in the MOA.

Under the terms of the MOA, if the 2.7 cfs average flow level is reached at the Warm Springs West gage, then the pump test is ended even if this occurs before two years. Following the pump test, if the average flow level at Warm Springs West gage remains below 2.7cfs, the total volume of groundwater that could be pumped from the regional carbonate aquifer in Coyote Spring Valley, California Wash, and the Warm Springs Area is 2,400 afy from Arrow Canyon Well, 724 afy from the MX-5 well or other CSI wells or wells, and 1,250 afy from California Wash, or a total of 4,374 afy. However, it is not certain that this amount would be pumped. The 4,374 afy total volume represents about an 80 percent increase above the current pumping volume from the Arrow Canyon Well. Assuming a proportional response in groundwater levels and spring discharge (e.g., an increase of the pumping rate results in a proportional increase in the rate of decline), then groundwater levels are predicted to decline about 1.8 times the present rate, or 0.7 ft/yr. Likewise, the spring discharge at the Warm Springs West gage would decline by about 1.8 times the present rate, or 0.14 cfs/yr. Using this approach, groundwater levels are projected to be about 8.5 ft lower than 1998 groundwater levels five years after the completion of the pump test. Total spring discharge from the Pedersen Unit, as measured at the Warm Springs West gage, would be about 2.0. cfs five years after completion of the pump test, (approximately 50 percent of 1998 flows). This likely represents the worst-case or lower bound of the range of possible impacts. The system may not respond as predicted, the pumping may be less than assumed, or the system may equilibrate, resulting in less severe impacts to groundwater levels and spring discharge.

Numerical Groundwater Model

The Service, in cooperation with other Federal agencies, has developed a numerical groundwater model for the southern half of the White River Groundwater Flow System (GeoTrans 2001). Several elements of the model were recently modified, including updated pumping and water-level information and updated spring elevation and discharge data (GeoTrans 2003). The model was recalibrated based on the modifications. Predicted water levels in the Warm Springs Area are still approximately 10 ft too low, but drawdown matches to carbonate wells EH4 and EH-5B were improved for the period 1998 to 2001 (GeoTrans 2003). However, when the model output from January 2002 to January 2004, was compared against measured water levels in EH-4 and EH-5B for the same period, the model was under-predicting drawdown considerably. The observed decreases in groundwater levels from January 2002 to January 2004, in both of these carbonate monitoring wells are greater than the model predicted. The model appears to be predicting some kind of equilibration of the system that has not yet been observed in the field data. For this reason, the model output is believed to be an underestimate of the impact of pumping on groundwater levels and spring discharge in the Warm Springs Area. The model results should be viewed as a likely best-case or upper bound of the range of possible impacts.

The model was used to evaluate several pumping scenarios including a fivefold increase in total pumping in the system, to 12,400 afy (2,400 afy from Arrow Canyon Well and 10,000 afy from Coyote Spring Valley). This modeling was completed prior to the current MOA draft and does not include either the 4,600 afy of pumping by CSI or the 2,500 afy of pumping by the Tribe. The model predicted about 1 ft of drawdown in monitoring well EH4 and 1.5 ft of drawdown in monitoring well EH5-B after two years of pumping 10,000 afy in Coyote Spring Valley and 2,400 afy from Arrow Canyon Well pumping.

It is difficult to use the modeled drawdown to estimate spring discharge. A head loss of 1.0 to 1.5 ft is estimated to equate to a reduction of about 0.25 to 0.37 cfs in flow at the Warm Springs West gage (Mayer 2004). But the groundwater levels and spring discharge at the beginning of the pump test are not known. Pumping-related declines are expected to continue with the Arrow Canyon Well pumping until the pipeline is constructed and the pump test begins. However, groundwater levels have generally increased recently, likely in response to the extremely wet winter experienced by the region in 2005. This is expected to be a transient response but the timing and level of a return to equilibrium conditions is not known for certain. The pumping reductions identified in the MOA in response to decreases in the flow at Warm Springs West were not modeled either. So the validity and the applicability of the model results are difficult to ascertain. What can be noted is that the model predicts that there will be declines in groundwater levels with increased pumping, as opposed to no declines. This will affect spring discharge.

The potential effects on spring discharge at the Warm Springs West gage discussed above are applied below to predict potential effects to Moapa dace habitat.

Moapa Dace Habitat Loss Within the Pedersen Unit of the MVNWR

Hydraulic Geometry Modeling

The Hydraulic Geometry Modeling was only conducted for the Pedersen Unit because of the susceptibility of the higher elevation springs in this area to reductions in groundwater levels. The lower-elevation springs are not as susceptible to the decreases in groundwater level; therefore, these springs will not be as affected as those on the Pedersen Unit. The hydraulic model HEC-RAS was used to model the effect of reduced spring discharge on Moapa dace habitat on the MVNWR (Otis Bay 2003). The variation in width, depth, and velocity as a function of discharge is known as hydraulic geometry. Channel topographical survey data were collected at cross sections of the Pedersen Unit in order to estimate the changes in channel hydraulic geometry associated with declining spring discharge.

Representative cross-sections for pool and riffle habitats at two different locations on the Pedersen Unit were analyzed. The first pair of riffle/pool cross-sections was located just below the confluence of the outflows from the Pedersen and Pedersen East Spring complexes. The second pair of riffle/pool cross-sections was located below the outflows from the five major spring complexes on the Pedersen Unit. The latter site represents approximately the total spring discharge as measured at the Warm Springs West gage. The relationship between groundwater levels and spring discharge on the Pedersen Unit was used to estimate the reduced flow at both pairs of cross-sections given an incremental decline in groundwater levels (Mayer 2004). The HEC-RAS modeling results were then used to estimate the change in hydraulic geometry and dace habitat at each cross-section based on the flow reductions (Otis Bay 2003). It is important to understand that higher elevation springs will show a greater percent flow reduction for a given head loss. Therefore, an equal percentage reduction cannot be applied to both pairs of cross-sections; the upstream pair will have a higher percentage loss of flow for a given decline in groundwater levels. Table 4 presents the estimated head differential, estimated flows, percent flow reduction, and percent habitat reduction as a function of groundwater levels for the upstream site (Pedersen and Pedersen East Spring groups) and the downstream site (Warm Springs West) for 1998.

The results indicate that both spring discharge and dace habitat are reduced with declines in groundwater levels. Flows and habitat loss at both upstream and downstream sites are projected as a function of incremental declines in groundwater levels in Table 4. As described in the section entitled Extrapolation of Current Groundwater Impacts and Trends, if flows decrease to 2.7 cfs by the end of the pump test, then groundwater levels are predicted to be about 5 ft below 1998 levels. Using the results in Table 4, flow at the upstream site is projected to be roughly 40 percent less than 1998 conditions at this groundwater level. Habitat is projected to be about 43 percent less for riffle habitat and 25 percent less for pool habitat relative to 1998 conditions. Flow at the downstream site is projected to be 30 percent less than 1998 conditions. Habitat at the downstream site is projected to be about 22 percent less for riffle habitat and 16 percent less for pool habitat relative to 1998 conditions. These results likely represent a worst-case or lower bound of impacts as discussed above.

Five years after the pump test is completed, groundwater levels are predicted to be approximately 8.5 ft below 1998 levels, under the worst-case scenario. Flows are projected to be about 65 and 53 percent of 1998 levels at the upstream and downstream sites, respectively. At the upstream site, riffle and pool habitat are projected to be 60 percent and 40 percent less, respectively, relative to 1998 conditions. At the downstream site, riffle and pool habitat are projected to be about 40 percent and 30 percent less, respectively, relative to 1998 conditions. Again, these results likely represent a worst-case or lower bound of impacts as discussed above.

The primary effect to the Moapa dace of diminished flows within the spring channels will be a decrease in the hydraulic conditions that create the diversity of habitat. A decrease in velocity and depth within riffles would result in a decrease of invertebrate and phytoplankton (food) production. Drift stations in pools are maintained by the scouring effect of turbulent flow. Scour will decrease in pools as water velocity and depth at the upstream end of the pool decreases. Perhaps the most prominent impact that would occur, as a result of decreased discharge and subsequent depth, is the reduction of overall volume of water that will be available to the species within the channel. Scoppettone et al. (1992) demonstrated that Moapa dace size is scaled to water volume. Thus, larger water volumes provide the habitat necessary for increased food production and subsequently larger fish, therefore greater fecundity. Hence, more numerous, larger eggs provide a better opportunity for the long-term survival of the species.

As previously stated, decreasing flows in the headwater spring channels of the upper Muddy River were modeled and resulted in a decrease in the hydraulic parameters of width, depth, and velocity, for a loss of habitat available to the species. Additional factors that would influence channel and hydraulic characteristics within the stream channels following a decline in spring discharge include, but are not limited to, changes in sediment transportation rates, and the alteration of riffle and pool maintenance that is accomplished at the present rate of discharge in each spring channel. Additionally, vegetative encroachment and subsequent channel obstruction may also occur as the wetted cross sectional area of the channel decreases, and new surfaces become exposed for vegetation growth. Decreases in these parameters will likely have an adverse impact on the overall diversity and quantity of hydraulic habitat.

Table 4. Estimated Habitat Loss

Pedersen Unit - Upstream Site (Combined flow of Pedersen Spring and Pedersen East Spring Groups)				
Groundwater Level Reduction Since 1998 (ft)	Estimated Flow (cfs)	Estimated Percent Flow Reduction from 1998 Conditions	Estimated Percent Habitat Reduction in Riffles from 1998 Conditions	Estimated Percent Habitat Reduction in Pools from 1998 Conditions
0	1.47*			
2	1.23	16 percent	23 percent	9 percent
3	1.11	24 percent	33 percent	14 percent
4	0.99	33 percent	37 percent	20 percent
5	0.87	41 percent	43 percent	25 percent
6	0.75	49 percent	50 percent	31 percent
7	0.63	57 percent	55 percent	46 percent
8	0.57	62 percent	58 percent	39 percent
9	0.48	68 percent	63 percent	43 percent
Pedersen Unit - Downstream Site (Combined flow of the 5 major spring groups/upstream of Warm Springs West gage)				
Groundwater Level Reduction Since 1998 (ft)	Estimated Flow (cfs)	Estimated Percent Flow Reduction from 1998 Conditions	Estimated Percent Habitat Reduction in Riffles from 1998 Conditions	Estimated Percent Habitat Reduction in Pools from 1998 Conditions
1	4.03*			
2	3.51	13 percent	8 percent	6 percent
3	3.26	19 percent	13 percent	10 percent
4	3.02	25 percent	17 percent	13 percent
5	2.78	31 percent	22 percent	16 percent
6	2.50	38 percent	27 percent	20 percent
7	2.26	44 percent	32 percent	23 percent
8	2.03	51 percent	37 percent	27 percent
9	1.82	54 percent	42 percent	31 percent

* based on a back-calculated estimate of flows at this site, as described in text

Note: Highlighted row indicates the level at which groundwater pumping would be reduced to levels stipulated in the MOA.

Thermal Load Modeling

A Stream Segment Temperature Model (SSTEMP) was used to predict impacts of decreasing spring flows to the natural thermal load of the system (Brock 2004). A study area downstream of all the spring complexes was selected on the Pedersen Unit of the MNVWR that was approximately 220 meters (722 ft) long and appeared to have a minimal net accrual or loss of stream flows. The model was calibrated to the 220-meter-long segment and was based on inputs of meteorology, stream geometry, riparian shading, and hydrology. SSTEMP simulates downstream water temperature in a discrete homogenous segment of a flowing stream channel over a 24-hour day.

In all 16 scenarios the simulated result of the reductions in spring discharges was reduced water temperatures (Brock 2004); however, only 4 scenarios are presented herein (Table 5). The greatest impact of flow reduction to thermal load occurred during the winter (December) when air temperature is the coldest, relative to the temperature of the thermal spring channel. Since Moapa dace have a reproductive temperature threshold of 30° C (86° F) (Scoppettone et al. 1992) any area with cooler temperatures is not considered reproductive habitat. In the winter, a reduction in flow (3.6 cfs) by 10 percent (3.25 cfs), 20 percent (2.90 cfs), and 30 percent (2.50 cfs) brought about a respective decrease of 0.06° C, 0.14° C, and 0.25° C in the temperature of the spring channel at the end of the study segment (Brock 2004). These reductions of 10, 20, and 30 percent in spring flows would result in an upstream shift of the base thermal tail temperature by approximately 66 (20 meters), 131 (40 meters), and 197-ft (60 meters), respectively. Although under these scenarios the temperatures at the downstream reach of the study segment would remain above 30° C (86° F) and therefore within the reproductive temperature threshold, the model illustrates that reduced flows result in decreases in temperature and an upstream shift in the base thermal tail. Therefore, assuming that there is a minimal net accrual or loss of stream flows, the shift in base thermal tail in the downstream reach of the Pedersen Unit tributary (Refuge Stream off of MVNWR) would result in the loss of spawning habitat based on temperature.

Reductions in some of the headwater sources within the system will have downgradient repercussions to the Moapa dace. Since the springs on the MVNWR's Pedersen Unit are the highest in elevation of all the headwater sources, these springs would be the first to be affected by groundwater pumping. Reductions in the spring flows on the Pedersen Unit would cause the stream to cool more rapidly as it travels downstream resulting in a loss of thermal load, thereby decreasing the available downstream spawning habitat in the Refuge Stream.

Table 5. Estimated Thermal Loss with 4-Water Flow Scenarios on the Pedersen Unit of the MVNWR

Flow Scenario (cfs) (Warm Springs West gage)	3.60	3.25	2.90	2.50
Percent reduction	0.00	10.00	20.00	30.00
Distance from head of segment (meters)	Water Temperature (degrees C)			
0	31.20	31.20	31.20	31.20
10	31.17	31.16	31.16	31.16
20	31.14	31.13	31.12	31.12
30	31.11	31.10	31.09	31.07
40	31.08	31.06	31.05	31.03
50	31.05	31.03	31.01	30.99
60	31.02	30.99	30.98	30.95
70	30.99	30.96	30.94	30.91
80	30.95	30.93	30.90	30.86
90	30.92	30.89	30.87	30.82
100	30.89	30.86	30.83	30.78
110	30.86	30.82	30.79	30.74
120	30.83	30.79	30.75	30.70
130	30.80	30.76	30.72	30.65
140	30.77	30.72	30.68	30.61
150	30.74	30.69	30.64	30.57
160	30.71	30.65	30.61	30.53
170	30.68	30.62	30.57	30.49
180	30.64	30.59	30.53	30.44
190	30.61	30.55	30.50	30.40
200	30.58	30.52	30.46	30.36
210	30.55	30.48	30.42	30.32
220	30.52	30.45	30.38	30.28

Shading shows the loss of stream survey length with various scenarios of reduced spring flows.

Summary of Adverse Effects Caused by the Proposed Groundwater Pumping

As discussed in the Status of the Species section, there are 5.6 miles of available habitat for all life stages of Moapa dace (Figure 4, Table 3) within the Muddy Springs Area. Of the total amount, approximately 1.78 miles of stream are located above the gabion barrier that protects the stream reaches on the MVNWR and the Refuge Stream on private property from tilapia predation (Figure 4). The remaining 3.82 miles of habitat continues to be threatened by the presence of tilapia and has been relatively uninhabitable. The 2005 dace survey data reflect that 95 percent of the dace population is relegated to the 1.78 miles (32 percent) of habitat above the gabion (Table 3) due to the presence of predatory non-native tilapia. However, dace still exist, albeit in low numbers, in the upper Muddy River mainstem and north and south forks of the Muddy River.

The 5.6 miles of the springs, tributaries, and mainstem of the Muddy River are not utilized proportionately by all life stages of the species due to the different hydrologic conditions of the various stream segments and the specific life history needs of adult, juvenile, and larval fish. The appropriate hydrologic conditions including velocity, depth, and temperature are necessary to provide for adequate spawning conditions. These various habitat types have not been quantified throughout the entire 5.6 miles of occupied or potential habitat. However, for the purposes of our analysis we have focused on the MVNWR streams and stream reaches above the gabion and attempted to quantify the availability of spawning, rearing and adult habitat. It is generally known that most of the habitat on the mainstem Muddy River is adult and juvenile habitat, with some limited spawning occurring in the north and south forks, and historically in the Muddy Spring. We have estimated that of the 1.78 miles of available occupied habitat above the gabion, 1.15 miles or approximately 66 percent of the habitat is essential spawning and rearing habitats. This habitat includes the 0.35 miles on the Pedersen Unit, 0.16 miles on the Plummer Unit, 0.14 miles on the Apcar Unit, 0.30 miles in the lower Apcar Stream, and 0.20 miles in the Refuge Stream upstream of the Iverson Flume.

The Pedersen Unit of the MVNWR is one of the six spring complexes that the Moapa dace depends on for successful reproduction and is devoid of tilapia. It is also the highest spring in elevation, and therefore, most susceptible to groundwater level declines. The analysis presented above likely represents the worst-case scenario or lower bound of impacts and it is uncertain whether it is likely to occur. The analysis estimates that at 2.7 cfs there is a loss of 31 percent in flow on the Pedersen Unit from 1998 conditions. This loss in flow is estimated to reduce available riffle habitat by 22 percent and pool habitat by 16 percent within the Pedersen Unit only. In addition to the loss of habitat, decreased flows would also result in a loss of temperature that would extend downstream, thereby reducing the thermal load in the system and thus the amount of available habitat at the appropriate spawning temperature. This loss in flow and habitat could further impact Moapa dace by restricting its reproductive potential and make it more vulnerable to catastrophic events such as wildfire.

The seepage run study conducted in 2001 by USGS reported the cumulative flows of the Refuge Stream at its confluence with the Muddy River to be approximately 12.99 cfs. The Pedersen Unit contributed approximately 3.5 cfs or 27 percent of that flow (see Hydrologic setting discussion). Assuming a loss of .8 cfs (from 3.5 cfs to 2.7 cfs at the Warm Springs West gage) from the Pedersen Unit due to groundwater pumping proposed under the MOA, flows at the confluence would be reduced to 12.19 cfs for an overall reduction in flow by 6 percent. This reduction in flow assumes that flows in the lower elevation springs and subsurface seepage gains are not likely affected by the groundwater pumping. The Hydraulic Geometry Model indicated that habitat further upstream in the system would be affected greater than habitat lower in the system; however, given the existing information the extent of the affects of the groundwater pumping in these lower elevation springs and stream reaches is unknown at this time. Therefore, based on the seepage run (USGS 2001), we are assuming that spring discharge from the Plummer and Apcar units and the subsurface flows will continue to flow at a rate that would provide approximately 12 cfs above the gabion, thus providing spawning, juvenile, and adult habitat in those reaches.

Although the overall reduction in flow by 6 percent to the system above the gabion is relatively minor; it does not adequately reflect the importance of the Pedersen Unit to Moapa dace reproduction and recruitment throughout the system. The various units of the MVNWR and the tributaries downstream of the MVNWR are currently the primary areas that provide suitable spawning habitat due to the absence of predatory tilapia. Collectively, these reaches are extremely important to the survival and recovery of the species. Our analysis indicates that there would be a loss of 31 percent of the available spawning habitat currently on the Pedersen Unit due to the proposed groundwater pump test. However, it is also recognized that much of the available spawning habitat on the Plummer and Apcar Units, and the Refuge Stream would not be as affected by groundwater pumping since they are lower in elevation and would continue to provide adequate spawning habitat. The conservation measures described in the next section were identified as actions that would be implemented by the signatories to minimize the effects to the Moapa dace, including the loss of habitat on the Pedersen Unit and other reaches of the Refuge Stream. Such measures include the removal of non-native fishes, enhancing, and restoring habitat and restoring instream flows (Apcar Unit) to increase the amount of habitat available for use by all life stages of the species.

Conservation Measures Identified to Minimize Effects of the Proposed Action

The major threats to the continued existence of the Moapa dace are: (1) loss of suitable habitat caused by reduced spring discharge/water flows; (2) loss of suitable habitat and direct predation resulting from the presence of non-natives species such as tilapia; (3) degradation and loss of suitable habitat resulting from habitat modification and increased occurrence of fire facilitated by non-native vegetation invasion; and (4) a restricted distribution, which increases the species vulnerability to catastrophic and stochastic events. The signatories to the MOA are proposing conservation measures (Attachment A) to minimize these threats to the Moapa dace and its habitat. These conservation measures are generally grouped in two categories and will result in the following: (1) reduction in pumping and dedication of water (surface and ground); and (2) implementation of habitat restoration activities including removal of non-native fishes. Reduction of groundwater pumping, dedication of water, and implementation of restoration actions would result in providing improved long-term habitat for the Moapa dace, and would promote an increase in its population size and distribution. The overall expected outcome of these measures is an increase in the species distribution and abundance throughout the range of the species.

While some of the restoration activities are currently in the planning phase, the funding that is being provided pursuant to the MOA will ensure a more timely completion of those activities. It is anticipated that most of these conservation measures will be implemented before or during the construction phase of the infrastructure required to develop and transport the water identified in the MOA. It is also anticipated that the Moapa dace population will respond positively, increasing in its distribution and abundance above current conditions Therefore, the conservation benefit to the species would be realized prior to and would off-set the effect of groundwater development. The following is a description of each action and its benefit to the Moapa dace.

Guaranteed Groundwater Pumping Reductions (Threshold levels)

The groundwater pumping will be reduced to 724 afy in the Coyote Spring Valley and 1,250 in California Wash, should stream flows reach 2.7 cfs at the Warm Springs West gage. This conservation measure will result in a reduction in the rate of decline of water levels and spring discharge. The reduction in the rate of decline will depend on the effect of remaining groundwater pumping in the Coyote Spring Valley, California Wash, and the Warm Springs Area (2,400 afy at Arrow Canyon by MVWD). This conservation measure provides certainty that if our analysis is correct and groundwater pumping in fact lowers the groundwater level thereby decreasing spring flows, then pumping will be substantially reduced.

Dedication of the MVWD Jones Spring Water Right of 1.0 cfs

As stated earlier, the Jones (a.k.a. Apcar) Spring is lower in elevation than the Pederson Unit and is not anticipated to be affected by groundwater pumping to the magnitude that higher elevation springs would be. The Jones Spring Agreement (Attachment B) guarantees an additional 1.0 cfs of flow entering the Muddy River flow system via the Jones Spring system located on the Apcar Unit of the MVNWR (this is in addition to the .5 cfs that is currently flowing in this reach as long as 1.0 cfs is provided to MVWD by other sources). This increase in flow guaranteed under the Agreement will provide additional water to support important spawning habitat in the system that is not currently available to the Moapa dace for reproduction, nursery, forage or long-term survival. The additional flows would increase the habitat available to Moapa dace both on the Apcar Unit and the tributary downstream. It is anticipated that the dace will respond positively and there will be an increase in the population. The addition of the 1.0 cfs of warm water from the Jones Spring to the system would also provide additional spawning habitat downstream by increasing the thermal load in the system. The additional water flow will contribute a greater quantity of warm water to the system, thus lengthening the thermal tail and thereby extending the species spawning habitat (temperatures at and above 30° C). This could contribute to an increase in the population by increasing its reproduction and distribution potential within the Apcar system, both on and off the MVNWR. In the past, population numbers have reached

200 individuals on the Apcar Unit of the MVNWR (personal communication 2005, G. Scoppettone), whereas in 2005, only 6 individuals were enumerated. It is anticipated that with an increase in flows and implementation of habitat restoration, as described below, the Moapa dace population would respond positively. An expanded species distribution would provide a more secure population since the species would not be as vulnerable to catastrophic events.

Dedication of Portion of CSI Water Rights

As agreed to in the MOA, a conservation easement would be recorded dedicating 460 afy (an amount equal to 10 percent of CSI's water right in Coyote Spring Valley, which may be a portion of CSI's water rights in Coyote Spring Valley or water rights from an alternative source in lieu of water from Coyote Spring Valley), to the survival of the Moapa dace and its habitat. In addition, CSI agrees that it will dedicate water rights in an amount equal to 5 percent of the water rights above 4,600 afy that CSI may be authorized by the Nevada State Engineer to appropriate from the Coyote Spring Valley, or import into the Basin for use at its project. The actual water rights so dedicated to the survival and recovery of the Moapa dace might be from sources other than Coyote Spring Valley Basin. The specific method of these water rights contributions to the Muddy River system from CSI is unknown at this time. However, through the Recovery Implementation Program, described below, a determination will be made of the most effective method for utilizing such water rights for the benefit of the Moapa dace.

The transfer of certificated water rights by CSI from Coyote Spring Valley for the use in the recovery of Moapa dace and its habitat is a long term benefit to the species. The dedication of future water rights from basins outside of Coyote Spring Valley would be analyzed in a future tiered section 7 consultation and the resulting benefit to the species determined at that time.

Improve/Restore Moapa Dace Habitat on the Apcar Unit of the MVNWR

SNWA will provide $750,000 to implement this action. This area currently is not optimum habitat for Moapa dace reproduction, nursery, food forage, and shelter. The Apcar Unit is currently overgrown with non-native vegetation and requires stream restoration throughout the entire unit. Historically, this unit supported hundreds of Moapa dace, which now supports only six individuals (Table 3). The habitat on this parcel was neglected and became less than optimum prior to purchase by the Service. Given, the history, this Unit has the potential to support a much larger number of individuals. The proposed funding, in addition to the Service's funds, will be used to restore habitat conditions to an optimum level for the Moapa dace. With the improved habitat and additional flow guarantees discussed above, the Moapa dace will likely increase its distribution and population to levels prior to the invasion of tilapia.

Restore Moapa Dace Habitat Outside of the MVNWR Boundary

CSI has agreed to provide $50,000 annually for four years to be used for habitat restoration outside of the MVNWR boundary to promote recovery of the Moapa dace. This funding will be applied towards various on-going or proposed activities that would improve and secure habitat that is currently not being utilized due to degraded conditions (i.e. illegal diversions or non-native species presence). The funding will provide a mechanism to restore habitat to a level that would provide a higher quality habitat for the species. These habitat improvements would contribute to the long term survival of the species by increasing the food production potential, providing additional habitat types that would be available for the various life stages and providing an environment that is void of predatory non-native fishes. Implementation of these actions would occur on private property and is dependent upon landowner permission.

Eradicate Non-native Fishes in the Warm Springs Area

SNWA will provide $25,000 towards this effort. As discussed in the Status of the Species section of this biological opinion, the invasion of tilapia has had a devastating effect on the Moapa dace. Only the Refuge and lower Apcar streams and those springs and outflows located on the MVNWR are devoid of the non-native tilapia. Tilapia currently occur throughout the remaining 3.82 miles of Moapa dace habitat which is on privately-owned lands. Due to the presence of tilapia, only 5 percent (68 individuals, Figure 3) of the population occur in these reaches where tilapia are present. Currently, the property that includes the majority of habitat with tilapia is privately held; however, SNWA has an access agreement with the property owner. Removal of tilapia from the 3.82 miles of the upper Muddy River will result in a substantial increase in the Moapa dace population, and the potential for a return to previous population levels when there was over a thousand Moapa dace in this reach.

Construct Fish Barriers in the Muddy River

Funding has been secured through the Southern Nevada Public Lands Management Act by BLM and the Service to construct a set of fish barriers on the Muddy River to prevent the further migration of non-native fishes, especially tilapia. SNWA would provide an additional $50,000 to be used towards the construction of a smaller structure upstream in the Muddy River tributaries; although the land is privately owned, SNWA maintains an access agreement with the private landowner. Fish barriers are essential to the overall effort to remove the invasive tilapia from the system and result in successful eradication efforts in order to benefit the Moapa dace.

In addition, the Tribe will allow access for the construction of at least one fish barrier. The location of a fish barrier on Tribal lands would be beneficial in order to reduce the opportunity for upstream movement into Moapa dace habitat by non-native fishes.

Development of a Recovery Implementation Program (Recovery Program)

In order to effectuate the goals of the MOA, a Recovery Program will be established whereby recovery measures are identified, prioritized and funded in order to accomplish the protection and recovery of the Moapa dace, the operation and development of regional water facilities and the inclusion of necessary and interested third parties are outlined and implemented. The cooperation of other entities within the region that have an interest in the development and management of water and biological resources in the Muddy River system will be sought. This Recovery Program will become instrumental in future site-specific actions tiered to this biological opinion by allowing the Service to evaluate the development of regional water resources while providing for the protection and conservation of the Moapa dace. SNWA will provide $300,000 towards the development of this Recovery Program.

Development of an Ecological Model for the Moapa dace

The Muddy River Recovery Implementation Team has identified the need to obtain additional biological/ecological information to better understand the needs of the Moapa dace. A study to assess the species physiological and biological response to the changing environmental conditions will be conducted concurrently with groundwater pumping. This model may assist in making critical management decisions that could result in minimizing or avoiding long-term adverse affects to the Moapa dace. SNWA and the Service will each provide $125,000 for the development of this ecological model for the Moapa dace. While this conservation/minimization measure will not provide short-term protection for the Moapa dace, the information obtained from this model would assist in the long-term management and recovery efforts of the species.

Hydrologic Review Team

The signatories to the MOA have agreed to establish a Hydrologic Review Team (HRT) for the purpose of developing a coordinated regional monitoring effort of the groundwater pumping proposed under the MOA and to satisfy the State Engineer requirement for monitoring under the various orders. The objectives of the HRT are to establish technically sound analyses of impacts on Muddy River Springs and Muddy River flows resulting from regional groundwater pumping, and ensure accuracy and efficiency in data collection as required under the Regional Monitoring Plans. Another objective of the HRT is to collect sufficient information and to adjust, through consensus, pumping restrictions of the signatories to better reflect the extent to which the individual pumping action may be causing impacts to the Muddy River Springs and Muddy River flows. The monitoring of the springs and stream reaches within the Muddy Springs Area and River is a critical component of the MOA that would provide early detection of effects from the proposed groundwater pumping. The commitment of the signatories to develop a regional monitoring plan would assure that all pumping effects within the basins (Coyote Spring Valley, Muddy River Springs Area, and California Wash) are being monitored such that if the average flow threshold levels are reached as stipulated in the MOA, actions could be implemented to protect the Moapa dace.

Overall Summary of Effects of the Proposed Action with the Conservation Measures

As previously described, the proposed conservation measures would provide additional flows (1.0 cfs) from the Jones Spring on the Apcar Unit that would increase thermal habitat and the reproductive potential of the species in the Apcar (upper and lower) and Refuge streams. In addition to the increased flows, the proposed restoration activities would reduce the potential for fire and restore the overall spawning and rearing habitat sufficient to sustain several hundred Moapa dace on the Apcar Unit of the MVNWR.

The proposed action also provides funding for conservation actions outside the boundary of the MVNWR, which include the restoration of habitat in one or more tributaries including the Apcar

Stream, North and South Forks and Muddy Springs streams; the construction of fish barriers; and removal of non-native fishes (e.g., tilapia) throughout the species range. These conservation measures would provide more secure habitat should water flows decline from groundwater development activities in the future. The implementation of the conservation actions assured by the funding committed in the MOA will improve habitat throughout the range of the species and will reduce the species vulnerability to catastrophic events. The expansion of the species within its range and increase in its current population size will minimize or off-set the effects of decreased flows within the Pedersen Unit that are anticipated to occur from the proposed groundwater development.

It is assumed that the conservation actions identified above would be initiated upon signature of the MOA with most of them completed prior to the actual groundwater development pump test. During the construction of facilities (18-24 months), and the subsequent pump test, critical conservation measures, including barrier construction, non-native species removal, and habitat restoration will all be initiated, if not completed, during the construction period and before the pump test. In addition, the Recovery Program will also be developed during the construction period and in advance of the pump test. It is anticipated that with the commencement of the pump test, the Recovery Program would have identified and funded additional conservation measures above and beyond those described herein to further the conservation of the species. The signatories to the MOA and the participants in the Recovery Program will be identifying and funding future conservation actions such as land acquisition and monitoring of groundwater pumping which are key to the success of the Recovery Program.

The conservation measures identified in this programmatic biological opinion and future actions developed as part of the Recovery Program would be implemented within the range of the Moapa dace in an effort to increase the population and expand its range from current levels and distribution in order to assure the continued existence of the species.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Future demand for groundwater will continue to threaten spring flows and surface water important for aquatic species such as the Moapa dace. In the Muddy Springs Area, MVWD's existing permit would allow more groundwater to be pumped from the Arrow Canyon Well in the future. The maximum permitted pumping rate at the Arrow Canyon Well is 7,200 afy or 10.0 cfs, as compared with the annual average of 2,400 afy or 3.3 cfs pumped currently. Depending on the outcome of the five-year study mandated in the State Engineer Order 1169 and subsequent ruling by the State Engineer, additional groundwater could potentially be pumped in Coyote Spring Valley. While the MOA includes the removal of 13,600 afy in Coyote Spring Valley, the total volume of permitted water rights in Coyote Spring Valley is 16,100 afy. Any of the remaining permitted water rights (2,500 afy) could be developed. The maximum volume that could be removed from the Coyote Spring/Warm Springs Area under existing permits is 23,300 afy. This represents almost a tenfold increase from current withdrawals in the system.

In addition to the existing permitted water rights, there are pending applications for a far greater volume of groundwater above and beyond the permitted amount in the Coyote Spring/Warm Springs Area as well as in Kane Springs Valley, both areas that are part of the White River Flow System, and where pumping could potentially affect groundwater levels and spring discharge in the Warm Springs Area. The State Engineer, through Order 1169, held all of these pending applications in abeyance until the completion of the two-year pump test and evaluated results. Given the possible impacts already associated with the current pumping at Arrow Canyon and the proposed pumping in Coyote Spring Valley and California Wash, further groundwater development in the area would have very serious impacts on the water resources and biota in the Warm Springs Area. However, if these applications are granted, it is uncertain which would require a future Federal action in order to develop the rights upon approval.

Any future groundwater pumping by private parties above that analyzed in this biological opinion that is determined to affect or take Moapa dace could only legally occur under the authorization of a Habitat Conservation Plan section 10(a)(1)(B) and its associated incidental take permit issued by the Service. The Service's action of issuing such a permit would involve an internal consultation to affirm that section 7(a)(2) of the Act would not be violated.

Conclusion

After reviewing the current status of and environmental baseline for the Moapa dace, the effects of the proposed MOA, and the cumulative effects, it is the Service's biological opinion that the Service becoming a signatory to the MOA, as proposed and analyzed, is not likely to jeopardize the continued existence of the endangered Moapa dace. Our finding is based on implementation of the MOA and its associated conservation actions that would be implemented within the range of the Moapa dace prior to the initiation of groundwater pumping, in an effort to increase the population and expand its range from current levels and distribution in order to assure the continued existence of the species, and that the groundwater pumping proposed in the MOA and the associated effects of such pumping occur as analyzed in this biological opinion.

The Service's signing of the MOA does not waive any of the statutory duties or authorities of the Service or the United States, nor relieve the participants of the MOA from complying with any Federal laws, including but not limited to, National Environmental Policy Act, Endangered Species Act, National Wildlife Refuge System Improvement Act of 1997, and Federal Land Policy and Management Act of 1976, and any and all rules and regulations thereunder. In addition, future site-specific actions for pumping groundwater identified in the MOA would require additional section 7 consultation that would be tiered to this programmatic biological opinion.

Incidental Take Statement

No exemption from Section 9 of the Act is issued through this biological opinion. The cumulative withdrawal of 16,100 afy from Coyote Spring Valley and California Wash is likely to adversely affect listed species. However, the proposed action of signing the MOA, in and of itself, does not result in the pumping of any groundwater, and is one of many steps in the planning process for proposed groundwater withdrawal projects identified in the MOA and in the action area. Therefore, the Service has taken a tiered-programmatic approach in an attempt to analyzing the effects of the action. This programmatic biological opinion does not authorize any incidental take for programmatic impacts associated with the activities included in the MOA. The likelihood of incidental take, and the identification of reasonable and prudent measures and terms and conditions to minimize such take, is anticipated to be addressed in future project-specific consultations (second stage). These tiered-consultations would incorporate conservation measures outlined in the MOA at the specific project level. Any incidental take and measures to reduce such take cannot be effectively identified at the programmatic level of the proposed action because of the number of impending actions by different entities and its regional scope. Incidental take and reasonable and prudent measures may be identified adequately through subsequent actions subject to section 7 consultation, and tiered to this programmatic biological opinion. Future site-specific projects that are in the Description of the Proposed Action section and identified in the MOA would require additional section 7 consultation (second stage) that would be tiered to this programmatic biological opinion.

Reporting Requirements

Upon locating a dead or injured endangered or threatened species, initial notification must be made to the Service's Division of Law Enforcement in Las Vegas, Nevada, at (702) 388-6380. Care should be taken in handling sick or injured fauna in order to ensure effective treatment and care. In addition, care should be given in the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured species or preservation of biological materials from a dead animal or fish, the finder has the responsibility to carry out instructions provided by the Service's Division of Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed. All deaths, injuries, and illnesses of Moapa dace, whether associated with project activities or not must be reported to the Service.

The following actions should be taken for injured or dead dace if directed by the Service's Division of Law Enforcement:

Dead Moapa dace suitable for preparation as museum specimens shall be frozen immediately and provided to the Southern Nevada Field Office in Las Vegas, Nevada.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act, by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. In any future consultation related to this programmatic biological opinion, the following conservation recommendations should be considered.

1. Acquire Moapa dace habitat and/or water rights that are currently privately owned and secure the management of these rights for the long-term benefit of the Moapa dace in perpetuity;
2. Restore and enhance additional Moapa dace habitat. This includes funding restoration actions at Baldwin Spring, Cardy Lamb, and/or Muddy Spring or other areas identified by the Muddy River Recovery Implementation Team;
3. Provide funding for pre- and post-construction monitoring of water quality and quantity throughout the range of the species;
4. Establish an access agreement with Warm Springs Ranch private property owners for the continued implementation of recovery actions; and
5. Develop and implement a Moapa dace habitat restoration plan.

Reinitiation Notice

This concludes formal consultation on the actions outlined in your request. As required by 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over an action has been retained (or is authorized by law) and if: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this opinion; (4) a new species is listed or critical habitat designated that may be affected by the action; or (5) there is failure to meet any of the measures or stipulations in the MOA. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If we can be of any further assistance, please contact me at (775) 861-6300 or Cynthia Martinez in the Southern Nevada Field Office at (702) 515-5230.

Robert D. Williams

Attachments

cc:
President, Coyote Springs Investment, LLC, Sparks, Nevada
Deputy General Manager, Engineering Operations, Southern Nevada Water Authority, Las Vegas, Nevada
General Manager, Moapa Valley Water District, Moapa, Nevada
Chairman, Moapa Band of Paiutes, Moapa, Nevada
Chief, Planning Division, Department of Army, Los Angeles District Corps of Engineers Office, Los Angeles, California
Project Leader, Desert National Wildlife Refuge Complex, Las Vegas, Nevada
Refuge Manager, Moapa Valley National Wildlife Refuge, Moapa Valley, Nevada
Assistant Regional Director, Ecological Services, Fish & Wildlife Service, Portland, Oregon (electronic copy only)

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Final 1/27/06

MEMORANDUM OF AGREEMENT

This Memorandum of Agreement ("MOA") is entered into this ______ day of __________, 2006, (the "Effective Date") by and between the Southern Nevada Water Authority ("SNWA"), a political subdivision of the State of Nevada, the United States Fish and Wildlife Service ("FWS"), Coyote Springs Investment LLC, a Nevada limited liability company ("CSI"), the Moapa Band of Paiutes ("Tribe") and the Moapa Valley Water District ("MVWD"), a political subdivision of the State of Nevada. For convenience, SNWA, FWS, CSI, the Tribe and MVWD are at times herein referred to individually as "Party" and collectively as "Parties."

RECITALS

A. In Order No. 1169 the Nevada State Engineer held in abeyance applications for new groundwater rights in certain groundwater basins, and mandated that SNWA, MVWD and other parties conduct a regional groundwater study including the pumping of at least 50 percent of the permitted water rights within the Coyote Spring Valley hydrographic basin for a period of at least two consecutive years ("Pump Test").[1] SNWA currently owns 9,000 afy of water rights with points of diversion within the Coyote Spring Valley hydrographic basin under Permit Nos. 49414, 49660 through 49662 and 49978 through 49987 ("SNWA Water Rights").

B. To facilitate the Pump Test and delivery of SNWA Water Rights, SNWA applied to the Bureau of Land Management ("BLM") for a right-of-way across Federal land for the

[1] Currently there are 16,100 acre-feet per year ("afy") of permitted groundwater rights in the Coyote Spring Valley hydrologic basin, including the SNWA Water Rights and CSI Water Rights, defined in Recitals A and D herein, and Order No. 1169 requires the continuous diversion of 8,050 acre-feet per year during the Pump Test.

construction and operation of a pipeline to deliver groundwater from the Coyote Spring hydrographic basin to either the Muddy River System or to MVWD's service system.

C. In Ruling No. 5115 the Nevada State Engineer granted Application No. 54075, filed by the Las Vegas Valley Water District ("District") on October 17, 1989, for a total duty of 2,500 afy with a diversion rate of 5.0 cubic feet per second ("cfs") within the California Wash hydrographic basin ("Permit No. 54075"). By separate agreement, the District has transferred ownership of Permit No. 54075 to the Tribe. The Tribe plans to divert and utilize groundwater under Permit No. 54075.

D. CSI is a private landowner in the Coyote Spring Valley hydrographic basin and owns 4,600 afy of water rights with points of diversion within the basin under Permit Nos. 70429 and 70430 ("CSI Water Rights").

E. MVWD is responsible for supplying the municipal water needs of Upper and Lower Moapa Valley located in Clark County, Nevada. MVWD owns several water rights within Upper Moapa Valley including surface rights to spring flows in the Muddy Springs area and groundwater rights (Permit Nos. 52520, 55450 and 58269) with points of diversion at the Arrow Canyon well and a right to 1.0 cfs of spring flow from the Jones Spring (Certificate No. 10060) ("Jones Water Right").

F. FWS is a Federal agency within the Department of the Interior. FWS' responsibilities include implementation of the Endangered Species Act and administration of the National Wildlife Refuge System. FWS holds a Nevada State water right certificate for a flow rate of not less than 3.5 cfs as measured at the Warm Springs West flume (Permit No. 56668; Certificate No. 15097 issued subject to the terms of Permit No. 56668) for the maintenance of habitat of the Moapa dace and other wildlife purposes ("FWS Water Right").

G. The Moapa dace (*Moapa coriacea*) is an endemic fish that inhabits the upper Muddy River and tributary thermal spring systems within the Warm Springs area in Clark County, Nevada. The Moapa dace was federally listed as endangered on March 11, 1967 (32 FR 4001). FWS manages the Moapa Valley National Wildlife Refuge established in 1979 as part of the National Wildlife Refuge System.

H. Based upon its evaluation of available data, FWS postulates that current groundwater pumping by MVWD at the Arrow Canyon well is causing a decline in spring flows in the Warm Springs area and that future withdrawals of groundwater by SNWA and/or CSI in the Coyote Spring Valley hydrographic basin and/or by the Tribe in the California Wash hydrographic basin may cause spring flows to decline. SNWA, CSI, and MVWD do not believe the available hydrologic data supports these conclusions.

I. The Tribe believes that regional groundwater monitoring and scientifically valid, but conservative, regional computer modeling have demonstrated and will continue to demonstrate that on-Reservation groundwater pumping authorized under Permit No. 54075 will not cause appreciable declines in spring flows in the Warm Springs area.

J. Prior to the issuance of Order No. 1169, a stipulation was executed on July 19, 2001, between Federal agencies and SNWA regarding protests filed by Federal agencies against SNWA applications for new groundwater rights in the Coyote Spring Valley hydrographic basin. The Federal agencies and SNWA agreed to implement a monitoring study that was clarified in a Monitoring, Management, and Mitigation Plan for Existing and Future Permitted Groundwater Development in Coyote Spring Valley ("3M Plan") attached to and incorporated in that stipulation.

K. As part of the approval of the MVWD water rights at the Arrow Canyon well, the Nevada State Engineer required a monitoring plan. A monitoring plan has been developed and agreed upon jointly by MVWD, Nevada Power Company, FWS and National Park Service, with the most recent amendments to that plan being submitted to the State Engineer in September 2002 ("MVWD Monitoring Plan").

L. State Engineer Ruling No. 5115 requires that "[a] monitoring program approved by the State Engineer prior to the diversion of any water [under Permit No. 54075] be prepared in conjunction with the [Pump Test] ordered in State Engineer's Order No. 1169."[2] The Tribe will develop, in coordination with the other Parties, a monitoring plan approved by the Nevada State Engineer prior to applying any groundwater to beneficial use under Permit No. 54075 ("Tribal Monitoring Plan").

M. On March 11, 2005, the Nevada State Engineer approved a document entitled "Southern Nevada Water Authority's Monitoring Plan for Groundwater Applications and Permits in Coyote Spring Valley, Hidden and Garnet Valleys, and California Wash Hydrographic Basin, Clark and Lincoln Counties March, 2005" ("SNWA Monitoring Plan"). The State Engineer directed that the SNWA Monitoring Plan serve as the monitoring plan required by the State Engineer for the SNWA Water Rights and the CSI Water Rights.

N. The Parties share a common interest in the conservation and recovery of the Moapa dace and its habitat. Each Party also has an interest in the protection, use and enjoyment of its water rights and entitlements. To serve these interests, the Parties have identified certain conservation measures with the objective of making measurable progress toward the conservation and recovery of the Moapa dace, and have agreed to coordinate the monitoring, management and mitigation measures included and to be included in the 3M Plan, MVWD

Monitoring Plan, SNWA Monitoring Plan, and Tribal Monitoring Plan (collectively the "Regional Monitoring Plans").

O. The Parties desire that FWS engage in consultation and prepare a formal biological opinion under the provisions of Section 7 of the Endangered Species Act and its implementing regulations prior to execution of this MOA. The consultation shall consider the effects on the Moapa dace from the pumping of 9,000 afy under the SNWA Water Rights, 4,600 afy under the CSI Water Rights, and 2,500 afy by the Tribe under Permit No. 54075, together with the implementation of the monitoring, management and conservation measures identified herein.

NOW, THEREFORE, in consideration of the mutual promises and covenants contained herein, the Parties do agree as follows:

I. Conservation Measures. The Parties agree that in order to make measurable progress toward protection and recovery of the Moapa dace and its habitat concurrent with the operation and development of water projects for human use, it is beneficial to the public interest to establish the following conservation measures:

1. Establishment of Recovery Implementation Program. To effectuate the goals of this MOA the Parties agree to establish a Recovery Implementation Program ("RIP") whereby measures necessary to accomplish the protection and recovery of the Moapa dace, the operation and development of regional water facilities, and the inclusion of necessary and interested third parties are outlined and implemented. To facilitate establishment of the RIP:

a. The Parties agree to cooperate in the selection of qualified personnel and/or contractors to oversee the development of the RIP.

[2] Ruling No. 5115 at 40.

b. SNWA agrees to provide funding in the amount of $300,000.00 to develop the RIP. SNWA agrees to execute such documents as may be necessary to ensure that these funds are available to meet the needs of those persons designated by the Parties with the task of establishing the RIP.

c. The Parties agree to seek the cooperation of other parties within the region that have an interest in the development and management of water and biological resources. To achieve the goals of the RIP, the Parties agree to employ principles of adaptive management to further the current understanding of the habitat and aquatic needs of the Moapa dace. The Parties will jointly negotiate the participation of any other party in the RIP.

2. <u>Dedication of the Jones Water Right</u>. The Parties agree that the recovery of the Moapa dace will be enhanced by the guarantee of additional in-stream flows in areas of historical Moapa dace habitat. One such area is the Apcar Stream down gradient of the Jones Spring. The Parties concur that the dedication of the Jones Water Right to the purpose of providing in-stream flows will be beneficial to the Moapa dace population in this area and further the recovery of the species. To effectuate the dedication of the Jones Water Right to the provision of in-stream flows in the Apcar Stream, the Parties agree as follows:

a. MVWD agrees to record an agreement between MVWD and FWS ("Jones Springs Agreement") on the Jones Water Right with both the Nevada State Engineer and the Clark County, Nevada, Recorder's Office that requires the entire 1.0 cfs flow right under the Jones Water Right to be dedicated to the purpose of maintaining in-stream flows in the Apcar Stream subject to the provisions of paragraph 7 of the Jones Springs Agreement. MVWD shall retain ownership of the Jones Water Right. The Jones Springs Agreement shall be executed and recorded promptly upon execution of this MOA. A draft of the Jones Springs Agreement is attached hereto as "Exhibit A." The Jones Springs Agreement ultimately recorded pursuant to this paragraph shall be in substantially the same form as Exhibit A.

b. SNWA agrees to transfer to MVWD, at no cost, a portion of Permit No. 49414 equal to 724 afy. This transferred portion of Permit No. 49414 shall remain of equal priority date with that portion of Permit No. 49414 retained by SNWA.

c. MVWD agrees to transfer to SNWA, at no cost, the first 724 afy, or any portion thereof if less than 724 afy is permitted, of any permit(s) issued by the Nevada State Engineer pursuant to Application Nos. 54055 through 54059, inclusive.

d. The Parties agree to cooperate with MVWD in the filing and processing of any change applications, including applications to change the manner or place of use that are filed by MVWD with the Nevada State Engineer in order to effectuate the Jones Springs Agreement referenced in paragraph I(2)(a) above.

e. Subject to paragraph 2 of the Jones Springs Agreement, the Parties agree to cooperatively determine the best methods to ensure that the Jones Water Right accomplishes the purpose stated in paragraph I(2)(a) above, as related to the recovery of the Moapa dace and other endemic species, including the possibility of restoration of the springhead at Jones Spring.

3. Dedication of Portion of CSI Water Rights.

a. CSI agrees to record a conservation easement with both the Nevada State Engineer and the Clark County, Nevada, Recorders Office dedicating 460 afy of the CSI Water Rights to the survival and recovery of the Moapa dace and its habitat. The use of this water would be at the discretion of the FWS in consultation with the CSI and the Parties.

b. In addition, CSI agrees to dedicate 5 percent of all water rights above 4,600 afy that CSI may in the future be entitled to withdraw from Coyote Spring Valley hydrographic basin or any water rights that CSI imports into and uses in the basin. The Parties, consistent with the RIP, will determine the most effective method for utilizing such water rights. CSI shall execute and record such documentation, including conservation easements, deeds, change applications and reports of conveyance, as may be necessary to effectuate the dedication of that portion of such water rights that is subject to the terms and conditions contained herein.

4. Habitat Restoration and Recovery Measures. To restore the habitat necessary for the Moapa dace and take other steps to protect and recover the species, the Parties agree as follows:

a. SNWA agrees to provide funding in the amount of $750,000.00 for the restoration of Moapa dace habitat under the direction of FWS on the Apcar Unit of the Moapa National Wildlife Refuge or otherwise. All tasks funded under this paragraph I(4)(a) shall be agreed to in advance by SNWA and FWS in consultation with the other Parties. SNWA agrees to execute such documents as may be necessary in order to ensure that these funds are available for such habitat restoration.

b. FWS agrees to provide funding in the amount of $125,000.00 and SNWA agrees to provide funding in the amount of $125,000.00 to develop an ecological model designed to investigate the effects of habitat change on the ecology of the Moapa dace. FWS and SNWA shall, in consultation with the other Parties, agree upon the selection of a contractor to prepare the model.

c. SNWA agrees to provide funding in the amount of $50,000.00 to construct fish barriers to help eliminate the predacious Tilapia from areas of Moapa dace habitat. FWS and SNWA shall, in consultation with the other Parties, agree upon the selection of a contractor to perform such work.

d. SNWA agrees to provide funding in the amount of $25,000.00 to implement programs related to the eradication of non-native fish species, including predacious Tilapia, in the Warm Springs area. FWS and SNWA shall, in consultation with the other Parties, agree upon the selection of a contractor to perform such work.

e. CSI agrees to provide FWS with funding on an annual basis in the amount of $50,000.00 for a period of four years following the execution of this MOA for the restoration of Moapa dace habitat outside the boundaries of the Moapa National Wildlife Refuge along the Apcar Stream, or at such other locations as CSI and FWS, in consultation with the other Parties, agree.

f. The Tribe agrees to use a reasonable portion of the existing on-Reservation greenhouse facility for a reasonable period of years, for the purpose of cultivating native vegetation for use in RIP-approved habitat restoration. The Parties understand that the greenhouse is in a state of major disrepair and that such use of the greenhouse will require repairs and a water supply. FWS will work with the Tribe to obtain the funding necessary to provide for such repairs and to identify and secure a water supply adequate for such use. The Tribe reserves the right to pursue, and if feasible implement, separate arrangements for the improvement and commercial operation of the remainder of the greenhouse.

g. The Tribe agrees to provide access to the Tribe's Reservation for the construction and subsequent maintenance of at least one fish barrier, at a mutually agreeable location, to help eliminate the predacious Tilapia from Moapa dace habitat. FWS will work with the Tribe to obtain the funding necessary for construction, maintenance and repair of such barrier(s).

h. The Tribe agrees to provide the services of the Tribe's Environmental Director for in-kind staff services and participation in the RIP.

5. Protection of In-Stream Flows. The Parties recognize that maintenance of minimum in-stream flows in the Warm Springs area is essential for the protection and recovery of the Moapa dace. Although those flows are unknown at this time, the Parties agree as follows:

a. For purposes of this paragraph I(5), all "Average Flow Levels" specified herein shall be determined by flow measurements at the Warm Springs West flume. Average Flow Levels will be determined to have reached a particular level within a range specified in paragraphs I(5)(b) through (g) ("Trigger Range"): (1) if the daily average flow for each of 45 consecutive days decreases to an amount within the Trigger Range, or if the 90 day average flow over any 90 consecutive day period decreases to an amount within the Trigger Range; or (2) if the daily average flow for each of 90 consecutive days increases to an amount within the Trigger Range, or if the 135 day average flow over any 135 consecutive day period increases to an amount within the Trigger Range. If determined to be necessary by the Parties, the Parties will cooperate in removing phreatophytes, repairing or replacing the flume or taking any other steps to ensure the accuracy of flume measurements. Any adjustment in the rating curve for the Warm Springs West flume shall result in a pro-rata adjustment of the Trigger Ranges. The remaining provisions of this paragraph I(5) apply both during and after the Pump Test, except for paragraphs I(5)(c)(i) and (ii) which apply only during the Pump Test.

b. If the Average Flow Level decreases to an amount within the Trigger Range of 3.2 cfs or less, the Parties agree to meet as soon as practicably possible to discuss and interpret all available data and plan for mitigation measures in the event flows continue to decline.

c. If the Average Flow Level decreases to an amount within the Trigger Range of 3.0 cfs or less, the following Parties agree to take the following further actions:

i. During the pendency of the Pump Test, MVWD agrees to immediately cease pumping from the Arrow Canyon well; and

ii. While the Arrow Canyon Well is shut down pursuant to paragraph I(5)(c)(i) above, SNWA agrees to supply MVWD with all necessary municipal and domestic water supplies from the MX-5 and RW-2 wells or other sources available to the SNWA. Except for the express provision contained in paragraph I(2)(b) of this MOA, nothing in this MOA will obligate SNWA to supply MVWD with any water from SNWA's existing permits in the Coyote Spring Valley following the completion of the Pump Test; and

iii. SNWA and CSI agree to take necessary actions to prepare to geographically redistribute their groundwater pumping in the Coyote Spring Valley should flow levels continue to decline; and

d. If the Average Flow Level is within the Trigger Range of 3.0 cfs or less but greater than 2.9 cfs, the pumping of SNWA from the MX-5, RW-2, CS-1 and CS-2 wells in combination with the pumping of CSI from the MX-5, RW-2, CS-1 and CS-2 and CSI's pumping from other wells within the Coyote Springs Valley ("CSV") shall be restricted to 8,050 afy.

e. If the Average Flow Level is within the Trigger Range of 2.9 cfs or less but greater than 2.8 cfs, the pumping of SNWA from the MX-5, RW-2, CS-1 and CS-2 wells in combination with the pumping of CSI from the MX-5, RW-2, CS-1 and CS-2 and CSI's pumping from other wells in CSV shall be restricted to 6,000 afy, and the pumping of the Tribe under Permit No. 54075 shall be restricted to 2,000 afy.

f. If the Average Flow Level is within the Trigger Range of 2.8 cfs or less but greater than 2.7 cfs, the pumping of SNWA from the MX-5, RW-2, CS-1 and CS-2 wells in combination with the pumping of CSI from the MX-5, RW-2, CS-1 and CS-2 and CSI's pumping from other wells in CSV shall be restricted to 4,000 afy, and the pumping of the Tribe under Permit No. 54075 shall be restricted to 1,700 afy.

g. If the Average Flow Level is within the Trigger Range of 2.7 cfs or less, the pumping of SNWA from the MX-5, RW-2, CS-1 and CS-2 wells in combination with the pumping of CSI from the MX-5, RW-2, CS-1 and CS-2 and CSI's pumping from other wells in CSV shall be restricted to 724 afy, and the pumping of the Tribe under Permit No. 54075 shall be restricted to 1,250 afy.

h. The Parties agree that any pumping of the 460 afy of CSI Water Rights dedicated to the survival and recovery of the Moapa dace pursuant to paragraph 3.a. of this MOA shall be at the discretion of FWS and not counted against the pumping restrictions set forth in paragraphs 5(d) through 5(g) of this MOA.

6. Hydrologic Review Team. Upon execution of this MOA, the Parties shall establish a Hydrologic Review Team ("HRT") which shall be constituted and function as follows:

a. Membership. Each Party shall appoint two representatives ("HRT Representatives"), including at least one with substantial formal training and experience in hydrogeology ("Technical Representative"). Except as otherwise provided herein, the two HRT Representatives shall together have one vote on HRT matters. By consensus, the HRT

Representatives may offer voting or non-voting HRT membership to others who provide regional monitoring records and analyses to the HRT.

b. Objectives. The objectives of the HRT shall be: (1) to identify opportunities and make recommendations for the purpose of coordinating and ensuring accuracy, consistency and efficiency in monitoring, other data collection, and analytical activities performed under the Regional Monitoring Plans; (2) to establish technically sound analyses of impacts on Muddy River Springs and Muddy River flows resulting from regional groundwater pumping; (3) to assess based thereon whether the pumping restrictions, but not the Trigger Ranges, under paragraphs I(5)(c) through (g) above (or any successors thereto) should be adjusted to better reflect the extent to which regional groundwater pumping by the respective Parties causes, or is likely to cause, impacts on Muddy River Springs and Muddy River flows; and (4) to adopt by consensus appropriate adjustments to such restrictions, if warranted.

c. Regional Baseline Pumping Analysis. Within one year following the execution of this MOA, the Technical Representatives shall prepare a written analysis of regional groundwater pumping data and impacts ("Regional Baseline Pumping Analysis"). In preparing such baseline analysis, the HRT shall consider all relevant and available data and analytical materials. The Regional Baseline Pumping Analysis shall set forth all shared and dissenting analyses, interpretations and recommendations of the participating Technical Representatives. All modeling analyses contained therein shall be based on modeling codes in the public domain and data files that are available for comprehensive review by all Technical Representatives.

d. Annual Determination. Based on the Regional Baseline Pumping Analysis, and no later than one year after preparation of that analysis and annually thereafter, the HRT shall endeavor to determine by consensus ("Annual Determination") whether the groundwater pumping restrictions, but not the Trigger Ranges, under paragraphs I(5)(c) through (g) above (or any successors thereto) should remain in place, or whether and how any of such restrictions should be adjusted ("Pumping Restriction Adjustments") to better reflect the extent to which regional groundwater pumping by the respective Parties causes, or is likely to cause, impacts on Muddy River Springs and Muddy River flows. However, no Pumping Restriction Adjustments will be made within the first five years following the Effective Date of this MOA. All Annual Determinations (including any Pumping Restriction Adjustments adopted by HRT consensus) shall be final and binding on all Parties, except that by consensus the HRT may at any time modify or vacate any Annual Determination.

e. Annual Determination Reports. Each Annual Determination shall be set forth and explained in a written Annual Determination Report which includes as appendices the Regional Baseline Pumping Analysis, all previously submitted Annual Technical Representative's Reports, and any other data or analytical materials considered by the HRT. If the Annual Determination is not made due to lack of consensus or any other reason, the positions thereon of the HRT Representatives shall be set forth and explained in the Annual Determination Report. Furthermore, if the HRT fails to adopt Pumping Restriction Adjustments recommended in a timely submitted Annual Technical Representative's Report, the Annual Determination Report shall briefly explain why such recommendation was not adopted.

f. Annual Technical Representative's Reports. Within six months after the close of the year of this MOA and annually thereafter, based on the best available scientific data and information, any Technical Representative may submit to all other HRT Representatives a written report ("Annual Technical Representative's Report") containing both: (1) a well-documented professional analysis of monitored regional pumping and pumping impacts; and (2) recommendations, if any, for Pumping Restriction Adjustments.

g. Provision for Peer Review. If the HRT Representatives are unable to reach consensus on an Annual Determination, the Parties shall refer the matter to a qualified panel of third party reviewers ("Panel") consisting of three scientists unaffiliated with any Party and having substantial formal training and experience in hydrogeology. If the Parties cannot agree by consensus on the make-up of the Panel, one member of the Panel shall be designated by each of the following from its own ranks: U.S. Geologic Survey, Desert Research Institute and a private firm with the requisite expertise designated by a majority of the Parties ("Appointing Entities"), provided that the Parties by consensus may designate different similarly qualified Appointing Entities. If any Appointing Entity for any reason is unable or refuses to designate a member of the Panel, the Parties by majority vote shall designate a qualified replacement Appointing Entity. The purpose of the referral to the Panel will be to obtain peer review of the then-current Annual Determination Report, the data upon which it is based, all previously submitted Annual Technical Representative's Reports, and any other relevant and available data and analytical materials. The Panel will be asked to make its recommendation based on the foregoing information concerning the appropriate content of the Annual Determination. All Parties shall have a fair and reasonable opportunity to present factual and analytical submissions in person and/or in writing to the Panel. The Parties contemplate that a determination of the Panel on the Annual Determination will constitute the best available scientific information concerning the impacts on Muddy River Springs and Muddy River flows resulting from regional groundwater pumping, and the appropriateness of any proposed Pumping Restriction Adjustments. The cost of the Panel shall be borne equally by the Parties.

7. Acquisition of Additional Land and Water Rights. As a potential conservation measure, the Parties agree to work cooperatively to identify both land and water rights that, if acquired and dedicated to the recovery of the Moapa dace, will assist in making measurable progress towards the recovery of the Moapa dace. SNWA agrees to make a good faith effort to acquire land and water rights identified by the Parties. The Parties expressly agree that the reasonableness of any terms and conditions for any acquisition of land or water rights by SNWA shall be determined by SNWA at SNWA's sole discretion, and that SNWA shall have no obligation to acquire any land or water rights upon terms and conditions that SNWA finds unreasonable. When such land or water rights are acquired by SNWA, SNWA will cooperate with FWS in establishing restrictions upon the use of such lands and water rights consistent with existing laws so as to effectuate the conservation of these resources and the recovery of the Moapa dace.

8. Operational Coordination Among FWS, SNWA, CSI and MVWD. Consistent with the terms of this MOA and to accomplish the goals of protecting and recovering the Moapa dace, and accommodating the operation of municipal water supply infrastructure, FWS, SNWA, CSI and MVWD agree to examine all reasonable water operational scenarios and agree to implement feasible scenarios that will minimize impacts to the Moapa dace and its habitat, including, but not limited to the provision of water to MVWD from the Coyote Spring Valley hydrographic basin during the Pump Test or other water supplies available to SNWA and MVWD. MVWD shall have the right during the Pump Test to use the Arrow Canyon Well only in the event and to the extent SNWA is unable to supply MVWD with "all necessary municipal and domestic water supplies" pursuant to the provisions of paragraph I(5)(c)(ii) of this MOA. Except for the express provision contained in paragraph I(2)(b) of this MOA, nothing in this

MOA will obligate SNWA to supply MVWD with any water from SNWA's existing permits in the Coyote Spring Valley hydrographic basin following the completion of the Pump Test.

SNWA and CSI agree, following the execution of this MOA, and in coordination with FWS, to cooperate in locating and drilling one or more production wells in the northern part of the Coyote Spring Valley hydrographic basin. The details of this cooperative effort shall be contained in a separate agreement between CSI and SNWA.

9. Adaptive Management Measures. The Parties agree to carry out additional conservation measures that will need to be taken to protect and recover the Moapa dace following the initiation of the RIP and as more data becomes available both as to the biology of the Moapa dace and regional hydrology. Thus, the Parties agree to cooperate in carrying out the following measures as may be appropriate:

a. Funding, preparation and implementation of biological and hydrological studies and activities supporting the recovery of the Moapa Dace; and

b. Establish a regional monitoring and management plan that will include science-based management and mitigation measures for RIP participants; and

c. Assessing the feasibility of augmenting and/or restoring in-stream flows and establishing those flows as deemed feasible.

d. Continue to re-evaluate necessary measures to protect and recover the Moapa dace.

II. Current Access Agreement. SNWA currently has an access agreement with the owners of the Warm Springs Ranch, which contains Moapa dace habitat, in order to conduct biological surveys of the Moapa dace. SNWA agrees to use its best efforts to seek to amend this access agreement so that each of the Parties to this MOA will have similar rights of access to the Warm Springs Ranch.

III. Modification of MVWD Monitoring Plan. Pursuant to the MVWD Monitoring Plan, submitted to the Nevada State Engineer in September 2002, FWS and MVWD agreed to a monitoring plan for development of MVWD's water rights at the Arrow Canyon well that contained certain management and mitigation measures that would be taken if flows at the Warm Springs West flume reached 3.17 cfs and 2.94 cfs respectively. This monitoring plan was recognized by the Nevada State Engineer in Ruling No. 5161. The Parties agree that, in order to effectuate a uniform regional monitoring and management plan, that the flow level restrictions and mitigation measures contained in this MOA shall replace the flow and water level restrictions and mitigation measures contained in the MVWD Monitoring Plan.

IV. No Assertion of FWS State Water Right. Provided that the other Parties to this MOA are in full compliance with the terms of this MOA, FWS expressly agrees not to assert a claim of injury to the FWS Water Right against either MVWD for pumping at the Arrow Canyon Well, against the Tribe for pumping within the California Wash hydrographic basin or against SNWA or CSI for any pumping in the Coyote Spring Valley for any diminution in flows at the Warm Springs West flume above 2.7 cfs. This provision shall in no way prejudice the FWS' ability and/or right to assert any and all rights inherent to the FWS Water Right for any diminution in flows at the Warm Springs West flume below 2.7 cfs.

V. No Waiver of Statutory Duties or Legal Rights. This MOA does not waive any of the authorities or duties of the FWS or the United States, nor does it relieve SNWA, CSI, the Tribe and MVWD from complying with any Federal laws, including but not limited to, the National Environmental Policy Act, Endangered Species Act, National Wildlife Refuge System

Improvement Act of 1997, and Federal Land Policy and Management Act of 1976, and any and all rules and regulations thereunder. Except as provided in paragraph IV of this MOA, it is the expressed intention of the Parties that FWS and the United States are not waiving any legal rights or obligations of any kind, including obligations to consult or re-consult under the Endangered Species Act, by entering into this MOA. Further, this agreement is entered as a good faith resolution of certain issues and is not intended to waive any party's rights in a subsequent legal proceeding regarding those issues. In addition, except for the restrictions set forth in paragraphs I(5)(e) through (g) above, this MOA does not in any respect waive, limit, or diminish any rights or claims of the Tribe to any federally-reserved or State surface or groundwater rights.

VI. No Modification of Previous Agreements. The Parties recognize that CSI, SNWA and MVWD have previously entered into multiple agreements concerning the sale, purchase and settlement of water rights within the Coyote Spring Basin including a certain *Agreement For Settlement Of All Claims To Groundwater In The Coyote Spring Basin* entered into between MVWD, CSI, SNWA and the District on March 7, 2002, and a certain *Agreement For Option, Purchase and Sale of Water Rights, Real Property and Easements* entered into between SNWA and CSI on April 16, 1998. Nothing contained herein is intended to abrogate or modify in any manner any of the provisions contained in any of those agreements except as expressly provided in paragraphs I(2)(b) and I(2)(c) of this MOA.

VII. Miscellaneous Provisions.

1. Notices. If notice is required to be sent by the Parties, the addresses are as follows:

If to FWS:

Supervisor
Nevada Fish and Wildlife Office
Fish and Wildlife Service
1340 Financial Blvd., #234
Reno, Nevada 89502

If to SNWA:

General Manager
Southern Nevada Water Authority
1001 South Valley View Boulevard
Las Vegas, Nevada 89153

If to MVWD:

General Manager
Moapa Valley Water District
Post Office Box 257
Logandale, Nevada 89021

If to CSI:

Carl Savely, General Counsel
Wingfield Nevada Group
6600 North Wingfield Parkway
Sparks, Nevada 89436

If to the Tribe:

Chairperson, Moapa Band of Paiute Indians
Post Office Box 340
Moapa, Nevada 89025
Fax: 702-865-2875

With copies to:

Steven H. Chestnut
Richard M. Berely
Ziontz, Chestnut, Varnell, Berely & Slonim
2101 Fourth Avenue, Suite 1230
Seattle, Washington 98121
Fax: 206-448-0962

2. Choice of Law. This MOA shall be governed in accordance with applicable Federal laws, and the laws of the State of Nevada to the extent not inconsistent with Federal law.

3. Funding. Any commitment of funding by FWS, MVWD or SNWA under this MOA is subject to appropriations by the respective governing bodies of those entities.

4. Amendment. This MOA may be amended in writing by mutual agreement of the Parties.

5. Integration. This MOA sets forth the entire agreement of the Parties and supercedes all prior discussions, negotiations, understandings or agreements with respect to the subject matter hereof. No alteration or variation of this MOA shall be valid or binding unless contained in an amendment in accordance with paragraph VI(4) of this MOA.

6. Binding Effect, Withdrawal From MOA. The terms and conditions of this MOA shall be binding upon and inure to the benefit of the Parties hereto and their respective personal representatives, successors, transferees and assigns. However, the Parties expressly agree that should the execution of this MOA, or any consultation held or biological opinion issued under Section 7 of the Endangered Species Act which is premised thereon, be challenged in a court of competent jurisdiction and be found in violation of the Endangered Species Act or any other law, any of the Parties may withdraw from the MOA upon thirty days written notice to the other Parties. Upon such withdrawal, the withdrawing Party shall have no further obligation to perform any commitment contained in this MOA.

7. Effective Date, Counterparts. This MOA will become effective as between the Parties upon all Parties signing this MOA. The Parties may execute this MOA in two or more counterparts, which shall, in the aggregate, be signed by all Parties; each counterpart shall be deemed an original as against any party who has signed it.

8. Additional Parties. Other entities may become Parties to this MOA by mutual written assent of the Parties.

9. Headings. The underlined paragraph headings used in this MOA are for the convenience of the Parties only, and shall not be deemed to be of substantive force in interpreting the MOA.

10. No Third Party Beneficiaries. This MOA does not create any right or benefit, substantive or procedural, enforceable by any third parties against the Parties or against any other person or entity. The terms of this MOA are not enforceable by any person or entity other than a Party.

IN WITNESS WHEREOF, the Parties have executed this Memorandum of Agreement on the ______ day of __________________, 2006.

MOAPA VALLEY WATER DISTRICT

____
By: Ivan Cooper
Title: Chairman

FISH AND WILDLIFE SERVICE

____
By: Steve Thompson
Title: Manager, California/Nevada Operations Office

SOUTHERN NEVADA WATER AUTHORITY

____
By: Amanda M. Cyphers
Title: Chair

COYOTE SPRINGS INVESTMENT, LLC

By: Robert R. Derck
Title: General Manager

MOAPA BAND OF PAIUTES:

By: Dalton Tom,
Title: Chairman

ATTACHMENT B

When Recorded Mail To:

____

____

____

Jones Springs Agreement

This Jones Springs Agreement ("Agreement") is entered into for the purposes described herein this ____ day of ____________________, 2004 by between Moapa Valley Water District ("MVWD") and the U.S. Fish and Wildlife Service ("FWS").

RECITALS

1. MVWD was created in 1983 by an act of the Nevada Legislature and is the municipal water purveyor in upper and lower Moapa Valleys and serves the communities of Moapa, Glendale, Logandale and Overton, and the surrounding areas, located in Clark County, Nevada.

2. One of MVWD's water sources is a spring known locally as Pipeline Jones Spring ("Jones Spring"). MVWD holds Certificate No.10060 issued by the Nevada State Engineer to divert 1 c.f.s. of flow of water from Jones Spring for municipal purposes. The waters of Jones Spring and Certificate No.10060 constitute a portion of the Muddy River Decreed water rights.

3. Water from Jones Spring, as well as numerous other springs, form small streams which make up the Muddy River ("Tributary Streams").

4. There lives in the upper reaches of the Muddy River and in the Tributary Streams, a small minnow known as the Moapa Dace ("Dace"). The Dace was listed as endangered in 1967 under the Endangered Species Preservation Act of 1966 and continues to be so listed and protected under the Endangered Species Act of 1973 as amended.

5. MVWD needs the quantity of water represented by Certificate No.10060 to serve its municipal customers.

6. As an inducement to MVWD to grant this Agreement, the Southern Nevada Water Authority ("SNWA") has agreed to furnish to MVWD a quantity of water equal to MVWD's rights under Certificate No.10060 from SNWA's wells and water rights in Coyote Spring Valley ("Coyote Spring Water"). The terms and conditions of SNWA's obligations are set forth in a separate agreement.

7. MVWD desires to help in the recovery and preservation of the Dace.

NOW THEREFORE, for the purpose of aiding in the recovery and preservation of the Dace, MVWD and FWS hereby agree as follows:

ATTACHMENT B

1. Effective on MVWD receiving Coyote Spring Water from Southern Nevada Water Authority, the water from Jones Spring shall not be diverted for municipal purposes pursuant to Certificate No.10060, but shall be allowed to flow down the Tributary Streams to the Muddy River.

2. MVWD may, as soon as Coyote Spring Water is available and being furnished to MVWD for municipal purposes disconnect their existing pumping facilities from the Jones Spring diversion pipe and or otherwise affix appurtenances that will allow the entire flow of water from Jones Spring to flow down to the Muddy River, thus increasing the flow of water in one or more Tributary Streams.

3. MVWD shall file any necessary change applications with the State Engineer as may be required by Nevada Law as a result of this Agreement.

4. The Agreement herein granted shall be for a non-consumptive use of water, with no warranty as to quality or quantity of flow.

5. MVWD reserves the right, in the future when it can use surface water, to change the point of diversion for its consumptive use right to the water from Jones Spring to a point on the Muddy River, below the Glendale gauging station. Any such change shall not affect the flow of water at Jones Spring for in-stream purposes.

6. This Agreement will be recorded with the Clark County Recorder and filed with the Nevada State Engineer.

7. So long as MVWD is in full compliance with the terms and conditions applicable to MVWD in the Memorandum of Agreement dated November ____, 2004 and attached hereto as Attachment 1, then, if for any reason, whether natural, man-made or otherwise, any portion of the Coyote Spring Water becomes unavailable or unusable to meet MVWD's municipal needs previously supplied by Certificate 10060 (Jones Spring), then MVWD shall have the right to utilize a like portion of water from Jones Spring to replace such portion of the Coyote Spring Water that remains unavailable to MVWD for so long as the Coyote Spring Water remains unavailable.

IN WITNESS WHEREOF, MVWD and FWS have executed this Agreement the date first above written.

MOAPA VALLEY WATER DISTRICT

By: ______________________________
Ivan Cooper, Chairman of the Board

U.S. FISH AND WILDLIFE SERVICE

By: ______________________________
Steve Thompson, Manager
California/Nevada Operations Office

Attachment C

WATER SUPPLY AGREEMENT

WATER SUPPLY AGREEMENT ("Agreement") effective ______________, 2006, among the Moapa Band of Paiutes ("Tribe"), Las Vegas Valley Water District ("LVVWD"), Southern Nevada Water Authority ("SNWA"), Muddy Valley Irrigation Company ("MVIC") and Moapa Valley Water District ("MVWD") referred to herein individually as a "Party" and collectively as the "Parties."

Recitals

A. The Tribe, LVVWD, SNWA, MVIC, MVWD and the State of Nevada ("State") have negotiated a proposed written Water Settlement Agreement and remain committed to consummating the Water Settlement Agreement substantially in its current form (the "WSA"). The proposed WSA is attached hereto as Exhibit A. The United States must approve and join in the WSA.

B. SNWA, Coyote Springs Investment LLC, MVWD and the United States Fish and Wildlife Service ("FWS") have negotiated a proposed Memorandum of Agreement (the "MOA") regarding certain planned groundwater pumping in the Coyote Spring Hydrographic Basin and measures to mitigate potential impacts of such pumping on the endangered Moapa dace. The proposed MOA is attached hereto as Exhibit B. This Agreement has been negotiated by the Parties to obtain and facilitate the Tribe's joinder in the MOA.

C. The Tribe will execute the MOA upon execution of this Agreement by all Parties and the satisfaction of certain conditions precedent which are explicitly set forth below. Among other features, subject to conditions set forth below, under this Agreement the Tribe will receive the State groundwater permit and State groundwater applications which are to be provided to the Tribe by LVVWD under the WSA, and a lease of Muddy River water rights which in certain respects will be functionally similar to the federally-reserved Muddy River rights to be secured to the Tribe under the WSA.

Terms and Conditions

The Parties hereto agree as follows:

1. **Commitment to WSA.** The Tribe, LVVWD, SNWA, MVIC and MVWD:

   a. shall make best efforts to secure Federal approval and execution of the WSA substantially in its current form;

b. on the securing of such Federal approval, shall execute the WSA; and

c. shall make best efforts to secure mutually satisfactory written confirmation from the State that it continues to support consummation of the WSA.

2. Commitment by Tribe to Execute the MOA. The Tribe shall execute the MOA upon satisfaction of the following conditions precedent:

a. **Condition Precedent No. 1.** Provision by the State of Nevada of the written confirmation described in ¶ 1.c above.

b. **Conditions Precedent Nos. 2 - 5.** The conditions precedent set forth in ¶¶ 3.e and 4.c below.

3. Provision of Groundwater Rights.

a. **2500 acre-feet per year (afy) Permit and Related LVVWD Groundwater Applications.** In 1989, LVVWD filed two State applications to appropriate groundwater from the California Wash Hydrographic Basin (Applications 54075 and 54076) totaling

20 cubic feet per second (cfs) and 14,480 afy. On April 18, 2002, the Nevada State Engineer issued Ruling 5115, which granted LVVWD a permit to withdraw 2,500 afy of groundwater under Application 54075 ("2500 afy Permit"), denied the balance of Application 54075, and held Application 54076 in abeyance pending completion of the groundwater study ordered in State Engineer's Order 1169.

b. **Tribal Appeal.** The Tribe has appealed Ruling 5115 to the Eighth Judicial District Court of Clark County, Nevada (the "Appeal"), and LVVWD has intervened as a defendant in the Appeal (which remains pending). Through the Appeal, the Tribe is seeking an increase in the quantity of groundwater currently permitted to be withdrawn under Application 54075 and restoration of the balance of Application 54075 pending further action by the State Engineer. This Agreement does not resolve the Tribe's claims in the Appeal. Application 54076 and any balance of Application 54075 which may be restored as a result of the Appeal are referred to herein as the "LVVWD Groundwater Applications" and individually as an "LVVWD Groundwater Application."

c. **Pending LVVWD Change Applications.** In July 2003, in contemplation of the consummation of the WSA, LVVWD in consultation with the Tribe filed three applications ("LVVWD Change Applications") with the State Engineer to change the point of diversion under the 2500 afy Permit to locations on the Moapa Indian Reservation ("Reservation"). The LVVWD Change Applications were not protested and are pending for approval before the State Engineer. LVVWD shall make best efforts to secure the promptest possible State Engineer approval of the LVVWD Change Applications.

d. **Transfer of 2500 afy Permit and LVVWD Groundwater Applications to Tribe.** Contemporaneous with the Tribe's execution of the MOA, LVVWD shall transfer to the Tribe, at no charge and free and clear of liens and encumbrances, full ownership of the 2500 afy Permit and the LVVWD Groundwater Applications, subject to reversion under ¶ 7 below. If the Tribe subsequently establishes a federally-reserved right to groundwater appurtenant to any portion of the Reservation, an equal quantity of State groundwater rights acquired by the Tribe under the 2500 afy Permit and/or LVVWD Groundwater Applications shall be deemed relinquished by the Tribe.

e. **Conditions Precedent Nos. 2 and 3.** The following are two additional conditions precedent that must be satisfied to trigger the Tribe's obligation to execute the MOA:

i. approval of the LVVWD Change Applications by the State Engineer on no conditions unacceptable to the Tribe; and

ii. transfer of the 2500 afy Permit and LVVWD Groundwater Applications to the Tribe as provided in ¶ 3.d above.

f. **LVVWD Disclaimers.** LVVWD makes no representation or warranty to the Tribe as to the quantity or quality of water that: (i) will ultimately be permitted by the State Engineer in response to the LVVWD Groundwater Applications; or (ii) can ultimately be developed under the 2500 afy Permit.

g. **Issuance of Further Rights to Tribe under LVVWD Groundwater Applications.** All Parties hereto shall withdraw their pending protests, if any, against the LVVWD Groundwater Applications. No Party shall oppose (or assist others to oppose), in any administrative or judicial proceeding or otherwise, any issuance to the Tribe by the State Engineer of additional groundwater rights under an LVVWD

Groundwater Application in the form of a permit or certificate ("Further Permit or Certificate"), except that LVVWD may contend in the Appeal or any remand therefrom that, as provided in State Engineer Ruling 5115, the 2500 afy Permit should be for 2500 afy with a maximum diversion of 5 cfs and that Application 54076 should be held in abeyance pending completion of the groundwater study ordered in State Engineer Order 1169. No Party hereto may oppose (or assist others to oppose) in any administrative or judicial proceeding or otherwise, any Tribal application to have an LVVWD Groundwater Application acted on by the State Engineer on a piecemeal basis over time, by dividing the LVVWD Groundwater Application into increments or by comparable means.[1]

h. **Change Applications.** No Party hereto may oppose (or assist others to oppose) in any administrative or judicial proceeding or otherwise, the granting by the State Engineer of the LVVWD Change Applications, or any Tribal application under a LVVWD Groundwater Application, the 2500 afy Permit, or a Further Permit or Certificate: (i) to change any point of groundwater diversion thereunder to any location on or off the Reservation within the

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[1] The Tribe acknowledges that the State has previously advised that the State Engineer does not decide groundwater applications on a piecemeal basis.

California Wash Hydrographic Basin, which lies at least one mile (in the case of a carbonate aquifer well) and two miles (in the case of an alluvial well) from Muddy Springs and the Muddy River; or (ii) to change any use or place of use of groundwater thereunder to facilitate the beneficial use thereof on or off the Reservation.

i. **Tribal Acquisition of Additional Groundwater Rights.** Subject to the protest rights of any other Party hereto (except for those relinquished under ¶¶ 3.g and h above), nothing in this Agreement shall prejudice the Tribe's right to apply under State law to the State Engineer either (i) for further groundwater rights appurtenant to the Reservation, or (ii) for transfer to the Reservation of State law-based groundwater rights having points of diversion or places of use located off the Reservation.

4. Provision of Surface Water Rights.

a. **Muddy River.** The Muddy River flows through the Reservation and the Tribe claims an unadjudicated 1873 federally-reserved water right in the river. MVIC holds legal title to certain State surface water rights in the Muddy River ("MVIC Surface Water Rights") awarded in a Judgment and Decree dated March 12, 1920, ("Muddy River Decree"), in *Muddy Valley Irrigation Co., et al. v. Moapa and Salt Lake Produce Co., et al.*, in Nevada's Tenth Judicial District Court (now Nevada's Eighth Judicial District Court). The Muddy River Decree also purported to award the Tribe surface water rights in the Muddy River appurtenant to the Reservation of 1.242 cfs (Apr. - Sept.) and 0.87 cfs (Oct. - Mar.). However it is the position of the Tribe that the Court did not have jurisdiction to adjudicate the Tribe's water rights, and the Tribe shall not claim or use the awarded right while the Surface Water Lease provided under ¶ 4.b below is in force. Each shareholder in MVIC holds, pursuant to its shares, a beneficial interest in MVIC Surface Water Rights, and collectively all MVIC shareholders hold all beneficial interests in all MVIC Surface Water Rights.

b. **Lease of MVIC Surface Water Rights.** Contemporaneous with the Tribe's execution of the MOA, MVIC and the Tribe shall enter into the lease attached hereto as Exhibit C ("Surface Water Lease"). The Surface Water Lease provides a rent-free 99-year lease of a portion of MVIC Surface Water Rights to the Tribe, sufficient to provide the Tribe with the right to divert at the existing Muddy River diversion points on the Reservation and beneficially use on the Reservation 11.5 cfs (Apr. - Sept.) and 10.5 cfs (Oct. - Mar.), subject to a maximum consumptive use limit of 3700 afy. The Surface Water Lease further provides that if the Tribe wishes, at any time during the term thereof, to change the manner of use or place of beneficial use within the Reservation of MVIC Surface Water Rights covered by the Surface Water Lease, MVIC shall fully cooperate with the Tribe in the preparation, filing and pursuit of State Engineer approval of a change application necessary to effect such change. No other Party hereto shall oppose (or assist others to oppose) the granting of such change application. The Surface Water Lease further provides that the Tribe's right to divert and use water pursuant to the Surface Water Lease is, as a matter of contract, functionally senior to the rights of all shareholders in MVIC to divert and use water pursuant to the MVIC Surface Water Rights. The Surface Water Lease is renewable on the same terms and conditions at the end of the 99-year term for an additional 99 years at the Tribe's option, provided that the Surface Water Lease is terminable as provided in ¶ 8 below. In exercising its rights under the Surface Water Lease, the Tribe shall otherwise have all rights and privileges, and be bound by all substantive and procedural laws, principles and rules, applicable to owners of MVIC Surface Water Rights, including without limitation with respect to beneficial use and changes in the point of diversion, place of use and manner of use. The foregoing notwithstanding, the Surface Water Lease does not expressly or impliedly have the effect, in law or in equity, of making the Tribe a shareholder in MVIC for any purpose.

c. **Conditions Precedent Nos. 4 and 5.** The following are two additional conditions precedent that must be satisfied to trigger the Tribe's obligation to execute the MOA:

i. execution and delivery to the Tribe of the Surface Water Lease; and

ii. State Engineer approval of the two filed change applications authorizing the Tribe to divert at the existing points of diversion for the Reservation and beneficially use on the Reservation the MVIC Surface Water Rights covered by the Surface Water Lease.

5. **Provision of Mitigation Surface Water Rights.**

a. **Pumping Limits.** As reflected in paragraph I(5)(e) - (g) of the attached MOA, the Tribe is prepared to agree therein that on-Reservation pumping under the 2500 afy Permit shall be reduced to specified amounts ("Pumping Limits") if flow levels at the Warm Springs West flume decline to specified levels. The Tribe believes, however, that monitoring data and sound hydrogeologic analysis show and will continue to show that on-Reservation pumping under the 2500 afy Permit will not appreciably impact flows as measured at the Warm Springs West flume. Nevertheless, the Tribe is prepared to agree to the Pumping Limits principally because:

i. as provided in paragraph I(6) of the MOA, the validity of the Pumping Limits will be regularly reconsidered by the Hydrologic Review Team on the basis of monitoring data and hydrogeologic analysis, and, as appropriate, adjusted; and

ii. MVWD has agreed to mitigate the effects of the Pumping Limits as provided in ¶ 5.b below.

b. **Mitigation Surface Water Rights.** To mitigate the effects of the Pumping Limits, the surface water rights described in subparagraph i. below (the "Mitigation Surface Water Rights") shall be available for use by the Tribe:

i. Subject to the approval of any necessary change application(s) as provided in subparagraph ii(3) below, upon the Tribe's execution of the MOA, the Tribe shall have the right, at no charge and free and clear of liens and encumbrances, to divert water from the Muddy River, at the existing Muddy River diversion points on the Reservation, at a maximum rate of 1 cfs, subject to a maximum diversion and consumptive use limit of 520 afy, from MVWD's "Jones Water Right" (Certificate No. 10060) dedicated to in-stream flows in accordance with paragraph I(2)(a) of the MOA. Such Mitigation Surface Water Rights shall be useable by the Tribe only during times, and only to the extent, that a Pumping Limit of less than 2500 afy is being implemented. At all times, and in all other respects, MVWD's Jones Water Right shall remain under the ownership and control of MVWD. The Tribe's use of the Mitigation Surface Water Rights will be monitored in accordance with ¶ 10 below.

ii. **Characteristics of Mitigation Surface Water Rights.** The Mitigation Surface Water Rights shall have the following characteristics:

(1) they shall be subject to reversion under ¶ 7 below;

(2) they shall provide to the Tribe a right to divert and use such water from the Muddy River;

(3) they shall be available for municipal use anywhere on the Reservation and, to facilitate such diversion and use, MVWD in consultation with the Tribe shall timely develop, file and secure issuance by the State Engineer of all legally required approvals of any necessary change applications. Any costs associated with the securing necessary approvals of any such change applications shall be born equally by the Tribe and MVWD;

(4) they shall be additive to the Tribe's rights under the Surface Water Lease to be provided under ¶ 4.b above; and

(5) in exercising the Mitigation Surface Water Rights, the Tribe shall have all rights and privileges, and be bound by all substantive and procedural laws, principles and rules, applicable to other owners of surface water rights in the Muddy River, including without limitation with respect to beneficial use and changes in the point of diversion, place of use and manner of use.

(6) MVWD agrees to keep the Jones Water Right or successor rights in good standing for so long as MVWD's obligation under this paragraph 5 is in existence. A copy of this Agreement shall be filed with the Office of the Nevada State Engineer and any successor to or assignee of MVWD shall be bound this paragraph 5.

6. State Law. The 2500 afy Permit, LVVWD Groundwater Applications and any Further Permit or Certificate acquired by the Tribe under ¶ 3 above, the Surface Water Lease acquired by the Tribe under ¶ 4.b above, and the Tribe's right to use the Mitigation Surface Water Rights under ¶ 5.b above, and any Tribal change application with respect to any of the foregoing, shall be held, sought, made and utilized by the Tribe in accordance with State law, both substantive and procedural. Without limitation, no such water right may be transferred by the Tribe for use at an off-Reservation location without compliance with State law. In addition, the provisions of ¶¶ 7 and 8 below shall be interpreted and enforced in accordance with State law. All of the foregoing shall be enforceable in administrative and judicial forums specified in State law for injunctive or declaratory enforcement of such water rights matters, and the Tribe hereby waives its sovereign immunity for the exclusive purpose of such enforcement in such forums, and as to any appeals therefrom in any appellate courts with jurisdiction over such appeals under State law. The Tribe hereby waives and foregoes any right to claim that exhaustion of Federal or Tribal court remedies is a prerequisite to any action by any Party to enforce the provisions of this ¶ 6 in the specified State administrative or judicial forums. However, no Party shall ever contend that any water right acquired by the Tribe under ¶¶ 3, 4.b or 5.b above has been abandoned or forfeited.

7. **Reversion of 2500 afy Permit, LVVWD Groundwater Applications, Further Permit or Certificate, and Mitigation Surface Water Rights.** Ownership of the 2500 afy Permit, LVVWD Groundwater Applications and any Further Permit or Certificate acquired by the Tribe under ¶ 3 above and the Tribe's entitlement to the Mitigation Surface Water Rights under ¶ 5.b above (collectively "Rights Subject to Reversion") shall revert to LVVWD or MVWD, as the case may be, as follows:

a. **Reversion.** The Rights Subject to Reversion shall revert if, prior to consummation of the WSA, the Tribe (or the United States on behalf of the Tribe), in any administrative or judicial proceeding, seeks federally-reserved groundwater rights appurtenant to the Reservation in excess of 14,480 afy ("Groundwater Reversion Trigger") or seeks federally-reserved surface water rights in the Muddy River appurtenant to the Reservation having diversion rates in excess of 11.5 cfs (Apr. - Sept.) and 10.5 cfs (Oct. - Mar.), a consumptive use limit in excess of 3700 afy, or a priority date earlier than March 12, 1873 ("Surface Water Reversion Trigger").

b. **Notice.** To exercise the above right of reversion, LVVWD or MVWD, as the case may be, must give the Tribe written notice of its intention to do so and the grounds therefor, and 120 days to reverse or terminate the Groundwater Reversion Trigger or Surface Water Reversion Trigger, as the case may be.

8. Termination of Surface Water Lease. The Surface Water Lease provided to the Tribe under ¶ 4.b above will instantly terminate upon the first occurrence of any of the following:

a. **Surface Water Reversion Trigger.** Occurrence of the Surface Water Reversion Trigger as defined in ¶ 7.a above, the giving of notice thereof by MVIC in the same manner provided in ¶ 7.b above, and the failure of the Tribe to reverse or terminate the Surface Water Reversion Trigger within the 120-day period specified in the notice.

b. **WSA.** "Judicial Confirmation" of the Tribe's federally-reserved water rights in the Muddy River as contemplated by the WSA.

c. **Adjudication.** Failing consummation of the WSA, adjudication in a court of competent jurisdiction of the Tribe's federally-reserved rights in the Muddy River appurtenant to the Reservation.

9. Change Applications in Case of Reversion or Termination. In the event of a reversion of Rights to Subject to Reversion under ¶ 7 above, or termination of the Surface Water Lease under ¶ 8 above, the Tribe shall cooperate with and not oppose the granting of any change applications reasonably necessary to restore the involved water rights to their original place of diversion, place of use and manner of use.

10. Monitoring Plan. The Parties shall in good faith diligently and cooperatively establish, agree on, and as necessary adjust over time a written plan for monitoring their respective uses of Muddy River water and groundwater from the California Wash Hydrographic Basin and adjacent hydrographic basins, and the water-related impacts therof, if any. Existing on-Reservation monitoring wells shall be incorporated in the monitoring plan and the plan shall be integrated with the Regional Monitoring Plans referred to in recital N of the MOA.

a. **Elements of Monitoring Plan.** Without limitation, such plan shall provide for: installation of appropriate metering devices by all Parties including parshall flumes (if not already installed) to meter the Parties' respective Muddy River diversions, provided that SNWA shall pay all costs of acquiring and installing (if not already installed) parshall flumes at the Muddy River diversion points on the Reservation (which shall be installed within 120 days of the effective date of this Agreement) ; the right of each Party to inspect diversion facilities, measuring devices (including any well meters) and pumping and diversion data of all other Parties; and appropriate methods for determining the Muddy River diversion rates, annual diversion amounts, and annual consumptive use amounts of each

Party, and the groundwater pumping rates and annual groundwater withdrawals of each Party.

b. **Interim Monitoring.** Pending finalization of such monitoring plan, each Party, on written notice, shall be accorded the right to reasonably monitor all ground and surface water diversions of any other Party from the Muddy River, the California Wash Hydrographic Basin and the hydrographic basins adjacent thereto, including reasonable access to and inspection of diversion facilities, measuring devices (including well meters) and pumping and diversion data.

11. Notices. All notices and communications given hereunder shall be in writing and shall be delivered by fax and first class, certified or registered mail, postage prepaid, to the fax numbers and addresses shown below, or to such other fax number or addressee as the Party entitled to notice may designate from time to time. Any notice given hereunder shall be deemed to be effective upon receipt.

If to Tribe: Chairperson, Moapa Band of Paiute Indians
Post Office Box 340
Moapa, Nevada 89025
Fax: 702-865-2875

with copies to:	Steven H. Chestnut Richard M. Berley Ziontz, Chestnut, Varnell, Berley & Slonim 2101 Fourth Avenue, Suite 1230 Seattle, Washington 98121 Fax: 206-448-0962
If to LVVWD:	General Counsel Las Vegas Valley Water District 1001 South Valley View Boulevard Las Vegas, Nevada 89153 Fax: 702-258-3268
If to SNWA:	General Counsel Southern Nevada Water Authority 1001 South Valley View Boulevard Las Vegas, Nevada 89153 Fax: 702-258-3268
If to MVIC:	General Manager Muddy Valley Irrigation Company Box 665 Overton, Nevada 89040 Fax: 702-397-6013
If to MVWD:	General Manager Moapa Valley Water District Post Office Box 257 Logandale, Nevada 89021 Fax: 702-397-6894

12. No Waiver. No failure by a Party to insist upon the strict performance of any term or condition of this Agreement, or to exercise any right or remedy consequent upon noncompliance therewith, shall constitute a waiver of any such term or condition, it being understood that any such waiver shall require the written agreement of such Party.

13. Amendment. All amendments or modifications of this Agreement shall be effective only when reduced to writing and signed by all Parties.

14. Further Documents and Action. The Parties shall execute all further documents and do all further things as may reasonably be necessary to give full force and effect to the provisions of this Agreement.

15. Interpretation. This Agreement shall be construed as a whole and in accordance with its fair meaning. Captions are used for convenience and shall not be used in construing meaning.

16. Successors. Every obligation, term and condition of this Agreement shall extend to and be binding upon, and every right and benefit hereunder shall inure to, the assignees, transferees or other successors of the respective Parties by operation of law or otherwise.

17. Representations and Warranties of Authority. Each Party represents and warrants as follows: (a) that it and the individual executing the Agreement on its behalf is fully empowered and authorized to execute and deliver this Agreement; (b) that it is fully empowered and authorized to approve and perform this Agreement; (c) that this Agreement is binding on its interest at the moment of execution and for so long as this Agreement is in effect; (d) that its governing body has authorized and approved the foregoing representations and warranties by duly adopted written resolution, a copy of which will be provided to the other Party on execution of this Agreement; and (e) that it has obtained all approvals necessary to enter into and perform this Agreement, including without limitation the Tribe's taking of all actions necessary to accomplish the Tribe's waivers of sovereign immunity set forth herein and delivery by MVIC to the Tribe of a shareholder resolution approving this Agreement and the Surface Water Lease.

18. Counterparts. This Agreement may be executed and approved in multiple counterparts, each of which shall be deemed an original.

19. Dispute Resolution. In ¶ 6 above, the Tribe has expressly granted a waiver of sovereign immunity with respect to the enforcement of certain matters set forth in ¶ 6. Further, if a dispute should arise among the Tribe and any other Party or Parties with respect to the meaning or enforcement of any provision of this Agreement, any Party to the dispute may seek to resolve it only through a suit among such Parties brought in the Eighth Judicial District Court, Clark County, Nevada. The Tribe hereby waives its sovereign immunity as to such suits in such Court with respect to declaratory or injunctive relief only, and as to any appeals therefrom in appellate courts with jurisdiction over such appeals under State law. The Tribe hereby waives and foregoes any right to claim that exhaustion of Federal or Tribal court remedies is a prerequisite to any action brought in State court under this ¶ 19.

20. Entire Agreement. This Agreement constitutes the entire agreement among the Parties with respect to the matters covered hereby, and subsumes and incorporates all prior written and oral statements and understandings.

MOAPA BAND OF PAIUTE INDIANS

By ______________________________ Date: ______________________________
Chairman

LAS VEGAS VALLEY WATER DISTRICT

By ______________________________ Date: ______________________________
President

SOUTHERN NEVADA WATER AUTHORITY

By ______________________________ Date: ______________________________
Chair

MUDDY VALLEY IRRIGATION COMPANY

By ______________________________ Date: ______________________________
Chairman of the Board

MOAPA VALLEY WATER DISTRICT

By ______________________________ Date: ______________________________
Chairman of the Board

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

May 9, 2007
1-5-05-FW-536-Tier 2

Memorandum

To: Field Manager, Bureau of Land Management, Las Vegas Field Office
Las Vegas, Nevada

From: Field Supervisor, Nevada Fish and Wildlife Office, Reno, Nevada

Subject: Proposed Right-of-Way Permit and Funding for a Water Conveyance System and Associated Groundwater Pumping in the Coyote Spring Valley on the Warm Springs Area, Clark County, Nevada (Bureau of Land Management's right-of-way File N-76493)

This document transmits the U.S. Fish and Wildlife Service's (Service) tiered biological opinion, based on our review of the Bureau of Land Management's (BLM) proposed issuance of a right-of-way permit to the Southern Nevada Water Authority (SNWA) and Federal funding provided to Moapa Valley Water District (MVWD) by the U.S. Corps of Engineers (Corps) and its effects on the threatened Mojave population of the desert tortoise (*Gopherus agassizii*), its critical habitat, and the endangered Moapa dace (*Moapa coriacea*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq*.). The right-of-way permit is needed for the construction, operation and maintenance of a water conveyance system, and its associated groundwater pumping in the Coyote Spring Valley, Nevada. We have assigned log number 1-5-05-FW-536-Tier 02 to this consultation. Please reference this number in future correspondence relating to this consultation.

The effects analysis for Moapa dace in this biological opinion is based off, and tiered to the January 30, 2006, *Intra-Service Programmatic Biological Opinion for the Proposed Muddy River Memorandum of Agreement Regarding the Groundwater Withdrawal of 16,100 Acre-Feet per Year from the Regional Carbonate Aquifer in the Coyote Spring Valley and California Wash Basins and Establish Conservation Measures for the Moapa dace, Clark County, Nevada* (Appendix A). The intra-Service biological opinion took a programmatic (landscape-level) approach to evaluating potential effects to the endangered Moapa dace from groundwater pumping by multiple parties in the Coyote Spring Valley and California Wash basins, considered in light of conservation measures proposed in the Muddy River Memorandum of Agreement

(MOA). Included in this evaluation was the groundwater pumping of SNWA's appropriated water right of 9,000 acre-ft per year (afy) from Coyote Spring Valley in order participate in the Nevada State Engineer Study (Order 1169), and to provide water to the Moapa Valley area for residential and commercial purposes. The Service prepared the programmatic biological opinion in the absence of site-specific information for individual projects; and while a non-jeopardy opinion was issued, incidental take was not authorized for any action undertaken by Federal agencies or with a Federal nexus. This approach assumed that site-specific actions proposed under the "umbrella" of the MOA would be submitted to the Service and evaluated pursuant to section 7 or section 10 of the Act, as appropriate. The specific effects associated with, and the incidental take authorized for individual projects, such as SNWA's pipeline construction, would be assessed separately in individual biological opinions. Under this approach, the project-specific documents will tier to the programmatic or parent document, incorporating portions of it by reference. Because the programmatic consultation did not evaluate impacts to federally listed species other than the Moapa dace, effects to other species will need to be evaluated in the tiered section 7 consultations. The programmatic biological opinion was assigned the log number 1-5-05-FW-536 and is appended to this tiered biological opinion (Appendix A).

BLM is the lead Federal agency, and the Corps is a cooperating Federal agency for this consultation. The Corps is a cooperating Federal agency for this consultation due to the fact they are providing Federal funding to the MVWD for system improvements associated with the proposed action. Your July 14, 2003, request for formal consultation was received on July 14, 2003. However, due to reduced staff levels and increased workloads we were unable to respond to your request until September 18, 2003, at which time we requested additional information and clarification regarding the subject action. After a meeting between our agencies and SNWA on September 22, 2003, we received a response to our request for information from SNWA on September 26, 2003, at which time formal consultation was initiated. A Service Log Number 1-5-03-F-575 was assigned to the consultation. However, after numerous meetings and discussions, the applicants later submitted to BLM an amendment to their right-of-way permit application, requesting to modify their proposed actions, thereby including conservation actions, which were identified in an MOA. It was determined that a tiered-programmatic biological opinion approach would be used to analyze the cumulative effects of all permitted groundwater withdrawals and conservation actions in the Muddy River area. Based on this approach, a new Service Log number was assigned to the proposed action (1-5-05-FW-536 Tier 02). The previously-used Service Log Number is now obsolete and is used only as a cross reference.

The Service has determined that the proposed action is likely to adversely affect the threatened desert tortoise, its designated critical habitat, and the endangered Moapa dace. No critical habitat has been designated for the Moapa dace; therefore, none will be affected and thus no further analysis is required. In the July 13, 2003 request for formal consultation you also requested our concurrence on "may affect, not likely to adversely affect" determinations for two listed and one candidate avian species identified below. The Service has reviewed all available information for the proposed project and its effects to the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), and the endangered Yuma clapper rail (*Rallus longirostris* *yumanensis*). In addition, we have evaluated the potential effects that the proposed project may have on the western U.S. distinct population segment of the Federal candidate yellow-billed cuckoo (*Coccyzus americanus*) (67 FR 40666). Although these avian species do not occur within the footprint of the project, they may also be affected. However, due to the fact that applicants have committed to abstaining from construction activities in areas adjacent to their potential habitat during their nesting/breeding seasons, and because no adverse effects to their occupied habitat are otherwise expected to occur from the proposed action, we concur that the proposed project is not likely to adversely affect the southwestern willow flycatcher, Yuma clapper rail, and the yellow-billed cuckoo.

This biological opinion is based on the following information: (1) BLM's July 8, 2003, Biological Assessment of the Coyote Spring Valley area (BLM 2003); (2) final programmatic biological opinion dated January 30, 2006 (Appendix A); (3) numerous meetings and discussions between the Service, SNWA, and MVWD; (4) discussions with species experts familiar with the ecology of the species; (5) hydrology data collected by SNWA, National Park Service (NPS), U. S. Geological Survey (USGS), and the Service; (6) information in our files; (7) SNWA's August 31, 2006, draft Environmental Assessment; and (7) other sources of available information cited herein. A complete administrative record for this consultation is on file at the Service's Southern Nevada Field Office.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (no. 03-35279) to complete the following analysis with respect to critical habitat.

Programmatic Consultation

This biological opinion was prepared in accordance with the July 16, 2003, guidance for programmatic-level consultations (Service 2003). Such consultations can provide the benefit of streamlining the consultation process while leading to a more landscape-based approach to consultations that can minimize the potential "piecemeal" effects that can occur when evaluating individual projects out of the context of a complete agency program. Some of the benefits of programmatic consultations include: (1) better and more cost effective integration of ecosystem/recovery planning activities with agency activities; (2) streamlined consultation processes; (3) added predictability for all signatories of the MOA; (4) minimization of the potential "piecemeal" effects that can occur when evaluating individual projects out of the context of a complete agency program; and (5) the opportunity to better and more efficiently integrate the action agency's 7(a)(1) responsibilities at the program level.

Due to the number of impending actions by different entities included in the proposed action, a tiered-programmatic approach has been taken by the Service in an attempt to analyze the effects of the proposed action. The tiered approach is a two-stage consultation process with the two stages fulfilling the same purposes. The first stage biological opinion or concurrence, as appropriate, evaluates the landscape-level effects. The second stage results in the completion of project-specific documentation that addresses the specific effects of each individual project. Under the tiered approach, two complete biological opinions are completed for each proposed action, with the second-stage documents "tiering" to the first-stage document by incorporating portions of it by reference. Thus each action has its own individual consultation document that is supported by the programmatic document.

Project-Specific Level Consultation under the Tiered Programmatic Consultation Approach

As individual projects are proposed under the tiered programmatic consultation approach, project-specific information will be provided that: (1) describes each proposed action and the specific areas to be affected; (2) identifies the species and critical habitat that may be affected; (3) describes the manner in which the proposed action may affect listed species; (4) describes the anticipated effects; (5) specifies the *anticipated effects from the proposed project are consistent with those analyzed in the programmatic biological opinion*; (6) describes proposed measures to minimize potential effects of the action; and (7) describes any additional effects, if any, not considered in the programmatic consultation. The Service reviews this information and then completes a tiered biological opinion with a project-specific incidental take statement. This document, while meeting the basic requirements of biological opinions as specified at 50 CFR 402.14(h), generally requires less effort to complete because it references back, or tiers, to the program-level biological opinion. This document represents our project-level consultation for the programmatic biological opinion.

Consultation History

On February 19, 2003, the Service provided technical assistance by issuing a species list for the proposed project area to Nevada Environmental Consultants, Inc. (File No. 1-5-03-SP-469).

On July 8, 2003, a final Biological Assessment was prepared for BLM on behalf of, and in cooperation with, SNWA by Wildland International of Las Vegas, Nevada. The final Biological Assessment was subsequently received by the Service.

On July 14, 2003, BLM requested formal consultation with the Service under section 7 of the Act with respect to the endangered Moapa dace, threatened Mojave population of the desert tortoise, and its critical habitat. The request also solicited the Service's concurrence on not likely to adversely affect determinations for the flycatcher, rail, and the cuckoo.

On July 25, 2003, the Corps requested formal consultation with the Service to evaluate the effects of the proposed project on the desert tortoise, Moapa dace, Yuma clapper rail, southwestern willow flycatcher, and the western yellow-billed cuckoo.

On July 30, 2003, the Corps advised the Service that BLM was the lead Federal agency for this consultation and withdrew its request for consultation.

On August 6, 2003, a meeting was held between the Service, BLM, and SNWA regarding the Coyote Spring Pipeline Biological Assessment and the section 7 consultation.

On August 11, 2003, SNWA submitted a letter to BLM clarifying various issues raised during the meeting by the Service.

On September 18, 2003, the Service submitted a letter to BLM requesting additional information and subsequently attended a meeting on September 22, 2003, with representatives from BLM, and SNWA to discuss the specifics of the request.

On September 30, 2003, the Service received a response to our request, with most of the additional information we requested. SNWA indicated that they would not be updating their 2001 hydrologic model or the hydrologic impact analysis previously submitted for the project's 2003 biological assessment. In addition, we were deferred to the State Engineer's Office to obtain the requested water rights information.

On October 30, 2003, a meeting was attended by the Service and SNWA staff to discuss the project and to examine various aspects of the project's footprint.

On November 4, 2003, the Service met with SNWA managers to discuss the formal consultation process and to clarify the differences between Reasonable and Prudent Measures and Reasonable and Prudent Alternatives. This meeting also initiated a dialogue to develop additional measures to reduce adverse effects of the proposed project on the Moapa dace and other imperiled aquatic species.

On November 13, 2003, the Service received a SNWA draft letter of conceptual minimization measures for the Moapa dace that they provided as an initial proposal for discussion.

On November 17, 2003, the Service met with SNWA staff to discuss conservation and minimization measures for the Moapa dace.

On December 12, 2003, the Service met with SNWA managers to further discuss project-related measures to minimize adverse effects to the Moapa dace.

On December 13, 2003, the Service received a draft letter from SNWA that outlined their proposed conservation and minimization measures for the Moapa dace.

On January 9, 2004, the Service met with SNWA managers to further discuss draft conservation and minimization measures for the Moapa dace.

On January 20, 2004, the Service submitted a letter to SNWA requesting written confirmation of their commitments to minimize project effects to the Moapa dace and have those actions incorporated into the project description.

On January 21, 2004, SNWA provided the Service with an assurance of their minimization actions by signing the Service's January 21, 2004, letter.

On January 29, 2004, the Service hand delivered to SNWA a copy of the draft biological opinion regarding the proposed action for their review and comment.

On February 10, 2004, SNWA requested an additional 10 days to provide their written comments to the Service on the draft biological opinion.

On February 18, 2004, a technical group met to discuss threshold levels for spring discharge at the Warm Springs West gage that would be established prior to construction activities, as outlined in the draft biological opinion. The technical group consisted of biologists and hydrologists from SNWA, BLM, and the Service.

On February 24, 2004, SNWA provided written comments on the draft biological opinion.

On March 12, 2004, SNWA submitted a request to BLM for the consultation period to be extended an additional 30 days until April 12, 2004.

On March 12, 2004, the technical group met for the second time to continue threshold level discussions. SNWA and the Service both presented their recommendations and the basis for their determinations. The technical meeting ended without establishing threshold levels.

On May 27, 2004, the Service formally requested a 60-day extension to the consultation period from April 12, 2004 to June 11, 2004.

On May 27, 2004, BLM approved the Service's request for an extension of the consultation period.

On June 28, 2004, a meeting was held to discuss groundwater water rights and pumping activities at Arrow Canyon, MX-5, and RW-2 wells. In addition to the Service and SNWA, attendee's included the Nevada Power Company and the MVWD.

On July 30, 2004, a meeting was held with SNWA, MVWD, and the Service to discuss conservation measures that would be implemented by the applicants and incorporated into an ongoing consultation for a proposed pipeline that would be necessary to comply with Nevada

State Engineer Order 1169. It was determined that an MOA was the appropriate mechanism to effectuate these commitments. The MOA would then become part of the project proposal and thus incorporated into the Description of the Proposed Action in the biological opinion (see programmatic biological opinion for consultation history of MOA and associated actions).

On September 3, 2004, we received a copy of the right-of-way permit application from SNWA to BLM to conduct the proposed activities addressed in this biological opinion.

On September 3, 2004, we received from SNWA a copy of the draft *Detailed Work Plans for Evaluating Water-Related Effects: Clark, Lincoln, and White Pine Counties Groundwater Development Project*, dated August 20, 2004.

On September 22, 2004, the Service issued a letter to the Clark County Manager raising concerns about the potential effects of residential/commercial developments in the Coyote Spring Valley on the threatened and endangered species. Specifically, concerns were raised about potential effects to the Moapa dace from groundwater pumping activities associated with a development known as Coyote Springs Investment, LLC (CSI). While incidental take of desert tortoise is currently covered under the Clark County Multiple Species Habitat Conservation Plan (MSHCP) for those actions that occur in Clark County, the Moapa dace is not covered under the MSHCP and incidental take is not authorized for this species.

On July 14, 2005, a Water Supply Agreement was agreed to by the Moapa River Band of Paiutes (Tribe), SNWA, MVWD, Las Vegas Valley Water District (LVVWD), and Muddy Valley Irrigation Company (MVIC). Among other features under this Water Supply Agreement, the Tribe will receive the State groundwater permit and State groundwater applications, which are to be provided to the Tribe by LVVWD under the Water Supply Agreement, and a lease of Muddy River water rights which in certain respects will be functionally similar to the federally-reserved Muddy River rights to be secured to the Tribe under the Water Supply Agreement.

On July 19, 2005, the Service determined that given the multiple parties involved and the complexity of issues at hand, a programmatic approach would most effectively evaluate the effects of actions included in the Muddy River MOA. This approach would assess landscape-level effects of the cumulative pumping of groundwater from the regional carbonate aquifer on the endangered Moapa dace, including conservation measures proposed in the MOA to offset these potential impacts. Future, site-specific actions and impacts to federally-listed species other than the Moapa dace will be evaluated in project-specific biological opinions that tier to the programmatic document.

On September 30, 2005, the draft programmatic biological opinion for the cumulative withdrawal of 16,100 afy of groundwater and conservation measures in the Coyote Spring Valley and California Wash was signed and submitted to the parties for comment.

On January 27, 2006, the final Muddy River MOA was agreed to in principle by the Tribe, SNWA, MVWD, CSI, and the Service to ensure that conservation actions were in place prior to potential impacts associated with the project's groundwater pumping.

On January 30, 2006, the Service finalized *Intra-Service Programmatic Biological Opinion for the Proposed Muddy River MOA Regarding the Groundwater Withdrawal of 16,100 afy from the Regional Carbonate Aquifer in the Coyote Spring Valley and California Wash Basins and Establish Conservation Measures for the Moapa dace, Clark County, Nevada* (File Number 1-5-05-FW-536) (Appendix A).

On February 16, 2006, the Service received a copy of the letter that SNWA submitted to BLM for minor revisions to the right-of-way application as a result of the development of an MOA, along with a few minor engineering changes that have developed since the original right-of-way application was filed.

On March 2, 2006, the Service provided a Tier 01 biological opinion to the Corps for the CSI Development (File Number 1-5-05-FW-536-Tier 01) located in Lincoln and Clark counties.

On April 20, 2006, an MOA was signed by the participating parties which outlined specific conservation actions that each party would complete in order to minimize potential impacts to the Moapa dace from the cumulative withdrawal of 16,100 afy of groundwater from two basins within the regional carbonate aquifer system (see Appendix A; programmatic biological opinion for the analysis of the MOA).

On July 12, 2006, the Service received an updated request for formal consultation under section 7 of the Act from BLM for a right-of-way permit for SNWA (BLM right-of-way File N-76493). BLM's written request indicated that the project description had been modified since the original consultation was submitted to the Service on July 14, 2003, including minor engineering changes and the addition of project specific conservation measures identified in the MOA.

On September 19, 2006, the Service received a copy of SNWA's August 31, 2006, draft Environmental Assessment from BLM.

On May 4, 2007 the Service received a letter from SNWA regarding additional information on groundwater levels and spring discharge that is currently under review by the Hydrologic Review Team established by the MOA.

BIOLOGICAL OPINION

Description of the Proposed Action

Groundwater Rights in Coyote Spring Valley and Muddy Springs Area

Relevant State Engineer rulings, permitted groundwater rights, rights held in abeyance, and pending applications for the Coyote Spring Valley (Basin 210) and Muddy Springs Area (Basin 219) hydrographic basins are summarized below. For further information, please refer to pages 6-10 in the programmatic biological opinion (Appendix A).

To date, the Nevada State Engineer has granted 16,300 afy of groundwater right permits in Coyote Spring Valley basin, which includes 4,600 afy owned by CSI and 9,000 afy owned by SNWA and LVVWD. So far, there has been almost no pumping of the permitted rights in Coyote Spring Valley (see below). The Nevada State Engineer has granted 14,800 afy of groundwater right permits in the Muddy River Springs Area basin, including the MVWD's permits totaling 10 cubic ft per second (cfs) or 7,240 afy from the carbonate aquifer in the Warm Springs Area, point of diversion at the Arrow Canyon Well, located approximately 2.3 miles west of the Moapa Valley National Wildlife Refuge (NWR). In Ruling 4243, the Nevada State Engineer ordered MVWD to take a phased-in pumping approach to the withdrawal of its groundwater rights at Arrow Canyon Well, increasing pumping incrementally from 1996 through 2004, with monitoring to evaluate impacts to springs and groundwater levels (Nevada State Engineer 1995). Demand for this water was less than forecasted by the MVWD and groundwater pumping from the Arrow Canyon Well has lagged behind the incremental pumping rate ordered by the State Engineer in Ruling 4243. Pumping was stepped up to 2.7 cfs in 1998, in part at the request of the Federal agencies to allow collection of data related to the effects of groundwater production from the carbonate aquifer. Approximately 2,400 afy has been pumped on average between 1998 and 2003 from the carbonate aquifer of the Muddy River Springs Area basin at the Arrow Canyon Well location.

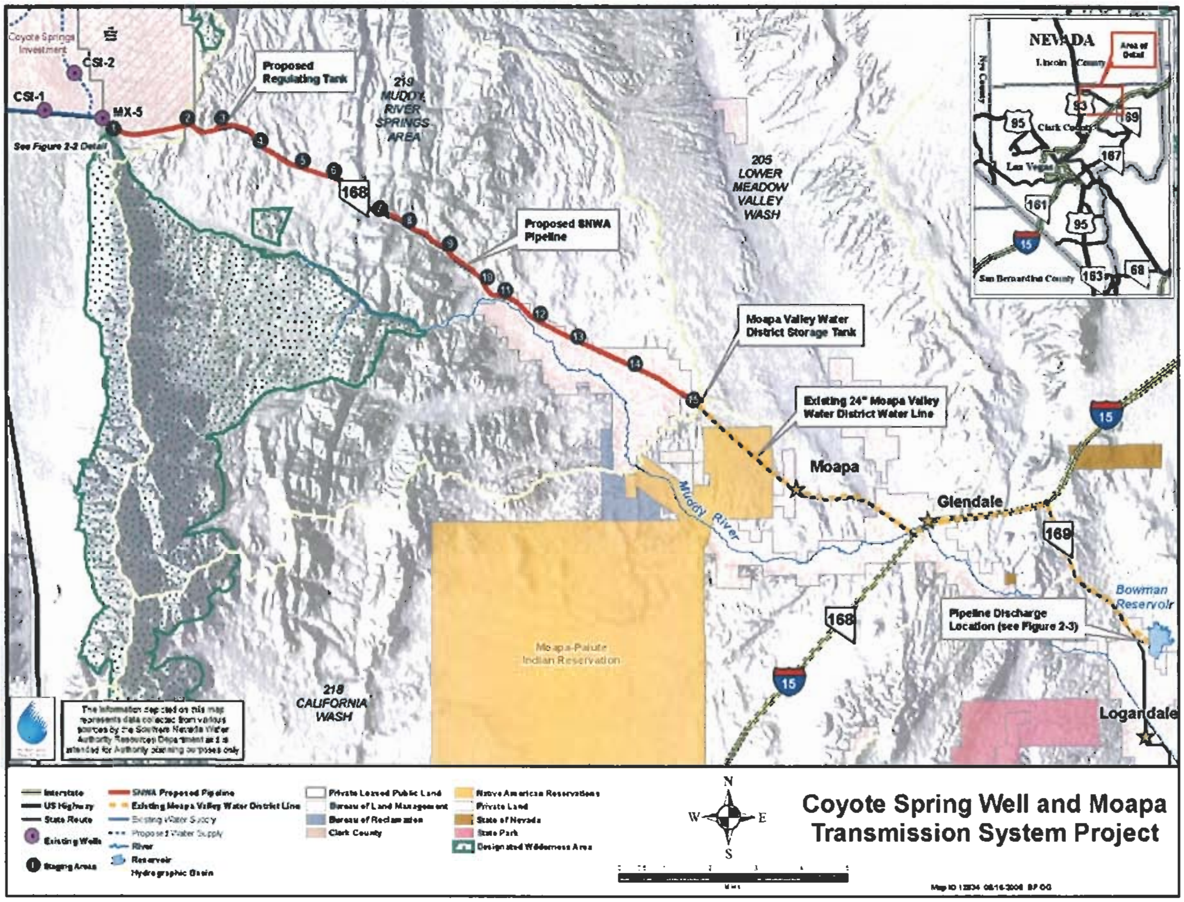
In March 2002, in response to water right protests filed by the Department of the Interior [Service, NPS, BLM] and other entities, the Nevada State Engineer issued a ruling (Order 1169) (Nevada State Engineer 2002) on groundwater applications in Coyote Spring Valley and other nearby hydrologic basins within the regional carbonate aquifer system. The State Engineer required that, before any additional water right permits would be granted in the area, the major groundwater water right permit holders should participate in a two to five-year study to provide information on the effect of pumping existing water right permits on the regional carbonate aquifer system, including the Warm Springs Area. For a description of State Engineer rulings and existing groundwater permits in the Coyote Spring Valley and Muddy Springs Area please refer to pages 6-10 in the programmatic biological opinion.

During the Order 1169 Study, a minimum of half the existing permitted groundwater rights in Coyote Spring Valley are to be pumped for a period of two consecutive years. Existing permitted groundwater rights in Coyote Spring Valley total 16,300 afy; therefore, a minimum of 8,150 afy must be pumped for two consecutive years. SNWA and LVVWD have existing water right permits for approximately 9,000 afy of groundwater in Coyote Spring Valley, which will be pumped to meet the minimum pumping requirement in Order 1169. In conjunction with the MVWD, SNWA will pump this water from Coyote Spring Valley to water users in Moapa Valley through the proposed pipeline. SNWA and LVVWD have begun implementing the study in cooperation with other water right holders and Federal agencies (Service, NPS, and BLM) by expanding existing monitoring efforts and drilling additional monitoring wells in Coyote Spring Valley and the upper Moapa Valley.

Proposed Action

For a complete description of the proposed actions see SNWA's draft Environmental Assessment (SNWA 2006). BLM is being requested by SNWA to issue a right-of-way permit for the construction of approximately 16 miles of 24-inch diameter pipeline to transport water from three existing groundwater pumping wells (MX-5 and/or CSI-1 and CSI-2) in the southern end of the Coyote Spring Valley to an existing MVWD storage tank and pipeline (Figure 1). System improvements will also be made to the MVWD facilities as part of this consultation. Those improvements include the construction of a chlorination facility at the MVWD storage reservoir tank, a de-chlorination facility near Bowman Reservoir, and a discharge pipeline into Bowman Reservoir and the MVIC diversion channel near Highway 169 (Figure 2). The Corps proposes to provide grant funding under Section 595 of the Water Resources Development Act of 1999 for a percentage of MVWD's portion of the proposed action.

Figure 1



Map provided by SNWA

Figure 2

Map provided by SNWA

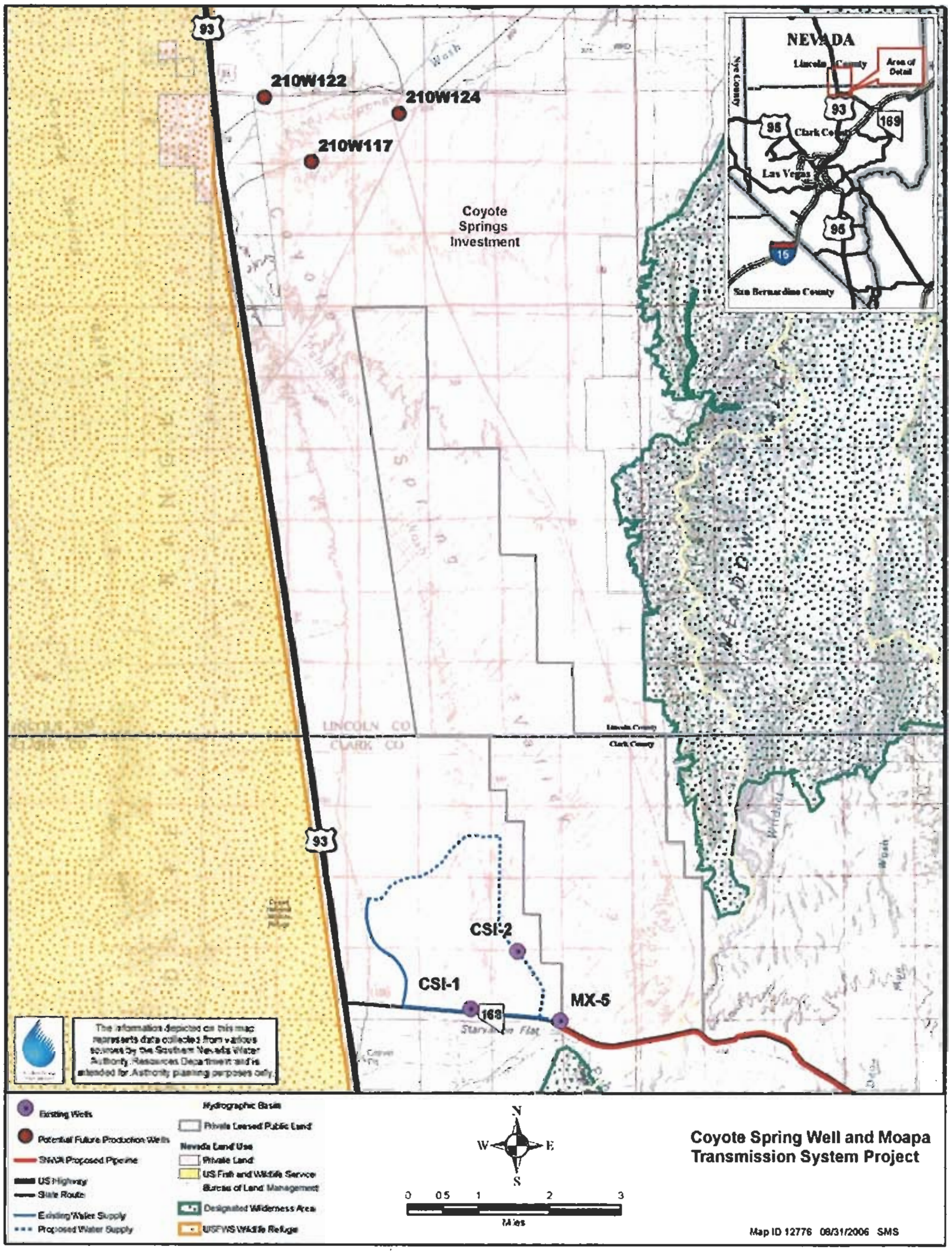
In the event that water levels decline below the 3.0 cfs threshold limit identified in the MOA (section 5d) at the Warms Springs West flume, SNWA has identified three additional groundwater production well sites that may be used to continue the Order 1169 Study. These wells have been identified as 210W122, 210W124, and 210W117, located on CSI property (Figure 3). Contingent upon the results of the 1169 Study, SNWA is also proposing to continue use of the Coyote Spring Project pipeline for the conveyance of their 9,000 afy of permitted water rights. Any unused portions of water will flow into the Reed Bowman Reservoir and overflow into the lower Muddy River, and ultimately, Lake Mead. Permits and approvals would be requested by SNWA from the appropriate agencies for the introduction of non-Colorado River system water for credit with any Colorado River water both during and following completion of the Order 1169 pumping study, and any necessary environmental review for those permits and approvals. Any change to the project purpose could result in modifications to the "Effects of the Action" section below and would need to be re-evaluated, thus requiring re-initiation of formal consultation. The proposed action is as follows:

1. Construct a pipeline that will convey groundwater withdrawals from potentially three carbonate wells located in the Coyote Spring Valley (Basin 210) to participate in a regional carbonate aquifer system study ordered by the Nevada State Engineer. The Nevada State Engineer ordered a two- to five-year study (Order 1169) to evaluate how groundwater withdrawals in the Coyote Spring Valley will impact the carbonate aquifer system and adjacent Muddy River ecosystem. The results of the Order 1169 will assist the State Engineer in making decisions for both pending and future water right applications in the area. The Order requires at least half of the permitted water rights or 8,150 afy, to be pumped from the Coyote Spring Valley for two consecutive years. In order to meet the requirements of the Order, SNWA is proposing to remove 9,000 afy of groundwater from the regional carbonate system. Data obtained from the study will be used to evaluate both present and future groundwater pumping activities within the regional carbonate groundwater system. SNWA has an agreement with MVWD to connect to their existing infrastructure and distribute the 9,000 afy of Coyote Spring Valley groundwater to MVWD through the proposed pipeline (Figure 1). The water will flow into MVWD's infrastructure, with any unused portions emptying into the Reed Bowman Reservoir. Should the reservoir reach full capacity, flows will continue into the lower Muddy River;

2. Upon completion of the State Engineer's Order 1169 Study, the applicants propose the continued use of the pipeline system to convey permitted water rights to beneficial uses. Therefore, should the results of the study indicate that water rights in the Coyote Spring Valley are fully allocated, it is the intent of the applicants to use the proposed pipeline to transfer their permitted water rights from other areas outside of Coyote Spring Valley.

3. Provide a means to convey 724 afy of SNWA's permitted Coyote Spring groundwater rights to MVWD. This would facilitate the dedication by MVWD of its existing 1.0 cfs Jones Spring water right for the purpose of providing in-stream flows that will be beneficial to the Moapa dace. The 724 afy of groundwater being transferred to MVWD through the pipeline replaces the surface water from Jones Spring.

Figure 3



Map provided by SNWA

<u>24-inch Pipeline and Associated Facilities</u>

The proposed water conveyance project consists of the construction and maintenance of a 15.5-mile long, 24-inch diameter water transmission system from the existing MX-5 well, and/or CSI wells 1 and 2 in Coyote Spring Valley, to the existing MVWD system. The pipeline shall be constructed mostly within the Nevada Department of Transportation (NDOT) right-of-way along State Route 168 and encroach on BLM lands. The permanent pipeline right-of-way will be about 30 ft wide. The temporary right-of-way will vary according to topography but will average 50 ft. The total area of disturbance associated with the installation of the pipeline will average 80 ft in width throughout the 15.5-mile length of the pipeline. There will be additional impacts through the construction of a regulating tank and access road, power facilities (powerline and tap structure), 15 staging areas along the project corridor, and system improvements by MVWD. Please refer to SNWA's draft Environmental Assessment for a complete description.

Description of the Action Area

The Action Area is defined as the terrestrial footprint area impacted by the construction of the pipeline as defined in the Biological Assessment (BLM 2004), and those hydrogeomorphic basins in the White River Flow System, which have hydrologic connectivity to the Muddy River and have the potential to be affected by groundwater development in Coyote Spring Valley. Given the geologic characteristics of this regional flow system, only the basins that are closest to the points of withdrawals, and down gradient, are expected to be potentially affected and are included in this action area. These basins include the Coyote Spring Valley (Basin 210), Muddy Springs Area (Basin 219), California Wash (Basin 218) and Lower Moapa Valley (Basin 220).

Conservation Measures

SNWA will implement the following general measures to minimize potential adverse effects to listed species:

1. The project proponent shall designate a field contact representative (FCR) who is responsible for overseeing these minimizing measures and coordinating with the agencies. The FCR shall have authority to halt all activities that are in violation of the permits. The FCR shall have a copy of all appropriate stipulations when work is conducted at the site. The FCR may be a contract biologist, or a person designated by the agencies. These individuals must be approved by BLM and the Service and be independent of the project proponent.

2. Prior to initiation of construction, a sensitive resource education program shall be presented to all personnel who will be on-site, including surveyors, construction engineers, proponent employees, contractors, contractors employees, supervisors, inspectors, and all visitors. The program shall include information on the biology of listed species and their occurrence in the project area; measures being implemented for

the protection of these species and their habitats during project activities; and means by which individual employees can facilitate this process. The program shall be developed by the project proponent and approved by BLM and the Service at least 15 days prior to its initial presentation. The program shall be presented by a biologist familiar with the issues being presented. Wallet-size cards signifying completion of training shall be provided to employees. For the desert tortoise: the program shall also explain to the employees the definition of "imminent danger" and discuss the actions they can take in relation to a desert tortoise. *Imminent danger* is defined as conditions in which the death or injury of a desert tortoise is immediate and unavoidable without direct human intervention.

The program shall cover the following topics at a minimum:

- Distribution of listed species
- General behavior and ecology of the affected species
- Sensitivity to human activities
- Legal protection
- Penalties for violation of State and Federal laws
- Reporting requirements
- Project minimization measures

3. No equipment shall be refueled within 100 ft of a water body or wash system whose runoff has the potential to enter the Muddy River or the Muddy River Ecosystem.

4. No equipment or construction materials shall be stored within 100 ft of a water body or wash system whose runoff has the potential to enter the Muddy River or the Muddy River Ecosystem.

5. Any fuel, transmission or brake fluid leaks or hazardous waste leaks, spills or releases shall be stopped/repaired immediately and cleaned up at the time of occurrence. All heavy equipment and vehicles shall carry a bucket and pads to absorb leaks or spills. If spills occur in a maintenance yard, they shall be cleaned up after construction is complete. Contaminated soil shall be removed and disposed of at an appropriate facility.

6. Prior to discharge for hydrostatic testing, the discharge and drainage location shall be surveyed for sensitive species. Measures as described in this section shall be implemented for any sensitive species identified in the discharge area.

<u>Conservation Measures Specific to the Desert Tortoise</u>

SNWA proposes the following measures to minimize potential impacts to the desert tortoise (as outlined in the draft Environmental Assessment) (SNWA 2006):

1. Qualified biologists shall be assigned to monitor during construction for the protection of desert tortoises and other listed species. The level of effort involved in this monitoring shall be dependent on desert tortoise activity.

2. A qualified biologist(s) shall act as a biological monitor(s) and be present on-site during project-related actions that may impact sensitive biological resources. All biological monitors shall be approved by BLM and the Service to handle desert tortoises and other threatened or endangered species.

   - The biological monitor shall be responsible for determining compliance with measures as defined by the Biological Opinion or other agreements between the project proponent and agencies. Biological monitors shall have the authority to briefly halt non-emergency construction activities that are not in compliance with these measures. Actions shall be halted long enough to remedy the immediate situation and shall apply only for the equipment and parties involved in the situation. All actions of non-compliance or conditions that threaten a listed species shall be recorded and reported to the project proponent, and the Federal agency, or Federal agency representatives immediately.

3. The area of disturbance shall be confined to the smallest practical area, considering topography, placement of facilities, location of sensitive resources including desert tortoise burrows, public health and safety, and other limiting factors. All storage areas shall be surveyed by a qualified biologist prior to use for construction efforts. Stockpiles, laydown sites, storage areas, and turnaround sites shall be located in previously disturbed areas to the extent that this is practical. Work area boundaries shall be clearly delineated with flagging, fencing or other marking to minimize surface disturbance.

4. Cross-country, vehicular travel outside of the right-of-way is prohibited unless approved by BLM. This includes pre-construction work activities such as survey and flagging of the work area.

5. Incidences of observations of listed species and their sign during activities shall be conveyed to the field supervisor and/or authorized biologist. Project personnel shall be notified that they are not authorized to handle or otherwise move listed species encountered on the site unless mitigating circumstances exist- (See “Imminent Danger” description above).

6. Trash and food items shall be contained in closed containers and removed regularly (at least once a week) to reduce attractiveness to opportunistic predators such as ravens, coyotes, and feral dogs. This trash will be disposed of properly. Trash includes but is not limited to, cigarettes, cigars, gum wrappers, tissue, cans, paper, and bags. Upon project completion, all construction refuse, including, but not limited to, broken equipment parts,

wrapping material, cords, cables, wire, rope, strapping, twine, buckets, metal or plastic containers, and boxes, shall be removed from the site and disposed of properly.

7. Firearms and domestic dogs shall be prohibited from the project site.

8. No intentional harassment or harming of animals shall be allowed. Whenever possible, animals found entrapped in open holes or excavations shall be removed. If the animal is a listed species, it shall be removed only by a qualified biologist.

9. After construction, disturbed areas shall be recontoured to match as closely as possible the original contours of the area, and reclamation actions shall be implemented, as appropriate. A formal reclamation plan shall be developed following standard BLM protocols. All restoration techniques shall be designed to achieve an agency-set rehabilitation criterion. This is typically 50 percent of the range site potential over a seven-year period. Final criteria shall be included in the reclamation plan.

10. Efforts shall be made to minimize impacts to vegetation and soils in the construction corridor. Where possible, vegetation shall be crushed instead of being removed by blading. Cacti, yucca and identified sensitive plant species shall be avoided or salvaged. All cacti and yucca that cannot be avoided during construction or a percentage determined by BLM shall be salvaged from the construction right-of-way and maintained appropriately at offsite nursery areas identified by BLM. At completion of construction or at a time most appropriate for the plants, all cacti and yucca shall be transplanted back within the right-of-way in tortoise critical habitat. Outside of critical habitat, the disposition of salvaged plants shall be determined by BLM.

    - Areas where surface disturbance and removal of vegetation exceeds 3 ft in width shall require topsoil removal and replacement to salvage the seed bed. Topsoil shall be salvaged to a depth of 6 inches. Immediately after the completion of construction for an area, removed topsoil shall be windrowed at the edge of the right-of-way and spread uniformly over the area from which it was removed. Any seed used for sensitive species restoration shall be taken from native sources and preferably from plants within or adjacent to the right-of-way. An example would be rosy twotone beardtongue (*Penstemon bicolor* ssp. *roseus*), which can be easily collected when the plants are senescent. Any temporary disturbance areas shall be seeded with a BLM-approved seed mix.

11. All activities shall be restricted to the rights-of-way and approved access roads/storage areas. If unforeseen circumstances require expansion of this width, prior written approval of BLM must be obtained. The potential expanded work areas shall be surveyed for species prior to use of the area. All appropriate measures shall be implemented within the expanded work areas, based on the judgment of the agencies. BLM shall notify the

Service if project changes result in additional effects to species not previously discussed in the Biological Assessment, then formal consultation shall be re-initiated.

12. All employees shall be instructed that their activities must be confined to locations within flagged areas. Specific routes of travel shall be approved by BLM and marked prior to construction crew arrival. All cross-country vehicular travel (including survey crews) may only occur after the route has been cleared by a biologist/biological monitor. Survey crews are often required to drive cross-country to position their equipment into remote areas. All project activities within desert tortoise habitat shall be monitored by a qualified biologist.

13. When working in desert tortoise habitat, plant salvage and restoration crews shall have a qualified biologist accompany them into the field.

14. Existing routes of travel shall be used whenever possible. To the extent possible, previously disturbed areas within the project sites shall be used for the stockpiling of excavated materials, storage of equipment, digging of slurry and borrow pits, locations of trailers, parking of vehicles, and any other surface-disturbing activity. Any routes of travel that require construction or modification shall have a qualified biologist(s) survey the area for tortoises prior to modification or construction of route.

15. At least 7 days and no more than 30 days prior to initiation of construction, authorized biologists shall survey the site for desert tortoises. The site boundaries shall be flagged prior to the biological survey. All burrows located, which cannot be avoided, shall be excavated by hand during a second survey near the time of actual construction. If a burrow is determined to be difficult to excavate, a fiber-optic scope may be used to determine occupancy. If the burrow's occupancy cannot be determined using this method or if the burrow is occupied but cannot be excavated, BLM shall be notified immediately for instructions on how to proceed. BLM shall notify the Service and the Nevada Department of Wildlife (NDOW). All desert tortoise handling and burrow excavation shall be in accordance with handling procedures developed by the Service and conducted by qualified desert tortoise biologists.

- A second pre-construction survey shall be conducted no more than 24 hours prior to any ground-breaking activity during the desert tortoise active season (March 1 through October 31) and no more than 72 hours during the desert tortoise inactive season (Nov. 1-Feb 28/29). This survey allows for the removal of tortoises that may move from adjacent habitat into the previously cleared area.

- Desert tortoises shall only be moved by a qualified desert tortoise biologist and solely for the purpose of moving them out of harm's way. Appropriate State and Federal permits or approvals shall be obtained prior to handling any live tortoise, tortoise carcass, or tortoise eggs.

- The project proponent shall submit the names of all proposed qualified biologist(s) to BLM and the Service for review and approval at least 30 days prior to initiation of any desert tortoise clearance surveys. Project activities shall not begin until a qualified biologist(s) has been approved.

16. All desert tortoise burrows or pallets located in the construction footprint that cannot be avoided, whether occupied or vacant, shall be excavated by a qualified biologist and collapsed or blocked to prevent desert tortoise re-entry. All burrows shall be excavated by hand with hand tools to allow removal of desert tortoises or desert tortoise eggs. All desert tortoise burrows, other species' burrows, and natural excavations that may be used by tortoises in which the burrow end cannot be seen or occupancy cannot be determined, shall be examined with a fiber-optic scope or miniature closed-circuit video probe to determine occupancy by the desert tortoise. All burrows within 100 ft of the rights-of-way shall be flagged to ensure that they are not affected by construction personnel.

17. Desert tortoises and desert tortoise eggs shall be handled only by the qualified biologist or BLM employees trained in the proper handling techniques and only when necessary. New latex gloves shall be used when handling each desert tortoise and desert tortoise eggs to avoid the transfer of infectious diseases between animals. Desert tortoises and desert tortoise eggs shall be moved the minimum distance possible within appropriate habitat to ensure their safety. In general, desert tortoises shall not be moved in excess of 1,000 ft for adults and 300 ft for hatchlings. The qualified biologist shall follow the general handling methods contained in the "Protocols for Handling Desert Tortoises during Construction Project" (Desert Tortoise Council. 1994-revised 1999).

18. Desert tortoises that are found above ground and need to be moved from harm's way shall be placed in the shade of a shrub. All desert tortoises removed from burrows shall be placed in an unoccupied burrow of approximately the same size and orientation as the one from which it was removed. If an existing burrow is unavailable, the qualified biologist shall construct or direct the construction of a burrow of similar shape, size, depth, and orientation as the original burrow. Burrow construction protocol shall follow Section B-5-f of the *Desert Tortoise Council Guidelines for Handling Desert Tortoises during Construction Projects* developed in 1994 and revised in 1999. Desert tortoises moved during inactive periods shall be monitored for at least two days after placement in the new burrows to ensure their safety. The authorized biologist shall be allowed some judgment and discretion to ensure that survival of the desert tortoise is likely.

19. If desert tortoises need to be moved at a time of the day when ambient temperatures could harm them, <40° Fahrenheit (F) or > 90° F, they shall be held overnight in a clean cardboard box in a predator-free location. Any tortoise found within one hour before nightfall shall be held overnight in a clean cardboard box. These desert tortoises shall be kept in the care of the authorized biologist under appropriately controlled temperatures.

The tortoises shall be released the following day, when temperatures are favorable, in the area in which they were originally collected. All cardboard boxes shall be appropriately discarded after one use.

20. Qualified biologist(s) shall be assigned to monitor heavy equipment during construction for the protection of desert tortoises and to monitor compliance. The level of effort involved in this monitoring shall be dependent on whether construction is taking place during the tortoise active period (March 1 through October 31) or inactive period (Nov. 1-Feb 28/29). The following guidelines are recommended:

- In areas not enclosed by temporary tortoise exclusion fence, a biological monitor shall be assigned to each piece of ground-breaking equipment in the construction train (grader, dozer, etc.). A biological monitor shall also be assigned to all backfilling, recontouring and reclamation activities.

- If blasting is required in desert tortoise habitat, a biological monitor shall be assigned to each blasting crew or area in which blasting would occur. Prior to any blast, a 200-foot (ft) area around the blast site shall be surveyed for desert tortoises. Above-ground tortoises located shall be relocated at least 500 ft from the blast site. Desert tortoises located in burrows up to 50 ft from the blast shall be relocated at least 75 ft away from the blast site to an unoccupied existing burrow of the same size and orientation. If a suitable existing burrow is unavailable, an artificial burrow of the same size and orientation may be constructed by an approved biologist using techniques developed by the Service. Burrows occupied by desert tortoise or with undetermined occupancy status and located 50 ft to 150 ft away from the blast site, shall be flagged and stuffed with newspaper prior to the blast. The newspaper shall be removed immediately after the blast and the burrows assessed for damage. The biologist shall wear latex disposable gloves to remove the newspaper; the gloves and newspaper shall then be disposed of without contact to other items.

21. The facilities at the well sites and associated permanent structures shall include a permanent tortoise-proof fence around the facility. This can be accomplished by installing a 2-inch vertical by 1-inch horizontal wire mesh along the base of the chain-link fence. The wire mesh must be buried at least 6 inches in the ground and extend at least 18 inches above the ground surface. T-posts or suitable anchor posts will be placed at appropriate intervals (10 to 16 ft). The fence shall be inspected at least quarterly and after major precipitation events. Any damage discovered to the tortoise-proof section of the fence shall be repaired as soon as possible.

22. Staging areas and lay-down sites shall be temporarily fenced prior to commencement of surface disturbing activities. Temporary fencing may also be used to enclose the pipeline construction area. Temporary fencing materials and construction shall be the same as

permanent fencing except it may be buried at least 6 inches below ground or bent at a right angle towards the outside of the fence, and covered with dirt, rocks, or gravel to prevent the desert tortoise from digging under the fence.

If the fence construction occurs during the desert tortoise active period, (March 1 through October 31) a qualified tortoise biologist shall also be on-site during the installation. Prior to fencing, a qualified desert tortoise biologist shall conduct two, 100-percent clearance surveys. Should the fence construction activities occur during the tortoise inactive period (November 1 through February 28/29), a biologist shall thoroughly examine the proposed fence line and nearby burrows for the presence of tortoises no more than five days before construction.

23. Gates shall be installed at appropriate access points that provide minimal ground clearance and deter ingress by desert tortoises.

24. All fences shall be regularly inspected and any damage discovered will be immediately repaired.

- After fence installation is complete, a qualified desert tortoise biologist(s) shall conduct a desert tortoise survey of the area prior to initiation of any activities at the site. All tortoises found shall be relocated outside the fence or removed to an area previously approved by the Service and BLM.

25. A speed limit of 25 miles per hour (mph) shall be maintained while on the construction site, access roads, and storage areas. This requirement should reduce dust and allow a safe speed at which personnel can observe desert tortoises in the road.

26. Any time a vehicle is parked, whether the engine is engaged or not, the ground around and under the vehicle shall be inspected for desert tortoises. If one is observed, an authorized biologist shall be contacted. If possible, the tortoise will be left to move on its own or be removed and relocated by the authorized biologist following the above described procedures.

27. In areas not enclosed by temporary desert tortoise exclusionary fencing, any construction pipe, culverts or similar structures with a diameter of 3 to 24 inches that is stored on the construction site (within desert tortoise habitat) for one or more nights, shall be inspected for tortoises before the material is moved, buried or capped. As an alternative, all such structures may be capped before being stored on the construction site.

28. During the desert tortoise active period, in areas not enclosed by temporary desert tortoise exclusionary fencing, trench segments and other excavations shall be covered at the close of each working day. If covering is not possible, tortoise escape ramps (of at least 3:1 slope) shall be installed at least every ¼ mile. Or as an alternative, any trench

segment left open may be covered with temporary tortoise-proof fencing. All fences and coverings shall have zero ground clearance. All pits or other excavations shall be inspected for tortoises by a qualified biologist prior to filling. Whenever possible, open trenches or pits shall be backfilled within 72 hours. If escape ramps are used, a qualified biologist shall routinely, including following periods of substantial rainfall, inspect to ensure integrity of the escape ramps. The trench itself shall be inspected twice each day (once in the morning and once in the late afternoon) for entrapped animals.

- During the desert tortoise non-active period, in areas not enclosed by temporary desert tortoise exclusionary fencing, the trench shall be inspected at least once each day and prior to backfill. Entrapped animals shall be removed. Tortoises shall be removed only by a qualified biologist.

29. Project activities that may endanger a tortoise shall cease if a tortoise is found on a project site. Project activities shall resume after the qualified biologist removes the tortoise from danger or after the tortoise has moved to a safe area.

30. SNWA shall provide compensation for desert tortoise habitat disturbance in the following manner:

    For Disturbance of BLM-administered lands: Prior to surface disturbance activities associated with the proposed project, SNWA shall pay a remuneration fee of $291,586 into the Desert Tortoise Public Lands Conservation Fund Number 730-9999-2315 (section 7 account) for disturbance of 97.8 acres of desert tortoise critical habitat and 12.1 acres of non-critical desert tortoise habitat, both on public lands. No fees would be paid into the section 7 account for disturbance of non-desert tortoise habitat (45.0 acres) or previously disturbed habitat (19.7 acres) for a total of 64.7 acres. This fee is based on the compensation formula approved by the Desert Tortoise Management Oversight Group (Hastey *et al.* 1991) and calculated as follows: $723 per acre (base rate) X 4 (critical habitat/Category 1 habitat + long-term disturbance in accordance with the Hastey *et al.* 1991) for an adjusted base rate of $2,892 per acre of disturbance, times 97.8 acres for a total amount of $282,838 for disturbance of critical habitat. For the fee associated with disturbance of non-critical desert tortoise habitat, the amount is determined by multiplying 12.1 by $723 (factor of 1), for a total of $8,748; $282,838 + $8,748 = $291,586. This fund is administered by Clark County, and used for securing and enhancing tortoise habitat and tortoise research. The administrator serves as the banker of these funds and receives no benefit from administering these funds. These funds are independent of any other fees collected by Clark County for desert tortoise conservation planning.

    The payment shall be accompanied by the Section 7 Fee Payment Form (Attachment B), and completed by the payee. The project proponent or applicant may receive credit for payment of such fees and deduct such costs from desert tortoise impact fees charged by local government entities. Payment shall be by certified check or money order payable to Clark County (or other administrator named by BLM and the Service), and delivered to:

Clark County
Department of Comprehensive Planning
500 South Grand Central Parkway, Third Floor
Las Vegas, Nevada 89155-1712

The fee is based on a rate of $723 per acre of disturbance. If fees are paid after March 1, 2007, the rate will be indexed for inflation based on the Bureau of Labor Statistics Consumer Price Index for All Urban Consumers (CPI-U). Refer to: *http://stats.bls.gov/news.release/cpi.nws.htm*, for information on the CPI-U.

For disturbance of 11.8 acres of private lands, the Service anticipates that SNWA will pay mitigation fees in the amount of $6,490, into the Clark County MSHCP based on the rate of $550 per acre of disturbance. SNWA shall provide a receipt of payment into the MSHCP fund to BLM.

Conservation Measure Specific to Non-Emergency Repairs in Desert Tortoise Critical Habitat

Prior to conducting repairs or pipeline replacement SNWA shall notify BLM at least three weeks in advance and follow desert tortoise protocols when conducting regular maintenance and associated activities in desert tortoise critical habitat.

Conservation Measure Specific to Emergency Repairs in Desert Tortoise Critical Habitat

For emergency repairs in critical habitat, SNWA shall notify BLM immediately. A qualified biologist shall be contacted to evaluate the site and, if required, monitor the emergency action. SNWA shall follow desert tortoise protocols when conducting emergency activities in desert tortoise critical habitat.

Conservation Measure Specific to Emergency and Non-Emergency Repairs Outside of Critical Habitat

Prior to conducting non-emergency repairs or pipeline replacement, SNWA shall notify BLM at least three weeks in advance. For emergency repairs, SNWA shall notify BLM immediately. SNWA shall follow desert tortoise protocols when conducting emergency and non-emergency activities in areas outside of critical habitat.

Conservation Measures Specific for the Moapa Dace

On April 20, 2006, an MOA was signed by the participating parties which outlined specific conservation actions that each party would complete in order to minimize potential impacts to the Moapa dace from the cumulative withdrawal of 16,100 afy of groundwater from two basins within the regional carbonate aquifer system (see Appendix A; programmatic biological opinion for the analysis of the MOA).

The applicants shall implement conservation measures analyzed in the programmatic biological opinion (Appendix A) to minimize effects to the Moapa dace, and consequently, other aquatic sensitive/dependent species that occur in the Muddy River ecosystem. In order to be considered a benefit to the species, it is assumed that any proposed conservation measure will be initiated or fully implemented prior to the proposed groundwater withdrawal associated with the proposed action. While the contribution of funding is crucial to any conservation action, the completed, on-the-ground activity that results from the funding is the action that will be the evaluated benefit to the species. The true benefit to the species will only occur with the implementation of the intended action. An overview of the applicants' terms identified in the MOA (Appendix A) is provided below:

1. Implement restoration of Moapa dace habitat on the Service's Apcar Unit of the Moapa Valley NWR and/or other areas outside of the Moapa Valley NWR;

2. Develop a Recovery Implementation Program (Recovery Program), which will be used to effectuate the goals of the MOA by implementing measures necessary to accomplish the protection and promote the recovery of the Moapa dace, as well as, outline the development of regional water facilities and include additional parties as appropriate. The Recovery Program will be developed for the purposes of continuing to identify the key conservation actions that, when implemented, would continue to contribute to offset any pumping impacts that may result from groundwater pumping;

3. Assist in developing an ecological study/model designed specifically to determine effects of groundwater pumping on the Moapa dace and other aquatic-dependent species in the Muddy River system;

4. Assist in the construction of fish barriers in the Muddy River in order to prevent additional non-native fishes from migrating into Moapa dace habitat;

5. Assist in the eradication of non-native fish, such as tilapia from the historic range of Moapa dace; and,

6. Permanent dedication of an existing 1.0 cfs Jones Spring water right (MVWD) towards establishing and maintaining in-stream flows in the Apcar tributary system (which empties into the Muddy River).

In addition, minimum in-stream flow levels were also established in the MOA, and analyzed in the programmatic biological opinion, that trigger various conservation actions should those predetermined levels be reached. For a complete description of these triggers and associated actions refer to pages 13-14 in Appendix A.

Status of the Species and Designated Critical Habitat

Desert Tortoise-Rangewide Status

The desert tortoise is a large, herbivorous reptile found in portions of California, Arizona, Nevada, and Utah. It also occurs in Sonora and Sinaloa, Mexico. The Mojave population of the desert tortoise includes those animals living north and west of the Colorado River in the Mojave Desert of California, Nevada, Arizona, southwestern Utah, and in the Sonoran Desert in California. Desert tortoises reach 8 to 15 inches in carapace length. Adults have a domed carapace and relatively flat, unhinged plastron. Shell color is brownish, with yellow to tan scute centers. The forelimbs are flattened and adapted for digging and burrowing. Optimal habitat has been characterized as creosote bush scrub in which precipitation ranges from 2 to 8 inches, where a diversity of perennial plants is relatively high, and production of ephemerals is high (Luckenbach 1982; Turner 1982; Turner and Brown 1982). Soils must be friable enough for digging of burrows, but firm enough so that burrows do not collapse. Desert tortoises occur from below sea level to an elevation of 7,300 ft, but the most favorable habitat occurs at elevations of approximately 1,000 to 3,000 ft (Luckenbach 1982).

Desert tortoises are most active during the spring and early summer when annual plants are most common. Additional activity occurs during warmer fall months and occasionally after summer rainstorms. Desert tortoises spend the remainder of the year in burrows, escaping the extreme conditions of the desert. In Nevada and Arizona, tortoises are considered to be active from approximately March 15 through October 15. Further information on the range, biology, and ecology of the desert tortoise can be found in Berry and Burge (1984), Burge (1978), Burge and Bradley (1976), Bury *et al.* (1994), Germano *et al.* (1994), Hovik and Hardenbrook (1989), Karl (1981, 1983a, 1983b), Luckenbach (1982), Service (1994), and Weinstein *et al.* (1987).

On August 4, 1989, the Service published an emergency rule listing the Mojave population of the desert tortoise as endangered (54 FR 42270). On April 2, 1990, the Service determined the Mojave population of the desert tortoise to be threatened (55 FR 12178). Reasons for the determination included significant population declines, loss of habitat from construction projects such as roads, housing and energy developments, and conversion of native habitat to agriculture. Grazing and off-highway vehicle (OHV) activity have degraded additional habitat. Also cited as threatening the desert tortoise's continuing existence were illegal collection by humans for pets or consumption, upper respiratory tract disease (URTD), predation on juvenile desert tortoises by common ravens (*Corvus corax*) and kit foxes (*Vulpes macrotis*), fire, and collisions with vehicles on paved and unpaved roads.

On June 28, 1994, the Service approved the final Desert Tortoise Recovery Plan (Service 1994). The Desert Tortoise Recovery Plan divides the range of the desert tortoise into 6 recovery units (RUs) and recommends establishment of 14 Desert Wildlife Management Areas (DWMAs) throughout the RUs. Within each DWMA, the Desert Tortoise Recovery Plan recommends implementation of reserve-level protection of desert tortoise populations and habitat, while maintaining and protecting other sensitive species and ecosystem functions. The design of DWMAs should follow accepted concepts of reserve design. As part of the actions needed to accomplish recovery, the Desert Tortoise Recovery Plan recommends that land management within all DWMAs should restrict human activities that negatively impact desert tortoises (Service 1994). The DWMAs/Areas of Critical Environmental Concern (ACECs) have been designated by BLM through development or modification of their land use plans in Arizona, Nevada, Utah, and parts of California.

The California Desert Conservation Area Plan (BLM 1980) is the primary plan that guides the overall management of desert tortoise habitat in California. Land use planning activities are underway in California to complete designation of DWMAs/ACECs. Desert tortoise habitat management in Arizona is covered primarily by the Mojave Amendment to BLM's Arizona Strip Resource Management Plan (RMP), which was prepared to implement the Desert Tortoise Recovery Plan. BLM Arizona Strip Field Office designated 167,065 acres of desert tortoise habitat as ACECs. In Nevada, BLM's Las Vegas, Ely, and Battle Mountain field offices manage desert tortoise habitat; 941,800 acres of desert tortoise habitat were designated as ACECs by the Las Vegas and Ely field offices. No desert tortoise critical habitat or proposed ACECs occur within the jurisdiction of the Battle Mountain Field Office. The regulation of activities within critical habitat through section 7 consultation is based on recommendations in the Desert Tortoise Recovery Plan (Service 1994).

Long-term monitoring of desert tortoise populations is a high priority recovery task as identified in the Desert Tortoise Recovery Plan. From 1995 to 1998, pilot field studies and workshops were conducted to develop a monitoring program for desert tortoise. In 1998, the Desert Tortoise Management Oversight Group identified line distance sampling as the appropriate method to determine rangewide desert tortoise population densities and trends. Monitoring of populations using this method is underway across the range of the desert tortoise. Successful rangewide monitoring will enable managers to evaluate the overall effectiveness of recovery actions and population responses to these actions, thus guiding recovery of the Mojave desert tortoise. Rangewide tortoise population monitoring began in 2001 and is conducted annually.

Disease was identified in the 1994 Recovery Plan as an important threat to the desert tortoise. Disease is a natural phenomenon in wild populations of animals and can contribute to population declines by increasing mortality and reducing reproduction. However, URTD appears to be a complex, multi-factorial disease interacting with other stressors to affect desert tortoises (Brown *et al.* 2002; Tracy *et al.* 2004). The disease occurs mostly in relatively dense desert tortoise populations, as mycoplasmal infections are dependent upon higher densities of the host (Tracy *et al.* 2004).

Changing ecological condition as a result of natural events or human-caused activities may stress individuals and result in a more severe clinical expression of URTD (Brown *et al.* 2002). For example, the proliferation of non-native plants within the range of the tortoise has had far-reaching impacts on tortoise populations. Tortoises have been found to prefer native vegetation over non-natives (Tracy *et al.* 2004). Non-native annual plants in desert tortoise critical habitat in the western Mojave Desert were found to compose over 60 percent of the annual biomass (Brooks 1998). The reduction in quantity and quality of forage may stress tortoises and make them more susceptible to drought- and disease-related mortality (Brown *et al.* 1994). Malnutrition has been associated with several disease outbreaks in both humans and turtles (Borysenko and Lewis 1979). What is currently known with certainty about disease in the desert tortoise relates entirely to individual tortoises and not populations; virtually nothing is known about the demographic consequences of disease (Tracy *et al.* 2004).

Land managers and field scientists identified 116 species of alien plants in the Mojave and Colorado Deserts (Brooks and Esque 2002). The proliferation of non-native plant species has also contributed to an increase in fire frequency in tortoise habitat by providing sufficient fuel to carry fires, especially in the intershrub spaces that are mostly devoid of native vegetation (Service 1994; Brooks 1998; Brown and Minnich 1986). Changes in plant communities caused by alien plants and recurrent fire may negatively affect the desert tortoise by altering habitat structure and species composition of their food plants (Brooks and Esque 2002).

Desert Tortoise Recovery Plan Assessment and Recommendations

The General Accounting Office (GAO) Report, *Endangered Species: Research Strategy and Long-Term Monitoring Needed for the Mojave Desert Tortoise Recovery Program* (U.S. GAO 2002), directed the Service to periodically reassess the Recovery Plan to determine whether scientific information developed since its publication could alter implementation actions or allay some of the uncertainties about its recommendations. In response to the GAO report, the Service initiated a review of the existing Recovery Plan in 2003.

In March 2003, the Service impaneled the Desert Tortoise Recovery Plan Assessment Committee to assess the Recovery Plan. The Committee was selected to represent several important characteristics with particular emphasis on commitment to solid science. The charge to the Committee was to review the entire Recovery Plan in relation to contemporary knowledge to determine which parts of the recovery plan will need updating. The recommendations of the Committee were presented to the Service and Desert Tortoise Management Oversight Group approximately a year later, on March 24, 2004. The recommendations will be used as a guide by a recovery team of scientists and stakeholders to modify the 1994 Recovery Plan. A revised recovery plan is anticipated by the end of 2005.

The Committee recognized that the distribution and abundance data indicate trends leading away from recovery goals in some parts of the species' range. These results indicate a need for more aggressive efforts to facilitate recovery. Many of the original prescriptions of the Recovery Plan were never implemented although these prescriptions continue to be appropriate. New prescriptions should be prioritized to assess redundancies and synergies within individual threats.

Desert Tortoise RUs

The Northeastern Mojave RU occurs primarily in Nevada, but it also extends into California along the Ivanpah Valley and into extreme southwestern Utah and northwestern Arizona. Vegetation within this unit is characterized by creosote bush scrub, big galleta-scrub steppe, desert needlegrass scrub-steppe, and blackbrush scrub (in higher elevations). Topography is varied, with flats, valleys, alluvial fans, washes, and rocky slopes. Much of the northern portion of the Northeastern Mojave RU is characterized as basin and range, with elevations from 2,500 to 12,000 ft. Desert tortoises typically eat summer and winter annuals, cacti, and perennial grasses. Desert tortoises in this RU, the northern portion of which represents the northernmost distribution of the species, are typically found in low densities (about 10 to 20 adults per square mile).

A kernel analysis was conducted in 2003-2004 for the desert tortoise (Tracy *et al.* 2004) as part of the reassessment of the 1994 Recovery Plan. The kernel analyses revealed several areas in which the kernel estimations for live tortoises and carcasses did not overlap. The pattern of non-overlapping kernels that is of greatest concern is those in which there were large areas where the kernels encompassed carcasses but not live animals. These regions represent areas within DWMAs where there were likely recent die-offs or declines in tortoise populations. The kernel analysis indicated large areas in the Piute-Eldorado Valley where there were carcasses but no live tortoises. For this entire area in 2001, there were 103 miles of transects walked, and a total of 6 live and 15 dead tortoises were found, resulting in a live encounter rate of 0.06 tortoises per mile of transect for this area. This encounter rate was among the lowest that year for any of the areas sampled in the range of the Mojave Desert tortoise (Tracy *et al.* 2004).

Kernel analysis for the Coyote Springs DWMA showed areas where the distributions of carcasses and living tortoises do not overlap; however, densities of adult tortoises for the region do not show a statistical trend over time. Thus, while there may be a local die-off occurring in the northern portion of this DWMA, this does not appear to influence the overall trend in the region as interpreted by study plot data. Because permanent study plots for this region were discontinued after 1996, if there have been recent declines in numbers they are not reflected in the kernel analysis. Nevertheless, large regions of non-overlapping carcass and live tortoise kernels in the regions were not identified adjacent to the Coyote Springs DWMA. The probability of finding either a live tortoise or a carcass was relatively very low for Beaver Dam Slope and Gold-Butte Pakoon and moderately low for Mormon Mesa/Coyote Springs.

The Eastern Mojave RU is situated primarily in California, but also extends into Nevada in the Amargosa, Pahrump, and Piute valleys. In the Eastern Mojave RU, desert tortoises are often active in late summer and early autumn in addition to spring because this region receives both winter and summer rains and supports two distinct annual floras on which they can feed. Desert tortoises in the Eastern Mojave RU occupy a variety of vegetation types and feed on summer and winter annuals, cacti, perennial grasses, and herbaceous perennials. They den singly in caliche caves, bajadas, and washes. This RU is isolated from the Western Mojave RU by the Baker Sink, a low-elevation, extremely hot and arid strip that extends from Death Valley to Bristol Dry Lake. The Baker Sink area is generally not considered suitable for desert tortoises. Desert tortoise densities in the Eastern Mojave RU can vary dramatically, ranging from 5 to as much as 350 adults per square mile (Service 1994).

Ivanpah and Piute–Eldorado valleys contained study plots that were analyzed in the East Mojave RU analysis. While there was no overall statistical trend in adult density over time, the 2000 survey at Goffs and the 2002 survey at Shadow Valley indicate low densities of adult tortoises relative to earlier years. Unfortunately, there are no data in the latter years for all five study plots within this RU, and therefore, while there is no statistical trend in adult densities, we cannot conclude that tortoises have not experienced recent declines in this area. The probability of finding a carcass on a distance sampling transect was considerably higher for Ivanpah, Chemehuevi, Fenner, and Piute-Eldorado, which make up the Eastern Mojave RU.

The Northern Colorado RU is located completely in California. Here desert tortoises are found in the valleys, on bajadas and desert pavements, and to a lesser extent in the broad, well-developed washes. They feed on both summer and winter annuals and den singly in burrows under shrubs, in intershrub spaces, and rarely in washes. The climate is somewhat warmer than in other RUs, with only 2 to 12 freezing days per year. The tortoises have the California mitochondrial DNA (mtDNA) haplotype and phenotype. Allozyme frequencies differ significantly between this RU and the Western Mojave, indicating some degree of reproductive isolation between the two.

Desert tortoises in the Eastern Colorado RU, also located completely in California, occupy well-developed washes, desert pavements, piedmonts, and rocky slopes characterized by relatively species-rich Succulent Scrub, Creosote Bush Scrub, and Blue Palo Verde-Ironwood-Smoke Tree communities. Winter burrows are generally shorter in length, and activity periods are longer than elsewhere due to mild winters and substantial summer precipitation. The tortoises feed on summer and winter annuals and some cacti; they den singly. They also have the California mtDNA haplotype and shell type.

The Upper Virgin River RU encompasses all desert tortoise habitat in Washington County, Utah, except the Beaver Dam Slope, Utah population. The desert tortoise population in the area of St. George, Utah is at the extreme northeastern edge of the species' range and experiences long, cold winters (about 100 freezing days) and mild summers, during which the tortoises are continually active. Here the animals live in a complex topography consisting of canyons, mesas, sand dunes, and sandstone outcrops where the vegetation is a transitional mixture of sagebrush scrub, creosote bush scrub, blackbush scrub, and a psammophytic community. Desert tortoises use sandstone and lava caves instead of burrows, travel to sand dunes for egg-laying, and use still other habitats for foraging. Two or more desert tortoises often use the same burrow. Shell morphology and mtDNA have not been studied in this RU, but allozyme variation is similar to that found in the Northeastern Mojave RU.

The Western Mojave RU occurs completely in California and is exceptionally heterogeneous and large. It is composed of the Western Mojave, Southern Mojave, and Central Mojave regions, each of which has distinct climatic and vegetational characteristics. The most pronounced difference between the Western Mojave and other RUs is in timing of rainfall and the resulting vegetation. Most rainfall occurs in fall and winter and produces winter annuals, which are the primary food source of tortoises. Above ground activity occurs primarily in spring, associated with winter annual production. Thus, tortoises are adapted to a regime of winter rains and rare summer storms. Here, desert tortoises occur primarily in valleys, on alluvial fans, bajadas, and rolling hills in saltbrush, creosote bush, and scrub steppe communities. Tortoises dig deep burrows (usually located under shrubs on bajadas) for winter hibernation and summer aestivation. These desert tortoises generally den singly. They have a California mtDNA haplotype and a California shell type.

Desert tortoises are most commonly found within the desert scrub vegetation type, primarily in creosote bush scrub. In addition, they occur in succulent scrub, cheesebush scrub, blackbrush scrub, hopsage scrub, shadscale scrub, microphyll woodland, Mojave saltbush-allscale scrub, and scrub-steppe vegetation types of the desert and semidesert grassland complex (Service 1994). Within these vegetation types, desert tortoises potentially can survive and reproduce where their basic habitat requirements are met. These requirements include a sufficient amount and quality of forage species; shelter sites for protection from predators and environmental extremes; suitable substrates for burrowing, nesting, and overwintering; various plants for shelter; and adequate area for movement, dispersal, and gene flow. Throughout most of the Mojave Region, tortoises occur most commonly on gently sloping terrain with soils ranging from sandy-gravel and with scattered shrubs, and where there is abundant inter-shrub space for growth of herbaceous plants. Throughout their range, however, tortoises can be found in steeper, rockier areas.

The size of desert tortoise home ranges varies with respect to location and year. Females have long-term home ranges that are approximately half that of the average male, which range from 25 to 200 acres (Berry 1986). Over its lifetime, each desert tortoise may require more than 1.5 square miles of habitat and make forays of more than 7 miles at a time (Berry 1986). In drought years, the ability of tortoises to drink while surface water is available following rains may be crucial for tortoise survival. During droughts, tortoises forage over larger areas, increasing the likelihood of encounters with sources of injury or mortality including humans and other predators.

Desert Tortoise Distribution-Rangewide

The prescriptions for recovery in the Recovery Plan were for individual populations and assumed that preserving large blocks of habitat and managing threats in that habitat would be principally all that would be necessary to recover the species. However, that original paradigm, and the prescriptions made within that paradigm, may be wrong. Existing data have revealed population crashes that have occurred asynchronously across the range. There are reports that some populations, which have crashed previously, have subsequently increased in population density. Additionally, all know dense populations of desert tortoises have crashed. This suggests that density-dependent mortality occurs in desert tortoise populations, and that population dynamics may be asynchronous.

These characteristics indicate that tortoises may exist in a classic metapopulation structure (Hanski 1999; Levins and Culver 1971; Levin *et al.* 1984), and this should portend profoundly different prescriptions for recovery. In particular, if desert tortoises have historically existed in metapopulations, then connections among habitat patches are a necessary part of conservation prescriptions. Additionally, habitat suitable for tortoises, but without tortoises, should be regarded as equally necessary for recovery. Long-term persistence cannot be determined from tortoise density or tortoise numbers alone, but assessment must include the complexities of metapopulation dynamics and the habitat characteristics that promote metapopulation dynamics including habitat connectivity through inefficient corridors (*i.e.*, partial connectivity), asynchrony of subpopulation dynamics, and several separate habitat patches. Some of the characteristics of proper metapopulation function may already have been obviated by proliferation of highways, and habitat fragmentation due to satellite urbanization. Thus, management may require artificially facilitating metapopulation processes such as movement among patches.

The genetic distinctness of tortoise populations and their pathogens should be assessed to guide all manipulative management actions (*e.g.*, head starting, translocation, habitat restoration, and corridor management). The Committee proposed a revision to the previous delineation of RUs, or distinct population segments (DPSs) based on new scientific information. The recommended delineations reflect the prevailing concepts of subpopulation "discreteness," and "significance," and incorporate morphological, behavioral, genetic, and environmental information. The Committee's recommendation reduces the number of DPSs from six to five by leaving the original Upper Virgin River and Western Mojave units intact and recombining the four central units into three reconfigured units: Lower Virgin River Desert, Northeastern Mojave Desert (including Amargosa Valley, Ivanpah Valley, and Shadow Valley), and Eastern Mojave and Colorado Desert. These recommended DPSs are based largely on the best resolving biochemical/genetic data of Rainboth *et al.* (1989), Lamb *et al.* (1989), Lamb and Lydehard

(1994), and Britten *et al.* (1997). Because these delineations are general and not definitive at this time, more data and analyses are required which may result in additional modification. The action area for this consultation occurs in the Lower Virgin River Desert and Northeastern Mojave DPSs.

The 1994 Recovery Plan conceived desert tortoises to be distributed in large populations that required large areas and large densities to recover. However, existing data are consistent with the possibility that tortoises have evolved to exist in *metapopulations*. Metapopulation theory conceives that tortoises are distributed in metapopulation patches connected with corridors that allow inefficient and asynchronous movements of individuals among the patches. This paradigm conceives that some habitat patches within the range of the desert tortoise will have low population numbers or no tortoises at all, and others will have higher population numbers. Movement among the patches is necessary for persistence of the "system." If desert tortoises evolved to exist in metapopulations, then long-term persistence requires addressing habitat fragmentation caused by highways and satellite urbanization. Ensuring the integrity and function of natural corridors among habitat patches might require active management of tortoise densities in habitat patches and associated corridors.

Land managers and field scientists identified 116 species of alien plants in the Mojave and Colorado Deserts (Brooks and Esque 2002). The proliferation of non-native plant species has also contributed to an increase in fire frequency in tortoise habitat by providing sufficient fuel to carry fires, especially in the intershrub spaces that are mostly devoid of native vegetation (Service 1994; Brooks 1998; Brown and Minnich 1986). Changes in plant communities caused by alien plants and recurrent fire may negatively affect the desert tortoise by altering habitat structure and species composition of their food plants (Brooks and Esque 2002).

Disease was identified in the 1994 Recovery Plan as an important threat to the desert tortoise. Disease is a natural phenomenon in wild populations of animals and can contribute to population declines by increasing mortality and reducing reproduction. However, URTD appears to be a complex, multi-factorial disease interacting with other stressors to affect desert tortoises (Brown *et al.* 2002; Tracy *et al.* 2004). The disease occurs mostly in relatively dense desert tortoise populations, as mycoplasmal infections are dependent upon higher densities of the host (Tracy *et al.* 2004).

Desert Tortoise Reproduction-Rangewide

Desert tortoises possess a combination of life history and reproductive characteristics that affect the ability of populations to survive external threats. Tortoises grow slowly, require 15 to 20 years to reach sexual maturity, and have low reproductive rates during a long period of reproductive potential (Turner *et al.* 1984; Bury 1987; Tracy *et al.* 2004). At Yucca Mountain, Nye County Nevada (Northeastern Mojave RU), Mueller *et al.* (1998) estimated that the mean age of first reproduction was 19 to 20 years; clutch size (1 to 10 eggs) and annual fecundity (0 to 16 eggs) were related to female size but annual clutch frequency (0 to 2) was not. Further, Mueller suggested that body condition during July to October may determine the number of eggs a tortoise can produce the following spring.

McLuckie and Friedell (2002) determined that the Beaver Dam Slope desert tortoise population, within the Northeastern Mojave RU, had a lower clutch frequency (1.33 ± 0.14) per reproductive female and fewer reproductive females (14 out of 21) when compared with other Mojave desert tortoise populations. In the 1990's, Beaver Dam Slope experienced dramatic population declines due primarily to disease and habitat degradation and alteration (Service 1994). The number of eggs that a female desert tortoise can produce in a season is dependent on a variety of factors including environment, habitat, availability of forage and drinking water, and physiological condition (Henen 1997; McLuckie and Fridell 2002).

Desert Tortoise Numbers-Rangewide

Data collected on 1-square-mile permanent study plots indicate that tortoise populations have declined both in numbers of tortoises found during surveys and in densities of live tortoises at most sites since the plots were first established 20-30 years ago (Berry *et al.* 2002). Declines of 50 to 96 percent have occurred regardless of initial tortoise densities. Increases in the occurrence of shell-skeletal remains have been found to correspond with declines in numbers and densities of live tortoises with the exception of certain plots where poaching has been documented (Berry 2003).

Results of desert tortoise surveys at three survey plots in Arizona indicate that all three sites have experienced significant die-offs. Six live tortoises were located in a 2001 survey of the Beaver Dam Slope Exclosure Plot (Walker and Woodman 2002). Three had definitive signs of URTD, and two of those also had lesions indicative of cutaneous dyskeratosis. Previous surveys of this plot detected 31 live tortoises in 1996, 20 live tortoises in 1989, and 19 live tortoises in 1980. The 2001 survey report indicated that it is likely that there is no longer a reproductively viable population of tortoises on this study plot. Thirty-seven live tortoises were located in a 2002 survey of the Littlefield Plot (Young *et al.* 2002). None had definitive signs of URTD. Twenty-three tortoises had lesions indicative of cutaneous dyskeratosis. Previous surveys of this plot detected 80 live tortoises in 1998 and 46 live tortoises in 1993. The survey report indicated that the site might be in the middle of a die-off due to the high number of carcasses found since the site was last surveyed in 1998. Nine live tortoises were located during the mark phase of a 2003 survey of the Virgin Slope Plot (Goodlett and Woodman 2003). The surveyors determined that the confidence intervals of the population estimate would be excessively wide and not lead to an accurate population estimate, so the recapture phase was not conducted. One tortoise had definitive signs of URTD. Seven tortoises had lesions indicative of cutaneous dyskeratosis. Previous surveys of this plot detected 41 live tortoises in 1997 and 15 live tortoises in 1992. The survey report indicated that the site may be at the end of a die-off that began around 1996-1997.

The Western Mojave has experienced marked population declines as indicated in the Recovery Plan and continues today. Spatial analyses of the West Mojave show areas with increased probabilities of encountering dead rather than live animals, areas where kernel estimates for carcasses exist in the absence of live animals, and extensive regions where there are clusters of carcasses where there are no clusters of live animals. Collectively, these analyses point generally toward the same areas within the West Mojave, namely the northern portion of the Fremont-Kramer DWMA and the northwestern part of the Superior–Cronese DWMA. Together, these independent analyses, based on different combinations of data, all suggest the same conclusion for the Western Mojave. Data are not currently available with sufficient detail for most of the range of the desert tortoise with the exception of the Western Mojave (Tracy *et al.* 2004).

Declines in tortoise abundance appear to correspond with increased incidence of disease in tortoise populations. The Goffs permanent study plot in Ivanpah Valley, California, suffered 92 to 96 percent decreases in tortoise density between 1994 and 2000 (Berry 2003). The high prevalence of disease in Goffs tortoises likely contributed to this decline (Christopher *et al.* 2003). Upper respiratory tract disease has not yet been detected at permanent study plots in the Sonoran Desert of California, but is prevalent at study plots across the rest of the species' range (Berry 2003) and has been shown to be a contributing factor in population declines in the western Mojave Desert (Brown *et al.* 1999; Christopher *et al.* 2003). High mortality rates at permanent study plots in the northeastern and eastern Mojave and Sonoran Deserts appear to be associated with incidence of shell diseases in tortoises (Jacobson *et al.* 1994). Low levels of shell diseases were detected in many populations when the plots were first established, but were found to increase during the 1980s and 1990s (Jacobson *et al.* 1994; Christopher *et al.* 2003). A herpesvirus has recently been discovered in desert tortoises, but little is known about its effects on tortoise populations at this time (Berry *et al.* 2002; Origgi *et al.* 2002).

The kernel analysis of the Eastern Colorado RU shows that the distributions of the living tortoises and carcasses overlap for most of the region. The Chuckwalla Bench study plot occurs outside the study area, which creates a problem in evaluating what may be occurring in that area of the RU. However, the few transects walked in that portion of the DWMA yielded no observations of live or dead tortoises. This illustrates our concern for drawing conclusions from areas represented by too few study plots and leaves us with guarded concern for this region. The percentage of transects with live animals was relatively high for most DWMAs within the Eastern Colorado RU. In addition, the ratio of carcasses to live animals was low within this RU relative to others.

The status and trends of desert tortoise populations are difficult to determine based only upon assessment of tortoise density due largely to their overall low abundance, subterranean sheltering behavior, and cryptic nature of the species. Thus, monitoring and recovery should include a comprehensive assessment of the status and trends of threats and habitats as well as population distribution and abundance.

For more information on desert tortoise or expanded discussions on RUs and recommended DPSs, please refer to the Desert Tortoise Recovery Plan (Service 1994) and report prepared by the Desert Tortoise Recovery Plan Assessment Committee (Tracy *et al.* 2004).

Moapa Dace

Please refer to pages 14-30 of the programmatic biological opinion (Appendix A) for a complete description of the Moapa dace status, including the hydro-geological setting, distribution and abundance, reproduction, and threats.

Desert Tortoise Critical Habitat-Rangewide Status

On February 8, 1994, the Service designated approximately 6.45 million acres of critical habitat for the Mojave population of the desert tortoise in portions of California (4.75 million acres), Nevada (1.22 million acres), Arizona (339 thousand acres), and Utah (129 thousand acres)(59 FR 5820-5846, also see corrections in 59 FR 9032-9036), which became effective on March 10, 1994. Desert tortoise critical habitat (DTCH) was designated by the Service to identify the key biological and physical needs of the desert tortoise and key areas for recovery, and focuses conservation actions on those areas. DTCH is composed of specific geographic areas that contain the primary constituent elements of critical habitat, consisting of the biological and physical attributes essential to the species' conservation within those areas, such as space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats. The specific primary constituent elements of DTCH are: Sufficient space to support viable populations within each of the six RUs, and to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality.

Critical habitat units (CHUs) were based on recommendations for DWMAs outlined in the *Draft Recovery Plan for the Desert Tortoise (Mojave Population)* (Service 1993). These DWMAs are also identified as "desert tortoise ACECs" by BLM. Because the critical habitat boundaries were drawn to optimize reserve design, the critical habitat unit may contain both "suitable" and "unsuitable" habitat. Suitable habitat can be generally defined as areas that provide the primary constituent elements.

Although recovery of the tortoise will focus on DWMAs/ACECs, section II.A.6. of the Recovery Plan and section 2(b) of the Act provide for protection and conservation of ecosystems on which federally-listed threatened and endangered species depend, which includes both recovery and non-recovery areas. The Mojave Desert ecosystem, of which the desert tortoise and its habitat are an integral part, consists of a dynamic complex of plant, animal, fungal, and microorganism communities and their associated nonliving environment interacting as an ecological unit (Noss and Cooperrider 1994). Actions that adversely affect components of the Mojave Desert ecosystem may directly or indirectly affect the desert tortoise. The Recovery Plan further states that desert tortoises and habitat outside recovery areas may be important in recovery of the tortoise. Healthy, isolated tortoise populations outside recovery areas may have a better chance of surviving catastrophic effects such as disease, than large, contiguous populations (Service 1994).

The Recovery Plan recommended DWMAs and the Service designated CHU based on the following seven principles of conservation biology:

(1) "Reserves should be well-distributed across the species' range." The entire range of the Mojave desert tortoise occurs within the six RUs identified in the Recovery Plan and at least one DWMA and CHU occurs within each RU. The reserves remain well-distributed across the range of the desert tortoise.

(2) "Reserves should contain large blocks of habitat with large populations of target species." Each DWMA and its associated CHUs that were designated to conserve it represent contiguous blocks of habitat that exceed 500,000 acres, with the exception of the Upper Virgin River (UVR) RU (Table 1). The UVR RU does not meet the minimum size requirement identified in the Recovery Plan, however the Service anticipates that reserve-level management will adequately conserve the desert tortoise within this RU. Designation of CHUs were based largely on transect data and included areas with the largest populations of desert tortoises.

(3) "Blocks of habitat should be close together." This principle was met when CHUs were designated and remains valid.

(4) "Reserves should contain contiguous rather than fragmented habitat." This principle was met when CHUs were designated and generally continue to be met. Desert tortoise-proof fencing has been constructed along major roads and highways that traverse critical habitat including Interstate 15 in Nevada and California (Ivanpah Valley DWMA/CHU), U.S. Highway 95 in Nevada (Piute-Eldorado DWMA/CHU), and Highway 58 in California (Fremont-Kramer DWMA/CHU). Major roads and highways alone constitute a barrier to tortoise movements without fencing, however, the fencing minimized take of tortoises and culverts or underpasses allow for limited tortoise movement across the road or highway.

(5) "Habitat patches should contain minimal edge-to-area ratios." This principle was met when CHUs were designated and continue to meet this principle. Notable exceptions include the northern Gold Butte-Pakoon CHU, and the southern termini of the Mormon Mesa, Ivanpah Valley, and Chuckwalla CHUs which have large edge-to-area rations and further compromised by highways that traverse these relatively narrow areas within the CHUs.

(6) "Blocks should be interconnected by corridors or linkages connecting protected, preferred habitat for the target species." Most CHUs are contiguous with another CHU with the exception of Ord-Rodman, Ivanpah Valley, Gold Butte Pakoon, and Upper Virgin River CHUs. Interstate

15 and the Virgin River separate the Gold Butte-Pakoon CHU from other CHUs in the Northeastern Mojave RU. Similarly, Interstate 40 separates the Piute-Eldorado and Chemehuevi CHUs, and Ord Rodman and Superior-Cronese CHUs.

(7) "Blocks of habitat should be without roads or otherwise inaccessible to humans." Achieving this principle is the most problematic. A 2001 inventory of roads in the West Mojave suggests that road density increased from the mid-1980's. Further evaluation should be conducted as some of the recently mapped roads were actually historical roads especially with the advent of effective mapping capabilities (Tracy *et al.* 2004).

The recommendations for DTCH in the Recovery Plan for DTCH include elimination of specified activities that are incompatible with desert tortoise conservation including habitat destruction that diminishes the capacity of the land to support desert tortoises, and grazing by livestock, and feral burros and horses. Since approval of the Recovery Plan, all livestock grazing in DTCH has either been eliminated or substantially reduced and managed to minimize potential impacts to DTCH. BLM and NPS manage for zero burros in Nevada DTCH. The California Desert Managers Group developed a draft burro management plan in 2004.

Table 1. Desert Tortoise Critical Habitat, DWMAs, and RUs - Size and Location

CRITICAL HABITAT UNIT	DWMA	RU	STATE	CHU SIZE (AC.)
Chemehuevi	Chemehuevi	Northern Colorado	CA	937,400
Chuckwalla	Chuckwalla	Eastern Colorado	CA	1,020,600
Fremont-Kramer	Fremont-Kramer	Western Mojave	CA	518,000
Ivanpah Valley	Ivanpah Valley	Eastern Mojave	CA	632,400
Pinto Mtns.	Joshua Tree	Western Mojave/Eastern Colorado	CA	171,700
Ord-Rodman	Ord-Rodman	Western Mojave	CA	253,200
Piute-Eldorado - CA Piute-Eldorado- NV	Fenner Piute-Eldorado	Eastern Mojave Northeastern Mojave/Eastern Mojave	CA NV	453,800 516,800
Superior-Cronese	Superior-Cronese Lakes	Western Mojave	CA	766,900
Beaver Dam: NV UT AZ	 Beaver Dam Beaver Dam Beaver Dam	Northeastern Mojave (all)	 NV UT AZ	204,600 87,400 74,500 42,700
Gold Butte-Pakoon NV AZ	 Gold Butte-Pakoon Gold Butte-Pakoon	Northeastern Mojave (all)	 NV AZ	488,300 192,300 296,000
Mormon Mesa	Mormon Mesa Coyote Springs	Northeastern Mojave	NV	427,900
Upper Virgin River	Upper Virgin River	Upper Virgin River	UT	54,600

The status of desert tortoise critical habitat- rangewide was assessed for the tiered biological opinion (Service File No. 1-5-05-FW-536- Tier 01) issued to the Corps on March 2, 2006. The Corps proposed to issue a permit to CSI pursuant to Section 404 of the Clean Water Act of 1972 to allow proposed development in Coyote Spring Valley. Since March 2, 2006, the Service estimates that less than 50,000 acres of desert tortoise habitat burned across the range of the species during 2006 as a result of wildfires, which includes desert tortoise critical habitat. More precise estimates of acres affected by wildfire in 2006 are in preparation.

Further information on the status of CHUs can be found in the following documents:

- Desert Tortoise Recovery Plan Assessment Report (Tracy *et al.* 2004)-all CHUs
- Final Environmental Impact Report and Statement for the West Mojave Plan (BLM 2005)-Fremont-Kramer CHU, Superior-Cronese CHU, Ord-Rodman CHU, and Pinto Mountains CHU
- Mojave National Preserve General Management Plan (NPS 2002)-Ivanpah Valley CHU and Piute-Eldorado CHU
- Northern and Eastern Colorado Coordinated Management Plan (BLM 2002a)-Chemehuevi CHU, Pinto Mountains CHU, and Chuckwalla CHU
- Proposed Northern and Eastern Mojave Desert Management Plan (BLM 2002b)-Ivanpah Valley CHU, Piute-Eldorado CHU, and Chemehuevi CHU
- Clark County MSHCP (RECON 2000)-Beaver Dam Slope CHU, Mormon Mesa CHU, Gold Butte-Pakoon CHU, and Piute-Eldorado CHU
- Washington County Habitat Conservation Plan (HCP) (Washington County Commission 1995)
- Biological Assessment for the Proposed Addition of Maneuver Training Land at Fort Irwin, California (U.S. Army National Training Center 2003)-Superior-Cronese CHU

Environmental Baseline

Description of Affected Habitat

The project area is located in the northern reaches of the Mojave Desert within the Basin and Range complex of Nevada. Paralleling State Route 168, the proposed project extends southeasterly for 15.5 miles from the MX-5, CSI-1, and CSI-2 production wells in the Coyote

Spring Valley to a storage tank in the upper Moapa Valley. The Coyote Spring Valley is a north and south-trending valley about 50 miles north of Las Vegas. The project area is bounded by the Meadow Valley Mountains to the north and the Arrow Canyon Range to the south. The terrain in the region is characterized by alluvial bajadas in the Coyote Spring Valley, moderately rugged incised benches and up-thrusts created by seismic and volcanic events between the Meadow Valley Mountains and Arrow Canyon Range to the rolling hills and relatively flat valleys of the Moapa Valley. Elevation along the project route ranges from 2,200 ft in the Coyote Spring Valley to 1,800 ft at the project terminus in the Moapa Valley with a high of 2,400 ft and a low of 1,740 ft. The valleys in the study area were created by Miocene extension of the crust that formed the basins and ranges that make up most of Nevada today (Stewart 1980). The basins are filled primarily with Quaternary alluvium and Miocene tuffaceous sedimentary rocks. Hydrologically, the basins in the area are part of the ancient White River pluvial system (BLM 2003).

The two dominant habitat types in the upland project area are Mojave creosote bush scrub and desert saltbush scrub. The habitat is dominated by Mojave creosote bush scrub in the western 2/3rd's of the project area and gradually transitions to desert saltbush scrub in the Moapa Valley as the substrate becomes more alkaline. Included within these two dominant habitats are lesser components of desert wash scrub and mesquite woodland (bosque) (BLM 2003).

Upland desert scrub habitats in the project area include Mojave creosote bush scrub, mesquite bosque, and desert saltbush scrub. Desert scrub habitats are typically characterized by the presence of an open, scattered assemblage of shrubs and low-growing forbs and grasses. Vegetation height ranges from 0.5 to 2 meters, and canopy cover generally does not exceed 50 percent. Soils range from well-drained and coarse within Mojave creosote bush scrub communities to fine-textured and poorly-drained within desert saltbush scrub communities. A high concentration of salts often forms a hardpan subsurface in this latter community. Seasonal rainfall and surface ponding is the primary source of water (BLM 2003).

Primary resident species in upland desert scrub habitats include a diversity of reptiles, rodents, and small passerines (songbirds). Resident species are defined as those wildlife species that spend their entire life cycle within a single habitat or habitat complex. Characteristic rodent species include Merriam's kangaroo rat *(Dipodomys merriamii),* desert kangaroo rat (*Dipodomys deserti*), white-tailed antelope ground squirrel *(Ammospermophilus leucurus),* desert woodrat *(Neotoma lepida),* southern grasshopper mouse *(Onychomys torridus),* cactus mouse *(Peromyscus eremicus),* and canyon mouse *(Peromyscus crinitus).* Desert cottontail *(Sylvilagus audoboni')* and black-tailed jack rabbit *(Lepus californicus)* are also common. Resident bird species typically associated with upland desert scrub habitats include LeConte's thrasher (*Toxostoma lecontei*), common raven, house finch (*Carpodacus mexicanus*), mourning dove (*Zenaida macroura*), horned lark (*Eremophila alpestris*), rock wren (*Salpinctes obsoletus*), black-throated sparrow (*Amphispiza bilineata*), and greater roadrunner (*Geococcyx californianus*). A variety of migratory bird species also utilize desert scrub associations, either during the summer breeding season or as wintering habitat. Migratory species associated with upland desert scrub habitats in the project area include Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), yellow-rumped warbler (*Dendroica coronata*), American pipit (*Anthus rubescens*), and western burrowing owl (BLM 2003).

The open vegetative structure and abundant prey base available within desert scrub habitats also provide foraging opportunities for a variety of raptors and mammalian predators, including red-tailed hawk (*Buteo jamaicensis*), golden eagle (*Aquila chrysaetos*), great horned owl (*Bubo virginianus*), coyote, gray fox (*Urocyon cinereoargenteus*), desert kit fox, and bobcat (*Felis rufus*). These predatory species are typically associated with a mosaic of habitat types within a contiguous geographical area, and may require other habitat features, such as trees or cliffs, to fulfill habitat requirements throughout their life cycles (BLM 2003).

Upland desert scrub habitats are also associated with higher elevations in the project area such as the Las Vegas, Sheep, and Arrow Canyon Ranges. Desert bighorn sheep (*Ovis canadensis nelsoni*), one of the region's highest profile wildlife species, is a resident of this habitat within many of the local mountain ranges. NDOW indicates that a movement corridor between the Meadow Valley and Arrow Canyon ranges crosses the proposed right-of-way near mile post 22 along State Road 168 (BLM 2003).

The upper Moapa Valley also encompasses the headwaters of the Muddy River system. The Muddy River originates from a series of localized warm water springs in the area. The springs are known as the Warm Springs (aka, Muddy River Springs). The water from the springs flows into the Muddy River and the Muddy River historically flowed into the Virgin River and later into the Colorado River. With the construction of Hoover Dam and subsequent impounding of water, the Muddy River now flows into the upper Overton area of Lake Mead. The spring system is approximately 15 miles from the proposed project footprint. The springs are localized, with more than 20 springs and seeps in an approximate 1.2-mile radius (Scoppettone *et. al.* 1998). The vegetation community within the action area does not change substantially until the headwaters of the Muddy River in the upper Moapa Valley. Here, along the Muddy River and its tributaries, are the only substantial areas of riparian vegetation in the action area, consisting primarily of two non-native species: saltcedar (*Tamarix* spp.) and a non-native palm tree (*Washingtonia filifera*). Historically, these areas hosted a native broad-leaf riparian community of Fremont cottonwood (*Populus fremontii*), willow (*Salix gooddingii, S. exigua*), and velvet ash (*Fraxinus velutina*) that now exist only as small pockets, primarily along the lower Muddy River and Virgin River in Clark County.

Desert Tortoise-Status within the Action Area

Field investigations were conducted along the proposed pipeline corridor and associated facilities by Knight & Leavitt Associates in February and March 2003 (BLM 2003). These inventories were conducted using the standard survey protocol for the desert tortoise. Pedestrian transects were conducted at 33-ft intervals covering 100 percent of the construction footprint (80 ft) within the proposed pipeline (15.5 miles) and associated utility corridor (1,840 ft). Proposed above-ground facilities at the MX-5, CSI-1, and CSI-2 production well sites, the Regulating Tank and each of the 15 staging areas along the pipeline route were also surveyed at 100 percent coverage. In addition, individual pedestrian Zone of Influence (ZOI) transects were conducted at 328, 656, 1,312, and 2,625 ft from the outer edge of the 100 percent coverage surveys. ZOI surveys were limited in areas of private land where permission to access the property could not be obtained.

The surveys identified the presence of desert tortoise within the project area. A single male tortoise was observed on the 2,640 ft ZOI. Within the pipeline right-of-way footprint, only 7 burrows/pallets and 1 scat were observed. Within 33 ft of the pipeline right-of-way, sign consisted of 25 additional burrows/pallets. Desert tortoise sign observed at the MX-5 well site and the regulating tank consisted of 5 burrows and 1 pallet, respectively. Caliche caves and shelter sites observed during the survey were also documented. However, without associated tortoise sign such as scat, tracks, or plastron marks, the presence of caliches caves and shelter sites alone does not assist in determining potential desert tortoise densities in the project area. The number of burrows/pallets observed was greater on the individual ZOI transects than within proposed pipeline corridor or within 33 ft of the proposed construction footprint. Approximately 45.0 acres of the 186.4-acre project was identified as non-desert tortoise habitat, with an additional 19.7 acres that were previously disturbed (SNWA 2006).

Additional desert tortoise surveys were conducted in June 2006 for the three additional production well sites (210W117, 210W122, and 210W124) on private land in the northern part of Coyote Spring Valley (CSI property) (Figure 3). All three sites were lightly disturbed but still are considered potential desert tortoise habitat. Sites 210W117 and 210W122 had no tortoise sign. On site 210W124, a class two desert tortoise burrow was found but had no evidence of recent use (SNWA 2006).

Existing disturbance in the vicinity of the project include sparse residential housing, Palm Creek Recreational Vehicle Park, plant nursery, the Church of Jesus Christ of Latter-Day Saints' Recreation Area, power lines, MVWD water lines and associated structures, Reid Gardner Power Station, and both improved and unimproved roads.

Because many visitors come from California, Utah, and Arizona to Las Vegas and surrounding communities, traffic volume in outlying areas has increased in recent years. In addition, because mortality of desert tortoises occur along these roadways, county, Federal, and State agencies are currently installing tortoise-proof fencing along roads and highways that have been identified as problematic sources of mortality. Tortoises and their habitat are impacted by human-caused activities that occur from communities that are within a several mile radius of the project. For example, domestic dogs can be found digging up and killing desert tortoises several miles from home (Service 1994).

Desert Tortoise Critical Habitat- Status in the Action Area

DTCH anticipated to be affected by the proposed action occur within the action area for the tiered biological opinion (Service File No. 1-5-05-FW-536- Tier 01) issued to the Corps on March 2, 2006. Since March 2, 2006, no important impacts to desert tortoise critical habitat have occurred in the action area.

Moapa Dace-Status within the Action Area

Please refer to pages 31-43 of the programmatic biological opinion (Appendix A) for a complete description of the Environmental Baseline for the Moapa dace, including groundwater elevation/spring discharge relationships, current groundwater pumping at the Arrow Canyon Well and impacts, completed or ongoing conservation actions, conservation needs for the species, and major activities authorized under sections 7 and 10(a)(1)(A) of the Act in the Action Area.

<u>Additional Information on Groundwater Levels and Spring Discharge</u>

On May 4, 2007, the Service received a letter from SNWA regarding additional information on groundwater levels and spring discharge compiled since the completion of the programmatic biological opinion. SNWA noted in this letter that the additional hydrologic information is being reviewed by the Hydrologic Review Team consistent with the procedures set forth in the MOA. The Service has reviewed this information and does not regard this information as affecting our conclusions regarding the effects of groundwater pumping on the Moapa dace.

<u>Recent Information on Habitat Restoration Measures and Implementation of the MOA</u>

Since the completion of the programmatic biological opinion, significant habitat restoration work has been completed on the Plummer Unit of the Moapa Valley NWR, including removal of non-native palms and other streambed restoration. This work was undertaken by Moapa Valley NWR staff with funding provided under the Southern Nevada Public Lands Management Act (SNPLMA). As discussed in the programmatic biological opinion, the limited geographic distribution of the Moapa dace increases the vulnerability of the species to catastrophic and stochastic events. Restoration of habitat on the Plummer Unit has benefited the Moapa dace by not only expanding usable habitat within the historic range of the species, but also by providing additional habitat on the Plummer Unit, which is expected to be less susceptible to any potential declines in water levels because its springs are situated at lower elevations (See programmatic biological opinion at pages 21 and 55).

On July 20, 2006, SNWA signed a purchase agreement for acquisition of the Warm Springs Ranch, near Moapa, Nevada. The 1,200-acre ranch contains prime Moapa dace habitat and encompasses the majority of the historic range of the species. To date, $68 million in SNPLMA funding has been secured for acquisition. The transaction is expected to close by July 2007. In the meantime, SNWA is working collaboratively with the ranch owner to obtain access rights to conduct population surveys and to address maintenance and management issues for the benefit of the Moapa dace. The Service, NDOW and SNWA conducted population surveys for Moapa dace in the Warm Springs area in February 2007 and found 1172 Moapa dace in the system. Since 1999, population counts have been as high as 1296 in 2005, and as low as 907 in 2003.

As part of the MOA entered into with the Service and other parties, SNWA committed to make good faith efforts to identify and acquire additional land and water rights to benefit the Moapa dace. However, the Warm Springs Ranch is significantly beyond the scale of acquisitions contemplated by the MOA and considered in the programmatic biological opinion. It is reasonable to anticipate that acquisition of the Warm Springs Ranch, combined with habitat restoration and management for the benefit of the species will provide significant additional benefits to the Moapa dace, over and above those anticipated in the programmatic biological opinion.

The SNWA Board of Directors approved an agreement with ENTRIX, Inc. for an amount not to exceed $300,000 at its February 2007 meeting. This agreement is for the development of the Muddy River Recovery Implementation Plan. In the same board meeting, SNWA also entered into a cooperative agreement with the Service for an amount up to $950,000 to implement additional conservation measures provide for under the MOA. Furthermore, SNWA has invested approximately $10,000 in 6-inch multi-spectral aerial photography of the Muddy River to assist with habitat restoration planning.

In addition to the measures contemplated under the MOA, other activities benefiting the Moapa dace have occurred in the programmatic action area. BLM completed construction of a barrier on the mainstem Muddy River in late 2006. The barrier is located a couple miles north of the Paiute diversion structure and south of the Warm Springs Ranch. This barrier will assist in the maintenance and recovery of Moapa dace populations by preventing introduction of additional non-native species from downstream sources and assist in future removal of invasive species from Moapa dace habitat.

Factors Affecting the Desert Tortoise Environment and Critical Habitat within the Action Area

Major Activities Authorized Under Section 7 of the Act

File No. 1-5-97-F-251. On November 21, 1997, the Service issued a programmatic biological opinion to BLM for implementation of multiple-use actions within their Las Vegas District, excluding desert tortoise critical habitat, proposed desert tortoise ACECs, and the area covered by the Las Vegas Valley programmatic consultation. BLM proposes to authorize activities within the programmatic area that may result in loss of tortoises or their habitat through surface disturbance, land disposal, and fencing, for a period of five years. The total area covered by this programmatic biological opinion is approximately 2,636,600 acres, which includes approximately 263,900 acres of BLM-withdrawn lands in Clark County. This programmatic consultation is limited to activities which may affect up to 240 acres per project, and a cumulative total of 10,000 acres of desert tortoise habitat excluding land exchanges and sales. Only land disposals by sale or exchange within Clark County may be covered under this consultation up to a cumulative total of 14,637 acres. Therefore, a maximum total of 24,637 acres of desert tortoise habitat may be affected by the proposed programmatic activities. BLM collects a remuneration fee of $660 per acre of disturbance of desert tortoise habitat, as indexed for inflation.

File No. 1-5-98-F-053. On June 18, 1998, the Service issued a programmatic biological opinion to BLM for implementation of the Las Vegas RMP. BLM collects a remuneration fee of $623 per acre of disturbance of desert tortoise habitat, as indexed for inflation. The project area for this consultation covers all lands managed by BLM's Las Vegas Field Office, including desert tortoise critical habitat, proposed desert tortoise ACECs, and BLM-withdrawn land. The Las Vegas Field Office designated approximately 648 square miles of tortoise habitat as desert tortoise ACEC in the Northeastern Mojave RU, and approximately 514 square miles of tortoise habitat as desert tortoise ACEC in the East Mojave RU, through the final RMP. As identified in the RMP, BLM manages 743,209 acres of desert tortoise habitat within four tortoise ACECs for desert tortoise recovery. To accomplish recovery of the desert tortoise in the Northeastern and Eastern Mojave RUs, the Las Vegas Field Office implements appropriate management actions in desert tortoise ACECs through the RMP including:

1. Manage for zero wild horses and burros within desert tortoise ACECs.

2. Limit utility corridors to 3,000 ft in width, or less.

3. Do not authorize new landfills or military maneuvers.

4. Require reclamation for activities which result in loss or degradation of tortoise habitat, with habitat to be reclaimed so that pre-disturbance conditions can be reached within a reasonable time frame.

5. Limit all motorized and mechanized vehicles to designated roads and trails within ACECs and existing roads, trails, and defined dry washes outside ACECs.

6. Allow non-speed OHV events within ACECs, subject to restrictions and monitoring determinations.

7. Prohibit OHV speed events, mountain bike races, horse endurance rides, four-wheel hill climbs, mini-events, publicity rides, high-speed testing, and similar speed based events.

8. Within ACECs, do not allow commercial collection of flora; only allow commercial collection of fauna within ACECs upon completion of a scientifically credible study that demonstrates that commercial collection of fauna does not adversely impact affected species or their habitat. This action will not affect hunting or trapping, and casual collection as permitted by the State.

On March 3, 2000, the Service issued a programmatic biological opinion (Service File No. 1-5-99-F-450) to BLM's Ely Field Office on their proposed *Caliente Framework Management Plan Amendment for the Management of Desert Tortoise Habitat.* The opinion exempted take of tortoises for each category of management activities and loss of desert tortoise habitat totaling 25,521 acres for all activities over the 10-year term of the biological opinion. The plan outlines how BLM will manage land in the plan area to aid in the recovery and delisting of the desert tortoise within a multiple-use management context. The planning area includes all desert tortoise habitat in Lincoln County, Nevada including portions of the Mormon Mesa and Beaver Dam Slope CHUs. This land use plan amendment contains four major components:

1) Designation of three ACEC with associated management prescriptions. These areas will be managed primarily for the recovery of the desert tortoise.
2) Management prescriptions for areas inside and outside of ACECs.
3) Participation in a Service-developed and implemented environmental education program.
4) Implementation of the Service-approved interagency monitoring program (line distance sampling).

On March 2, 2006, the Service issued a Tier 01 Biological Opinion (Service File No. 1-5-05-FW-536-Tier 01) to the Corps for impacts to desert tortoise, its designated critical habitat, and Moapa dace in Lincoln and Clark counties. This biological opinion was tiered to the parent programmatic biological opinion (Service File No. 1-5-05-FW-536) that analyzed the effects of impacts and conservation measures to offset potential negative impacts of the cumulative groundwater withdrawal of 16,100 afy from the Coyote Spring Valley. These actions were identified in an MOA, which was analyzed in the abovementioned parent programmatic biological opinion. The Tier 1 biological opinion determined that based on the implementation of the measures to minimize and mitigate the effects of the action on desert tortoise and Moapa dace, the project would not jeopardize the continued existence of either species, nor adversely modify desert tortoise critical habitat.

<u>Major Activities Authorized Under Section 10(a)(1)(A) of the Act</u>

<u>File No. 1-5-91-FW-40</u>. On May 23, 1991, the Service issued a biological opinion on the issuance of a section 10(a)(1)(B) incidental take permit under the Act (No. PRT-756260). The Service

concluded that incidental take of 3,710 desert tortoises on up to 22,352 acres of habitat within the Las Vegas Valley and Boulder City in Clark County, Nevada, was not likely to jeopardize the continued existence of the desert tortoise. The permit application was accompanied by the *Short-Term HCP for the Desert Tortoise in the Las Vegas Valley, Clark County, Nevada* (Regional Environmental Consultants 1991) (Short-term HCP) and an implementation agreement that identified specific measures to minimize and mitigate the effects of the action on desert tortoises.

File No. 1-5-94-FW-237. On July 29, 1994, the Service issued a non-jeopardy biological opinion on the issuance of an amendment to the section 10(a)(1)(B) incidental take permit number PRT-756260 to extend the expiration date of the existing permit by one year (to July 31, 1995) and include an additional disturbance of 8,000 acres of desert tortoise habitat within the existing permit area. The amendment did not authorize an increase in the number of desert tortoises allowed to be taken under the existing permit. Additional measures to minimize and mitigate the effects of the amendment were also identified. Approximately 1,300 desert tortoises were taken under the authority of PRT-756260, as amended. In addition, during the Short-term HCP, as amended, approximately 541,000 acres of desert tortoise habitat have been conserved in Clark County on lands administered by BLM and NPS.

File No. 1-5-95-FW-233. On July 11, 1995, the Service issued an incidental take permit (PRT-801045) to Clark County, Nevada, including cities within the County and the NDOT, under authority of section 10(a)(1)(B) of the Act. The permit became effective August 1, 1995, and allowed the "incidental take" of desert tortoises for a period of 30 years on 111,000 acres of non-Federal land in Clark County, and approximately 2,900 acres associated with NDOT activities in Clark, Lincoln, Esmeralda, Mineral, and Nye counties, Nevada. The *Clark County Desert Conservation Plan* (Regional Environmental Consultants 1995) served as the permitees' habitat conservation plan and detailed their proposed measures to minimize, monitor, and mitigate the effects of the proposed take on the desert tortoise. The permittees imposed, and NDOT paid, a fee of $550 per acre of habitat disturbance to fund these measures. The permitees expended approximately $1.65 million per year to minimize and mitigate the potential loss of desert tortoise habitat. The majority of these funds were used to implement minimization and mitigation measures, such as increased law enforcement; construction of highway barriers; road designation, signing, closure, and rehabilitation; and tortoise inventory and monitoring within the lands initially conserved during the short-term HCP and other areas being managed for tortoise recovery (e.g., ACECs or DWMAs). The benefit to the species, as provided by the CCDCP, substantially minimized and mitigated those effects which occurred through development within the permit area and aided in recovery of the desert tortoise.

File No. 1-5-00-FW-575. On November 22, 2000, the Service issued an incidental take permit (TE-034927-0) to Clark County, Nevada, including cities within the County and the NDOT, under authority of section 10(a)(1)(B) of the Act. The permit supersedes the incidental take permit for the CCDCP. In the biological/conference opinion, the Service determined that issuance of the incidental take permit to Clark County would not jeopardize the listed desert tortoise or southwestern willow flycatcher, or any of the 76 unlisted, un-proposed species covered under the permit. Under the special permit terms and conditions of the permit, take of avian species, with the exception of American peregrine falcon (*Falco peregrinus anatum)* and phainopepla (*Phainopepla nitens*), would not be authorized until acquisition of private lands in desert riparian habitats along the Muddy and Virgin rivers, and Meadow Valley Wash has occurred. Covered avian species associated with desert riparian habitat that would benefit from this condition include southwestern willow flycatcher, yellow-billed cuckoo, blue grosbeak (*Guiraca caerulea*), summer tanager (*Piranga rubra*), vermilion flycatcher (*Pyrocephalus rubinus*), and Arizona Bell's vireo (*Vireo bellii arizonae*). The incidental take permit allows incidental take of covered species for a period of 30 years on 58,700 hectares (145,000 acres) of non-Federal land in Clark County, and within NDOT rights-of-way, south of the 38th parallel in Nevada. The Clark County MSHCP (Clark County and Service 2000), serves as the permitees' habitat conservation plan and details their proposed measures to minimize, monitor, and mitigate the effects of covered activities on the 78 species. In addition to measures specified in the MSHCP and its implementing agreement, the permittees shall comply with the special terms and conditions of the permit and measures stated in sections 3C and 3D of the CCDCP, which were incorporated by reference into the MSHCP and incidental take permit.

Factors Affecting the Moapa Dace Environment within the Action Area

Please refer to page 43 of the programmatic biological opinion (Appendix A) for a complete description of the major activities authorized under sections 7 and 10(a)(1)(A) of the Act within the Action Area.

Since the programmatic biological opinion was completed, the following additional major activity has been authorized:

File No. 1-5-05-FW-536-Tier 01. On March 2, 2006, the Service issued a non-jeopardy biological opinion to the Corps for the issuance of a Section 404 permit under the Clean Water Act of 1972, as amended, for the CSI residential development project. The Service concluded the proposed residential development is an interdependent activity with the Corps' action and will result in the permanent loss of 6,881 acres of desert tortoise habitat and take of no more than 645 desert tortoises. The proposed action falls within the scope and coverage of the 10(a)(1)(B) permit issued to Clark County for its MSHCP, and exemption for the anticipated take of the desert tortoise is provided via the incidental take statement for the MSHCP. The Service estimated that the proposed action will result in the incidental take of Moapa dace associated with the loss of 6 percent of riffle habitat and 5 percent of pool habitat. Incidental take was authorized, and reasonable and prudent measures were identified to minimize take of the species.

Effects of the Action

Direct effects encompass the immediate, often obvious effect of the proposed action on the species or its habitat. Indirect effects are caused by or will result from the proposed action and are later in time, but still reasonably certain to occur. In contrast to direct effects, indirect effects can often be more subtle, and may affect desert tortoise populations and habitat quality over an extended period of time, long after project activities have been completed. Indirect effects are of particular concern for long-lived species such as the desert tortoise, because project-related effects may not become evident in individuals or populations until years later.

The effects of the proposed action on the Moapa dace were previously analyzed in the January 30, 2006, programmatic biological opinion (Appendix A), which evaluated the effects of the cumulative groundwater withdrawal of 16,100 afy from the carbonate aquifer in Coyote Spring Valley and California Wash on the endangered Moapa dace. The applicants are only one of multiple parties that will be withdrawing groundwater from the Coyote Spring Valley basin under the programmatic action. The anticipated effects from this project are consistent with those anticipated in the programmatic biological opinion, though the effect attributable to the 9,000 afy of groundwater pumping represents only a portion of the total effect. Applicant-committed conservation measures for this project represent the majority of the conservation measures committed to by the parties to the MOA that are designed to protect and recover the Moapa dace.

Effects on the Desert Tortoise

Although the total disturbance anticipated as a result of the proposed project consists of 186.4 acres, the total disturbance of desert tortoise habitat, both publicly and privately owned, is 121.7 acres (SNWA 2006). Disturbance would consist of initial site preparation and vegetation clearing, trench construction, development of access roads, staging areas and facilities, crushing of adjacent vegetation due to parking of vehicles, storage of spoil piles, pull-off areas used when vehicles pass each other, and re-contouring during reclamation. These acreage estimates have been calculated by SNWA from the preliminary design documents. These areas will be rehabilitated as proposed by SNWA and approved by BLM after construction. Although disturbed habitat may eventually recover, habitat restoration in desert environments is a slow process and complete habitat recovery will likely require several years of good rainfall.

The pipeline alignment varies in position throughout the NDOT right-of-way, based on topography and existing utilities, and crosses the highway four times. In some places the pipeline is immediately adjacent to the highway, and in others it is at the edge of the NDOT right-of-way. In general, tortoise densities adjacent to highways are often reduced. The Knight & Leavitt study indicated that tortoise density along the project alignment is low. During future highway repairs, maintenance and/or widening, NDOT may disturb areas within their right-of-way. Through the MSHCP, permanent tortoise exclusion fencing may be installed in the future along State Route 168. This exclusion fencing is typically installed at the edge of the NDOT right-of-way.

Desert tortoises could be adversely affected during project activities. Vehicle and equipment operation in the project area and on access roads poses the greatest threat to desert tortoises. Desert tortoises could be killed, injured, or captured and moved out of harm’s way. If improperly handled, desert tortoise could be harmed or caused to void their bladder with moisture critical for their survival in the absence of rainfall. Additional harassment may occur from increased levels of noise and ground vibrations produced by vehicles and heavy equipment and blasting (Bondello 1976, Bondello *et al.* 1979). Ground vibrations can cause desert tortoises to emerge from their burrows. Tortoises may seek shelter underneath vehicles or equipment and be taken if not seen prior to moving the vehicles or equipment. Measures proposed by BLM should minimize these effects, which include: (1) provide biologists to oversee project activities, clear project areas, and appropriately handle tortoises as required, (2) construct tortoise-proof fencing around the project site, (3) educate project personnel on desert tortoise minimization measures, (4) stop work in the immediate vicinity of any tortoise that appears in the project area, (5) look for tortoises on access roads, (6) require workers to check for tortoises underneath project vehicles before moving them, (7) impose a 25 mph speed limit, (8) delineate and flag clearing limits, (9) excavate/block all tortoise burrows in the work area, (10) provide compensation to fund conservation actions, and (11) implement procedures to address blasting effects.

Tortoises may be entrapped in excavations or construction pipe or culverts. Measures proposed by BLM to construct tortoise-proof fencing around excavations, cover excavations, cap pipe, construct escape ramps for trenches and other excavations, and inspect potential entrapment areas for the presence of desert tortoises should minimize these effects.

Many animals have learned to associate human activity with food due to trash being disposed of improperly. Some of these animals such as common ravens, desert kit foxes, and coyotes also prey on the soft-shelled juvenile tortoises, thereby increasing predatory mortality. Domestic dogs brought to the site may attract canine predators to harm desert tortoises on the project site. Measures proposed by BLM to implement a litter-control program and prohibit dogs from the project site should minimize these effects.

Effects on Desert Tortoise Critical Habitat

Of the total desert tortoise habitat impacts, 109.6 acres are located within the boundaries of the designated Mormon Mesa CHU (SNWA 2006). There will be both permanent and temporary impacts to habitat as a result of the pipeline and related facilities. These include habitat within Critical Habitat on private land (11.8 acres), BLM land within NDOT ROW (88.8 acres), and BLM land outside of NDOT right-of-way (9.0 acres), and habitat outside of critical habitat on BLM land within NDOT right-of-way (6.7 acres), and BLM land outside of NDOT right-of-way (5.4 acres) for a total of 121.7 acres of impacts to desert tortoise habitat (SNWA 2006).

Additional potential habitat impacts that may result from construction activity include degradation of soil due to fuel contamination, loss of cover due to crushing and/or removal of vegetation, and introduction of nonnative plants on disturbed soil. Measures proposed by BLM to confine habitat disturbance to the smallest practical area, restrict activities to designated areas and prohibit cross-country vehicular travel, recontour and rehabilitate disturbed areas, and locate activities in previously disturbed areas where possible should minimize these effects.

Primary constituent elements of critical habitat would be affected by the proposed project to a minor degree; however, most effects would be short-term and are not anticipated to result in long-term harm to desert tortoises. Sufficient space will continue which would provide for movement, dispersal, and gene flow. Desert tortoises would continue to move across the project area upon completion of the project. Removal of native vegetation may facilitate establishment of alien plant species which may be less nutritious for the desert tortoise (Oftedal 2003). The soil would be removed by blading and equipment operations as a result of the project. If topsoil is removed, stockpiled, and replaced on disturbed areas, these effects should be relatively short-term. A relatively small amount of vegetation that serves as shelter and substrates suitable for burrowing, nesting, and overwintering will be affected by the project. Only desert tortoise burrows within the right-of-way would potentially be affected by the action.

Habitat impacts may be long-term if restoration is not successful or if alien plant species become established and displace native plants necessary to the tortoise. If a native annual and perennial plant composition returns to the rights-of-way that is similar to that currently found along the alignment, the impacts on tortoise habitat would be of shorter duration.

Considering the low-level of habitat impacts that may result from the proposed action, the Service does not anticipate that the function of the primary constituent elements of critical habitat within the affected CHU would be adversely affected to the point they no longer serve their role for conservation of the desert tortoise as identified in the Recovery Plan.

Moapa Dace

The Moapa dace will not be directly affected by the physical construction and maintenance of the proposed pipeline and associated facilities; however the groundwater pumping activities associated with the action are interrelated to the pipeline construction and will directly affect the headwater spring discharges to the Muddy River, and consequently, the Moapa dace. The pipeline will convey the 9,000 afy of groundwater that are proposed to be pumped from the Regional Carbonate Aquifer system at the MX-5 and/or CSI wells 1 and 2 in the Coyote Spring Valley (Basin 210).

Please refer to pages 44-60 in the programmatic biological opinion (Appendix A) for the complete analysis of effects to the carbonate aquifer/spring discharges and Moapa dace habitat from the cumulative groundwater withdrawal of 16,100 afy (which did include the 9,000 afy associated with this proposed action). However, that analysis was completed on a landscape level and not on a project specific level. Given the availability of more specific information associated with this proposed action, this biological opinion will concentrate on the specific effects to the Moapa dace from the actions associated with the pipeline construction and associated withdrawal of 9,000 afy of water from the regional carbonate aquifer system as described in the *Description of the Proposed Action.*

As indicated in Table 4 of the programmatic biological opinion (see page 51 in Appendix A), the effect to Moapa dace habitat resulting from the cumulative withdrawal of 16,100 afy was an approximate decrease in riffle and pool habitat by 22 percent and 16 percent, from 1998 conditions, respectively (see Pedersen Unit-Downstream Site section of Table 4). Based on the fact that the groundwater withdrawals associated with this action were included in the cumulative groundwater withdrawals evaluated in the programmatic biological opinion, we estimate that this action will affect Moapa dace habitat with the same proportion. Given this assumption, the groundwater withdrawal of 9,000 afy associated with this action is approximately 56 percent of the cumulative withdrawal of 16,100 afy. Therefore, we estimate that the specific withdrawal of 9,000 afy would result in a range-wide loss (since water flow declines at spring discharges would also have downgradient repercussions to aquatic habitat) of Moapa dace riffle and pool habitat, of approximately 12 percent (56 percent x 22 percent) and 9 percent (56 percent x 16 percent), respectively. However, this proportional effect is expected to be an upper bound on the potential effects attributable to the project.

Furthermore, Moapa dace conservation measures committed to in the MOA and considered in the programmatic biological opinion minimize the potential effects and ensure protection of the Moapa dace population within the historical range of the species. Minimum in-stream flows made certain by spring flow triggers and the dedication of water rights protects and will likely expand suitable habitat for all life stages. Restoration of habitat on the Apcar Unit of the Moapa NWR, construction of additional fish barriers and removal of non-native fishes will increase population numbers, expand occupied habitat and reduce the threat of stochastic events such as fire. Development of an ecological model will ensure continued improvement in knowledge regarding the specific ecological needs of the Moapa dace. A Recovery Program will provide coordination and funding for additional conservation measures, and a programmatic approach to future consultations. The implementation of these conservation measures coupled with the acquisition of the Warm Springs Ranch will result in the restoration and/or protection of approximately 6,350 meters of Moapa dace habitat, a 740% increase over what is currently restored and protected on the Refuge.

It should be noted that there is uncertainty inherent in extrapolating current impacts and trends into the future due to data limitations and simplifying assumptions. Since there have been no substantive pumping stresses imposed upon the regional carbonate aquifer in Coyote Spring Valley and California Wash, hydrologists are left to speculate as to the degree to which groundwater pumping in these basins will affect the Muddy Springs. The Nevada State Engineer, by Order 1169, seeks to reduce the uncertainty of the data analysis that underlies the current interpretations of the Service, SNWA and other stakeholders. The Order 1169 Pump Test, coupled with continuing monitoring throughout the Muddy Springs Area and vicinity, is expected to provide the requisite data and information to determine the impacts that pumping in Coyote Spring Valley might have on the Muddy Springs Area.

Consistent with the MOA, this data and information will be used by the Hydrologic Review Team to develop better conceptual models that describe: 1) the hydraulic connection between Coyote Spring Valley and the Muddy Springs; 2) the degree to which the fault structures that formed the Muddy Springs influence groundwater flow and spring discharge; and 3) the hydrologic influences of changing climatic conditions (e.g., droughts, wet periods, etc.).

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Actions on private lands and vehicle traffic in the action area are expected to increase appreciably as the human population and tourism increases in the area. The activities that are expected to increase in proportion to the increasing human population include, but not limited to, illegal OHV activity, trash dumping, vandalism, illegal collection or release of tortoises, release of exotic fishes, and illegal water diversions.

Desert tortoise habitat at the interface between developed lands and open desert is susceptible to negative impacts. Even near small settlements and isolated residences the same factors are present, and the collective impacts can spread in a radius of several miles from such areas. Dogs range into the desert, often for several miles, and have been found digging up and killing desert tortoises. In addition, an increase in the human population would likely result in an increase in the use of the desert, including Federal lands, for recreational activities. Recreationists often travel into undisturbed areas and may cause damage to tortoise habitat or harm to tortoises by causing wildfires, leaving trash that is harmful to tortoise or attracts predators, and producing noise or disturbance that disrupts tortoise behavior. Adults, as well as children, often use firearms and OHVs indiscriminately adjacent to towns (Service 1994).

Future demand for groundwater will continue to threaten spring flows and surface water flows that are important for aquatic species such as the Moapa dace. In the Muddy Springs Area, MVWD's existing permit would allow more groundwater to be pumped from the Arrow Canyon Well in the future. The maximum permitted pumping rate at the Arrow Canyon Well is 7,200 afy or 10.0 cfs, as compared with the annual average of 2,400 afy or 3.3 cfs pumped currently. Depending on the outcome of the Order 1169 Study mandated by the Nevada State Engineer and subsequent rulings, additional groundwater could potentially be pumped from the Coyote Spring Valley. While the MOA includes the removal of 13,600 afy in Coyote Spring Valley (Basin 210), the total volume of permitted water rights in Coyote Spring Valley is 16,300 afy. Any of the remaining permitted water rights (2,700 afy) could be developed. The maximum volume that could be removed from the Coyote Spring/Warm Springs Area under existing permits is 23,300 afy. This represents almost a ten-fold increase from current withdrawals in the system.

In addition to the existing permitted water rights, there are pending applications for a far greater volume of groundwater above and beyond the permitted amount in the Coyote Spring/Warm Springs Area, as well as in Kane Springs Valley. Both areas are part of the White River Flow System where pumping could potentially affect groundwater levels and spring discharge in the Warm Springs Area. The State Engineer, through Order 1169, held all of these pending applications in abeyance until the completion of the pump test and evaluated results. Given the possible impacts already associated with the current pumping at Arrow Canyon and the proposed pumping in Coyote Spring Valley, further groundwater development in the area would have very serious impacts on the water resources and biota in the Warm Springs Area. However, if these applications are granted, it is uncertain which would require a future Federal action in order to develop the rights upon approval.

Any future groundwater pumping by private parties, above that analyzed in this biological opinion, that is determined to affect or take Moapa dace could only legally occur under the authorization of an HCP section 10(a)(1)(B) and its associated incidental take permit issued by the Service. The Service's action of issuing such a permit would involve an internal consultation to affirm that section 7(a)(2) of the Act would not be violated.

Conclusion

The Service's signatory of the MOA, the action analyzed in the parent programmatic biological opinion, does not waive any of the statutory duties or authorities of the Service or the United States, nor relieve the participants of the MOA from complying with any Federal laws, including but not limited to, National Environmental Policy Act, Endangered Species Act, National Wildlife Refuge System Improvement Act of 1997, and Federal Land Policy and Management Act of 1976, and any and all rules and regulations there under. The biological opinion for SNWA's proposed action tiers to the programmatic document and represents the Service's project-specific analysis of the effects of SNWA's withdrawal of 9,000 afy of state-appropriated water rights from the Coyote Spring Valley basin on the endangered Moapa dace.

Desert Tortoise

After reviewing the current status of the desert tortoise, the range of the species, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of the Mojave desert population of the desert tortoise or adversely modify its critical habitat. The project's minimization measures will offset any negative impacts to the desert tortoise and the 109.6 acres of designated critical habitat in the Mormon Mesa CHU, thus the project will not be detrimental to the conservation of the species.

Moapa dace

After reviewing the current status of and environmental baseline for the Moapa dace, the effects associated with the cumulative groundwater withdrawal by multiple parties analyzed in the MOA biological opinion; the project-specific effects associated with SNWA's proposed action; and the cumulative effects; it is the Service's biological opinion that the action, as proposed and analyzed, is not likely to jeopardize the continued existence of the endangered Moapa dace. Our finding is based on implementation of the project's conservation actions within the range of the Moapa dace prior to the initiation of groundwater pumping. These conservation actions are an effort to increase the species population and expand its range from current levels and distribution in order to assure its long-term survival. Additionally, our finding is based on the assumption that the groundwater pumping proposed in the MOA and the associated effects of such pumping occur as analyzed in the programmatic and tiered biological opinions.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering (50 CFR § 17.3). Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is defined take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement. The measures provided below are non-discretionary, and must be undertaken by BLM and/or Corps so that they become binding conditions of any grant or permit issued to SNWA and/or MVWD, as appropriate, for the exemption of section 7(o)(2) to apply. BLM and the Corps have a continuing duty to regulate the activity covered by this incidental take statement. If BLM or the Corps fail to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take Anticipated

Desert tortoise

Based on the analysis of impacts provided above, measures proposed by BLM as the lead Federal agency, and anticipated project duration; the Service anticipates that the following take could occur as a result of the proposed action:

1. One desert tortoise may be accidentally injured or killed as a result of project-related activities, including vehicle encounters on access roads, within the project area.

2. An unknown number of desert tortoises encountered within the project area or access roads associated with the project may be taken by harassment or capture and movement out of harm's way during project construction activities; however, the Service believes that no more than five desert tortoises will be harassed or captured and moved.

3. An unknown number of desert tortoises may be taken in the form of indirect mortality through predation by ravens drawn to the project area; however, the Service believes this potential take will be low based upon implementation of a litter-control program.

4. An unknown number of desert tortoise eggs and non-emerged hatchlings may be moved or incidentally destroyed as a result of the project activities; however, the Service believes this potential take will be low based upon survey results.

5. An unknown number of desert tortoises may be taken indirectly in the form of harm or harassment through increased noise associated with operation of heavy equipment.

In addition, a total of 121.7 acres of desert tortoise habitat may be destroyed as a result of the proposed action (SNWA 2006).

The Service believes that no more than one desert tortoise would be accidentally injured or killed. Although unknown, the Service believes that no more than five tortoises would be taken by harassment or capture and movement out of harm's way during the proposed action; an unknown (low) number of desert tortoises may be taken in the form of indirect mortality through predation by ravens drawn to the project area; an unknown (low) number of desert tortoise eggs and non-emerged hatchlings may be moved or incidentally destroyed as a result of the project activities; an unknown number of desert tortoises may be taken indirectly in the form of harm or harassment through increased noise associated with operation of heavy equipment.

Moapa dace

The Service believes that the incidental take of Moapa dace will be difficult to detect for the following reasons: the species has a small body size; and finding a dead or impaired specimen is unlikely in flowing stream environment. However, the amount or extent of the take can be expressed as a loss of habitat resulting from a change in habitat characteristics such as water temperature or chemistry, and water flows. Although the extent of the effects to the species, as a result of proposed action is not yet known, future and on-going biological/hydrological studies will assist us in determining how changes to flow/thermal load will affect Moapa dace habitat, food availability, reproduction, and fecundity.

Perhaps the most prominent impact to the Moapa dace habitat that could occur as a result of the proposed action, as a result of decreased discharge and subsequent wetted area, is the reduction of overall volume of water that would be available to the species within the channel, thereby limiting the chance for long-term survival. Larger water volumes provide the habitat necessary for increased food production and subsequently larger fish, thus greater fecundity. Hence, more numerous, larger eggs provide a better opportunity for species long-term survival.

We have estimated that 12 percent of riffle habitat and 9 percent of pool habitat will be lost due to the withdrawal of 9,000 afy associated with this action; however there are other factors which complicate the establishment of incidental take at this level for the proposed action. Given the fact that there will be groundwater withdrawn from the same regional carbonate aquifer concurrently by different users and at different locations, it will be difficult to assign loss to a specific action. The most accurate way to establish incidental take is at the landscape-level, which was analyzed in the programmatic biological opinion. In that parent document, the cumulative withdrawal of 16,100 afy from all parties associated with the MOA predicted a loss of approximately 22 percent riffle and 16 percent pool habitat (as measured at the Warm Springs West gage downstream from the Pedersen Unit) when the flows reach 2.78 cfs (see Table 4; Appendix A). Therefore, the amount of incidental take of habitat is 22 percent loss in riffle habitat and 16 percent loss in pool habitat. Should flows at the Warm Springs West gage decline to a flow below 2.78 cfs, the amount of incidental take would be exceeded for the Moapa dace.

Effect of the Take

In the accompanying biological opinion, the Service determined that the level of anticipated take is not likely to result in jeopardy to the Moapa dace and desert tortoise, or destruction or adverse modification of its critical habitat when the minimization measures are followed as described in the project description and with the implementation of the reasonable and prudent measures.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize take of desert tortoise and Moapa dace:

1. BLM and the Corps shall implement measures to minimize injury and mortality of desert tortoises due to project-related activities and operation of heavy equipment.

2. BLM and the Corps shall implement measures to minimize entrapment of desert tortoises in open excavations or pipe.

3. BLM and the Corps shall implement measures to minimize predation on tortoises by ravens drawn to project areas.

4. BLM and the Corps shall implement measures to minimize destruction of desert tortoise habitat, such as soil compaction, erosion, or crushed vegetation due to project-related activities.

5. BLM and the Corps shall implement measures to ensure compliance with the reasonable and prudent measures, terms and conditions, reporting requirements, and reinitiation requirements contained in this biological opinion.

6. BLM and the Corps shall implement measures to minimize potential impacts to Moapa dace that may result from groundwater pumping and other activities associated with the project.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, BLM and involved Federal agencies must fully comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

The following terms and conditions: (1) restate measures proposed by BLM and the project proponent; (2) modify the measures proposed by BLM and the project proponent; or (3) specify additional measures considered necessary by the Service. Where these terms and conditions vary from or contradict the minimization measures proposed under the Description of the Proposed Action, specifications in these terms and conditions shall apply. The Service's evaluation of the effects of the proposed actions includes consideration of the measures developed by BLM and the project proponent, and repeated in the Description of the Proposed Action portion of this biological opinion, to minimize the adverse effects of the proposed action on the desert tortoise and Moapa dace. Any subsequent changes in the minimization measures proposed by BLM may constitute a modification of the proposed action and may warrant reinitiation of formal consultation, as specified in 50 CFR § 402.16. The reasonable and prudent measures are intended to clarify or supplement the protective measures as part of the proposed action.

The Corps will incorporate equivalent terms and conditions for relevant portions of the project as a condition of any funding provided under the Water Resources Development Act.

1. To implement Reasonable and Prudent Measure Number 1, BLM shall fully implement the following measures:

a. Prior to initiation of construction, a desert tortoise education program will be presented to all personnel who will be on-site, including surveyors, construction engineers, proponent employees, contractors, contractors' employees, supervisors, inspectors, and all visitors. The program shall include information on the biology of the desert tortoise and their occurrence in the project area; measures being implemented for the protection of the tortoise and its habitats during project activities; and means by which individual employees can facilitate this process. All employees shall be instructed that their activities must be confined to locations within the flagged areas. The program shall be developed by the project proponent and approved by BLM and the Service at least 15 days prior to its initial presentation. The program will be presented by a biologist familiar with the issues being presented. Wallet-size cards signifying completion of training will be provided to employees. The program will also explain "imminent danger" to the employees and discuss the actions they can take in relation to a desert tortoise in imminent danger. Imminent danger means when conditions exist in which the death or injury of a desert tortoise is immediate and unavoidable without direct human intervention.

The program shall cover the following topics at a minimum relative to the desert tortoise: occurrence and distribution within the project area, general behavior and ecology; sensitivity to human activities; legal protection and penalties for violation of State and Federal laws; reporting requirements, and project minimization measures.

b. All areas to be disturbed will have boundaries flagged before beginning the activity and all disturbances will be confined to the flagged areas. Disturbance beyond the actual construction zone is prohibited.

c. Before surface-disturbing activities, an authorized desert tortoise biologist will conduct a clearance survey to locate and remove tortoises using techniques providing 100-percent coverage of all areas. Two complete passes of complete coverage will be accomplished. All desert tortoise burrows, and other species' burrows that may be used by tortoises, will be examined to determine occupancy of each burrow by desert tortoises.

d. The project proponent shall designate an FCR, who may be a contract biologist, responsible for overseeing project activities and coordinating with the agencies.

Authorized biologists/biological monitors will be responsible for determining compliance with the required measures as defined by this biological opinion and Attachment A. The project proponent will submit completed forms (Attachment A) for all proposed authorized biologists and monitors to BLM for review and approval at least 30 days prior to initiation of any activity requiring an authorized biologist or monitor. Project activities shall not begin until authorized biologists have been approved. The FCR must also be approved by BLM. The FCR and authorized biologists/monitors shall have a copy of all appropriate stipulations when onsite, and perform their duties independent of the project proponent.

The FCR and authorized biologist/biological monitor shall have authority to halt all activities that are not in compliance with this biological opinion. Actions will be halted long enough to remedy the immediate situation and will apply only for the equipment and parties involved in the situation. All actions of non-compliance or conditions that threaten a listed species will be recorded and reported to the project proponent, BLM, and the Service immediately.

e. Incidences of observations or listed species and their sign during activities shall be conveyed to an authorized biologist and/or FCR.

f. Domestic dogs shall be prohibited from the project site.

g. Specific routes of travel shall be approved by BLM and marked prior to construction crew arrival. Cross-country, vehicular travel outside of the right-of-way is prohibited unless approved by BLM and cleared by an authorized biologist. This includes pre-construction work activities such as survey and flagging of the work area.

h. At least 7 days, and no more than 30 days prior to initiation of construction, authorized biologists shall survey the site for desert tortoises. The site boundaries shall be flagged prior to the biological survey.

i. The second pre-construction survey will be conducted no more than 24 hours prior to any ground-breaking activity. If conditions have been determined to be unfavorable for desert tortoise activity as determined by the authorized biologist, the pre-construction survey shall be conducted no more than 72 hours prior to any ground-breaking activity. BLM and the Service shall determine when conditions are favorable for desert tortoise activity/inactivity.

j. Desert tortoises will only be moved by an authorized desert tortoise biologist and solely for the purpose of moving them out of harm's way.

k. All desert tortoise burrows or pallets located in the construction footprint that cannot be avoided, whether occupied or vacant, will be excavated by an authorized biologist and collapsed or blocked to prevent desert tortoise re-entry. All burrows will be excavated by hand with hand tools to allow removal of desert tortoises or desert tortoise eggs. All desert tortoise burrows, other species' burrows, and natural excavations that may be used by tortoises in which the burrow end cannot be seen or occupancy cannot be determined, will be examined with a fiber-optic scope or miniature closed-circuit video probe to determine occupancy by desert tortoise. All burrows within 100 ft of the right-of-way will be flagged to ensure that they are not affected by construction personnel.

l. Desert tortoises and desert tortoise eggs shall be handled only by the authorized biologist and only when necessary. New latex gloves shall be used when handling each desert tortoise and desert tortoise eggs to avoid the transfer of infectious diseases between animals. Desert tortoises and desert tortoise eggs shall be moved the minimum distance possible within appropriate habitat to ensure their safety. In general, desert tortoises shall not be moved in excess of 1,000 ft for adults and 300 ft for hatchlings. The authorized biologist shall follow the general handling methods contained in Service-approved protocol (Desert Tortoise Council 1994, revised 1999).

m. Desert tortoises that are found above-ground and need to be moved from harm's way shall be placed in the shade of a shrub. All desert tortoises removed from burrows shall be placed in an unoccupied burrow of approximately the same size and orientation as the one from which it was removed. If an existing burrow is unavailable, the authorized biologist shall construct or direct the construction of a burrow of similar shape, size depth, and orientation as the original burrow. Burrow construction protocol will follow Section B-5-f of the Service-approved protocol (Desert Tortoise Council 1994, revised 1999). Desert tortoises moved during inactive periods shall be monitored for at least two days after placement in the new burrows to ensure their safety. The authorized biologist shall use professional judgment and discretion to ensure that survival of the desert tortoise.

n. If desert tortoises need to be moved at a time of the day when ambient temperatures could harm them (<10° C or 50° F or > 35° C or 95 ° F), or found within one hour before nightfall, shall be held overnight in a clean cardboard box in a predator-free location. These desert tortoises shall be kept in the care of the authorized biologist under appropriate controlled temperatures. The tortoises shall be released the following day in the area in which they were originally collected or when temperatures are favorable. All cardboard boxes shall be appropriately discarded after one use.

o. In areas not enclosed by tortoise exclusion fence, a biological monitor will be assigned to each piece of ground-breaking equipment. A biological monitor will also be assigned to all backfilling, recontouring and reclamation activities, and all access roads used by project vehicles and equipment.

p. If blasting is required in desert tortoise habitat, a biological monitor will be assigned to each blasting crew or area in which blasting would occur. Prior to any blast, a 61m (200 ft) area around the blast site will be surveyed for desert tortoises. Above-ground tortoises located will be relocated at least 152 m (500 ft) from the blast site. Desert tortoises located in burrows up to 15m (50 ft) from the blast will be relocated at least 23m (75 ft) away from the blast site to an unoccupied existing burrow of the same size and orientation. If a suitable existing burrow is unavailable, an artificial burrow of the same size and orientation may be constructed by an authorized biologist using Service-approved techniques (Desert Tortoise Council 1994, revised 1999). Burrows occupied by desert tortoise or with undetermined occupancy status and located 15 to 45m (50 to 150 ft) away from the blast site, shall be flagged and stuffed with newspaper prior to the blast. The newspaper will be removed immediately after the blast, and the burrows assessed for damage.

q. The facilities at the permanent well sites and the Regulating Tank site will include a permanent tortoise-proof fence around the facility. This shall be accomplished by installing a 2-inch vertical by 1-inch horizontal wire mesh along the base of the chain-link fence. The wire mesh must be buried at least 6 inches and extend at least 18 inches above the ground surface. T-posts or suitable anchor posts will be placed at appropriate intervals (*i.e.*, 10 to 16 ft). The fence will be inspected at least quarterly and after major precipitation events. Any damage discovered to the tortoise-proof section of the fence will be repaired as soon as possible.

r. Staging areas and laydown sites will be temporarily fenced prior to commencement of surface disturbing activities. Temporary fence may also be used to enclose the pipeline construction area. Temporary fencing materials and construction will be the same as permanent fencing except it may be bent at a right angle towards the outside of the fence, and covered with dirt, rocks, or gravel to prevent the desert tortoise from digging under the fence as an alternative to burying the fence at least 15cm (6 in) below the surface.

As an alternative to payment of the remuneration fees and temporary fencing described below, SNWA and the Service would develop a strategy to provide long-term conservation to the desert tortoise. Such a strategy may involve SNWA and the Service working in collaboration to install permanent desert tortoise-proof fencing along both sides of SR 168 (Z. Marshall, SNWA, pers. comm.), at the outermost boundary of the NDOT's right-of-way to fulfill the fencing needs for SR 168 beyond those fencing commitments of CSI. The permanent fencing would be constructed instead of the temporary fencing previously proposed by SNWA. Because the extent of permanent fencing exceeds the level and cost of temporary fencing proposed for the project, SNWA will receive credit towards remuneration fees described below for the difference. SNWA and the Service estimate that the total amount of remuneration fees required to fence SR 168 are equal to the difference between proposed permanent and temporary fencing.

However, fencing must be in place before construction of the pipeline commences with the exception of plant salvage activities which may be conducted prior to fence construction provided a desert tortoise biologist or monitor is onsite to oversee such activities and ensure that tortoises are not harmed.

s. If the fence construction occurs during conditions favorable for desert tortoise activity, as determined by the authorized biologist, a monitor will be onsite during the installation. Prior to fencing, an authorized desert tortoise biologist will conduct two 100-percent clearance surveys. If the fence construction occurs during conditions that have been determined to be unfavorable for desert tortoise activity, as determined by the authorized biologist, a biologist will thoroughly examine the proposed fence line and nearby burrows for the presence of tortoises no more than five days before construction, and a monitor is not required during fence construction if no tortoises were observed in the area surveyed within five days.

t. Gates will be installed at appropriate access points that provide zero ground clearance and deter ingress by desert tortoises.

u. After installation is complete, an authorized desert tortoise biologist(s) will conduct a desert tortoise survey of the area prior to initiation of any activities at the site using techniques that provide 100-percent coverage of the parcel. All tortoises found will be relocated outside the fence, or removed to an area previously approved by the agencies.

v. All fences will be regularly inspected and any gaps, breaches, or damage will be immediately repaired.

w. A speed limit of 25 mph will be established and enforced on the construction site, access roads, and storage areas.

x. Any time a vehicle is parked, whether the engine is engaged or not, the ground around and under the vehicle will be inspected for desert tortoises. If one is observed, an authorized biologist will be contacted. If possible, the tortoise will be left to move on its own, or removed and relocated by the authorized biologist following the above described procedures.

y. Prior to discharge for hydrostatic testing, the discharge and drainage location will be surveyed for sensitive species and relocated in accordance with the measures described in this biological opinion and the Service-approved protocol (Desert Tortoise Council 1994, revised 1999).

2. To implement Reasonable and Prudent Measure Number 2, BLM shall fully implement the following measures:

   a. During conditions favorable for desert tortoise activity as determined by the authorized biologist, in areas not enclosed by desert tortoise exclusionary fencing, trench segments and other excavations will be either: (1) covered at the close of each working day, (2) tortoise escape ramps (of at least 3:1 slope) will be installed at least every ¼ mile, or (3) covered with temporary tortoise-proof fencing. All fences and coverings will have zero ground clearance. All pits or other excavations will be inspected for tortoises by an authorized biologist/monitor prior to filling. Whenever possible, open trenches or pits will be backfilled within 72 hours. If escape ramps are used, an authorized biologist/monitor will routinely, including following periods of substantial rainfall, inspect to ensure integrity of the escape ramps. The trench will be inspected at least twice each day (once in the morning and once in the late afternoon) for entrapped animals.

      During conditions unfavorable for desert tortoise activity as determined by the authorized biologist, in areas not enclosed by temporary desert tortoise exclusionary fencing, the trench will be inspected at least once each day and prior to backfill.

   b. Desert tortoises found entrapped in open holes or excavations, will be removed by an authorized biologist.

   c. In areas not enclosed by desert tortoise exclusionary fencing, any construction pipe, culverts or similar structures that are stored on the construction site (within desert tortoise habitat) for one or more nights, will be inspected for tortoises before the material is moved, buried or capped. As an alternative, all such structures may be capped before being stored on the construction site.

3. To implement Reasonable and Prudent Measure Number 3, BLM shall fully implement the following measure:

   Trash and food items will be contained in closed containers and removed regularly (at least once a week) to reduce attractiveness to opportunistic predators such as ravens, coyotes, and feral dogs. This trash will be disposed of properly. Trash includes but is not limited to, cigarettes, cigars, gum wrappers, tissue, cans, paper, and bags. Upon project completion, all construction refuse, including, but not limited to, broken equipment parts, wrapping material, cords, cables, wire, rope, strapping, twine, buckets, metal or plastic containers, and boxes, will be removed from the site and disposed of properly.

4. To implement Reasonable and Prudent Measure Number 4, BLM shall fully implement the following measures:

a. Any fuel, transmission or break fluid leaks or hazardous waste leak, spills or releases will be stopped/repaired immediately and cleaned up at the time of occurrence. All heavy equipment and vehicles will carry a bucket and pads to absorb leaks or spills. Contaminated soil will be removed and disposed of at an appropriate facility. If spills occur in a maintenance yard, they will be cleaned up after construction is complete.

b. The area of disturbance shall be confined to the smallest practical area, considering topography, placement of facilities, location of sensitive resources including desert tortoise burrows, public health and safety, and other limiting factors. All storage areas shall be surveyed by a qualified biologist prior to use for construction efforts. Stockpiles, laydown sites, storage areas, and turnaround sites will be located in previously disturbed areas to the extent that this is practical. Existing routes of travel shall be used whenever possible. Work area boundaries shall be clearly delineated with flagging, fencing or other marking, to minimize surface disturbance.

c. After construction, the area will be recontoured to match as closely as possible, the original contours of the area as required, and reclamation will be implemented. A formal reclamation plan will be developed following standard BLM protocols. All restoration techniques will be designed to achieve an agency-set rehabilitation criterion. This is typically 50 percent of the range site potential over a seven-year period. Final criteria will be included in the reclamation plan.

d. Where possible, vegetation will be crushed instead of removed by blading. Cacti, yucca and identified sensitive plant species will be avoided or salvaged. All cactus and yucca that cannot be avoided during construction or a percentage determined by BLM, will be salvaged from the construction right-of-way and maintained appropriately at offsite nursery areas identified by BLM. At completion of construction or at a time most appropriate for the plants, all cacti and yucca will be transplanted back within the right-of-way in critical habitat.

e. Topsoil will be removed, stored, and replaced in all areas disturbed as a result of the project to salvage the seed bed. Topsoil will be salvaged to a depth of 15cm (6 inches). Removed topsoil will be windrowed at the edge of the right-of-way and spread uniformly over the area from which it was removed immediately after the completion of construction for that area. Any seed used for restoration will be BLM-approved seed mix taken from native sources and preferably plants within or adjacent to the right-of-way. An example would be rosy twotone beardtongue, which can be easily collected when the plants are senescent.

f. All activities shall be restricted to the right-of-way and approved access roads/storage areas. If unforeseen circumstances require expansion of this width, prior written approval of BLM must be obtained. The potential expanded work areas shall be surveyed for species prior to use of the area. All appropriate measures shall be implemented within the expanded work areas. BLM will notify the Service if project changes results in additional effects to species not addressed in this biological opinion.

g. Any routes of travel that require construction or modification shall have a qualified biologist survey the area for tortoises prior to modification or construction of route including plant salvage and restoration crews.

h. For Disturbance of BLM-administered lands: Prior to surface disturbance activities associated with the proposed project, SNWA shall pay a remuneration fee of $291,586 into the Desert Tortoise Public Lands Conservation Fund Number 730-9999-2315 (section 7 account) for disturbance of 97.8 acres of desert tortoise critical habitat and 12.1 acres of non-critical desert tortoise habitat, both on public lands. No fees would be paid into the section 7 account for disturbance of the either non-desert tortoise habitat (45.0 acres) or previously disturbed habitat (19.7 acres) for a total of 64.7 acres. This fee is based on the compensation formula approved by the Desert Tortoise Management Oversight Group (Hastey *et al.* 1991) and calculated as follows: $723 per acre (base rate) X 4 (critical habitat/Category 1 habitat + long-term disturbance in accordance with the Hastey *et al.* 1991) for an adjusted base rate of $2,892 per acre of disturbance, times 97.8 acres for a total amount of $282,838 for disturbance of critical habitat. For the fee associated with disturbance of non-critical desert tortoise habitat, the amount is determined by multiplying 12.1 by $723 (factor of 1), for a total of $8,748; $282,838 + $8,748 = $291,586. This fund is administered by Clark County, and used for securing and enhancing tortoise habitat and tortoise research. The administrator serves as the banker of these funds and receives no benefit from administering these funds. These funds are independent of any other fees collected by Clark County for desert tortoise conservation planning.

The payment shall be accompanied by the Section 7 Fee Payment Form (Attachment B), and completed by the payee. The project proponent or applicant may receive credit for payment of such fees and deduct such costs from desert tortoise impact fees charged by local government entities. Payment shall be by certified check or money order payable to Clark County (or other administrator named by BLM and the Service), and delivered to:

Clark County
Department of Comprehensive Planning
500 South Grand Central Parkway, Third Floor
Las Vegas, Nevada 89155-1712

The fee is based on a rate of $723 per acre of disturbance. If fees are paid after March 1, 2007, the rate will be indexed for inflation based on the Bureau of Labor Statistics Consumer Price Index for All Urban Consumers (CPI-U). Refer to: *http://stats.bls.gov/news.release/cpi.nws.htm*, for information on the CPI-U. For disturbance of 11.8 acres of private lands, the Service anticipates that SNWA will pay mitigation fees in the amount of $6,490, into the Clark County MSHCP based on the rate of $550 per acre of disturbance. SNWA shall provide a receipt of payment into the MSHCP fund to BLM.

5. To implement Reasonable and Prudent Measure Number 5, BLM shall fully implement the following measures:

   a. Appropriate State permits or approvals will be obtained prior to handling any live tortoise, tortoise carcass, or tortoise eggs.

   b. In accordance with *Procedures for Endangered Species Act Compliance for the Mojave Desert Tortoise* (Service 1992), an authorized desert tortoise biologist shall possess a bachelor's degree in biology, ecology, wildlife biology, herpetology, or closely related fields. The biologist must have demonstrated prior field experience using accepted resource agency techniques to survey for desert tortoises and tortoise sign. In addition, the biologist shall have the ability to recognize and accurately record survey results.

   c. The onsite biologist(s) will record each observation of desert tortoise within the project area. Information will include the following: Location, date, and time of observation; whether the tortoise was handled; general health and whether it voided its bladder; if moved, the point of release and distance moved; and unique characteristics of each tortoise. Reports documenting the observations, the effectiveness and compliance with the Terms and Conditions of this biological opinion will be submitted to BLM and the Service within 90 days of completion of construction.

      Reporting requirements for groundwater elevations in monitoring wells and surface water measurement sites will be in accordance with the Monitoring, Management, and Mitigation Plan, as established by the stipulated agreement.

6. To implement Reasonable and Prudent Measure Number 6, BLM shall fully implement the following measures prior to groundwater withdrawals (MOA in Appendix A):

a. MVWD will permanently dedicate the 1.0 cfs Jones Spring water right to the Apcar Stream for long term Moapa dace habitat;

b. SNWA will provide funding and implement the actions associated with their contribution of $300,000 for the development of a Recovery Program;

c. SNWA will provide funding and implement the actions associated with their contribution of $125,000 towards the development of an ecological model designed to investigate the effects of habitat change on the Moapa dace;

d. SNWA will provide funding and implement the actions associated with their contribution of $750,000 for restoration of habitat on the Apcar Unit of the Moapa Valley NWR or otherwise;

e. SNWA will provide funding and implement the actions associated with their contribution of $50,000 to construct fish barriers to assist in the elimination of predacious non-native fishes from Moapa dace habitat;

f. SNWA will provide funding and implement the actions associated with their contribution of $25,000 to implement programs related to the eradication of non-native fish species in the Warm Springs Area;

g. SNWA agrees to implement the protection of instream flows, as described in the MOA;

h. SNWA and MVWD agree to implement Adaptive Management Measures, as described in MOA;

i. SNWA and MVWD agree to participate in the Hydrologic Review Team, as described in the MOA;

j. SNWA will continuously monitor groundwater elevations in monitoring wells and surface water measurement sites in accordance with the Monitoring, Management, and Mitigation Plan outlined in the Biological Assessment. This includes working with USGS to equip Pedersen, Pedersen East, and Warm Springs West Gaging stations with real-time telemetry instrumentation, which can be remotely accessed by the Service and downloadable 24 hours a day, 7 days a week. If the Technical Review Panel, established by the stipulated agreement, or Hydrologic Review Team established by the MOA, identifies additional needs for surface water monitoring, SNWA will fund and establish such sites; and

k. To assist the Service in their efforts to achieve the goals of the Recovery Plan for the Muddy River Ecosystem, SNWA will continue to contribute funds and/or in-kind services to the annual fishery surveys and other biological monitoring activities identified by the Muddy River Recovery Implementation Team or Recovery Program.

Reporting Requirements

Upon locating a dead or injured endangered or threatened species, initial notification must be made to the Service at (702) 515-5230. Care should be taken in handling sick or injured fauna in order to ensure effective treatment and care. In addition, care should be given in the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured species or preservation of biological materials from a dead animal or fish, the finder has the responsibility to carry out instructions provided by the Service to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed. All deaths, injuries, and illnesses of Moapa dace, whether associated with project activities or not must be reported to the Service.

The following actions should be taken for injured or dead dace if directed by the Service:

Dead Moapa dace suitable for preparation as museum specimens shall be frozen immediately and provided to the Service's Southern Nevada Field Office in Las Vegas, Nevada.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As stated in the programmatic biological opinion, the following conservation recommendations should be considered:

1. Acquire Moapa dace habitat and/or water rights that are currently privately owned and secure the management of these rights for the long-term benefit of the Moapa dace in perpetuity;
2. Restore and enhance additional Moapa dace habitat. This includes funding restoration actions at Baldwin Spring, Cardy Lamb, and/or Muddy Spring or other areas identified by the Muddy River Recovery Implementation Team or Recovery Program;
3. Provide funding for pre- and post-construction monitoring of water quality and quantity throughout the range of the species;
4. Amend the existing access agreement that SNWA has with the owners of the Warm Springs Ranch to include the Service and NDOW for the continued implementation of recovery actions; and

5. Work with the Service and NDOW to develop and implement a Moapa dace habitat restoration/monitoring plan.

In order for the Service to be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

Reinitiation Notice

This concludes formal consultation on the actions outlined in your request. As required by 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over an action has been retained (or is authorized by law) and if: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the parent programmatic biological opinion or this tiered biological opinion; (4) a new species is listed or critical habitat designated that may be affected by the action; (5) there is failure to meet any of the measures or stipulations in the MOA; or (6) assumptions used for the programmatic biological opinion's analysis have not been met or become invalid. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any question of if we can be of any further assistance, please contact Janet Bair at (702) 515-5230 or me at (775) 861-6300.

Robert D. Williams

Attachments

cc: (w/o attachments)
Deputy General Manager, Engineering Operations, Southern Nevada Water Authority, Las Vegas, Nevada
General Manager, Moapa Valley Water District, Moapa, Nevada
Chairman, Moapa Band of Paiutes, Moapa, Nevada
President, Coyote Springs Investment, LLC; Sparks, Nevada
Chief, Planning Division, Department of Army, Los Angeles District Corps of Engineers Office, Los Angeles, California
State Director, Nevada State Office, Bureau of Land Management, Reno, Nevada
Complex Manager, Desert National Wildlife Refuge Complex, Las Vegas, Nevada

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Appendix A

Intra-Service Programmatic Biological Opinion for the Proposed Muddy River Memorandum of Agreement Regarding the Groundwater Withdrawal of 16,100 Acre-Feet per Year from the Regional Carbonate Aquifer in the Coyote Spring Valley and California Wash Basins and Establish Conservation Measures for the Moapa dace, Clark County, Nevada - 1-5-05-FW-536 dated January 30, 2006

ATTACHMENT A

DESERT TORTOISE MONITOR AND BIOLOGIST RESPONSIBILITIES AND QUALIFICATIONS

DESERT TORTOISE MONITOR -- Approved by the Fish and Wildlife Service to monitor project activities within desert tortoise habitat, ensure proper implementation of protective measures, and record and report desert tortoise and sign observations in accordance with approved protocol, report incidents of noncompliance in accordance with a biological opinion or permit, move desert tortoises from harm's way when desert tortoises enter project sites and place these animals in "safe areas" pre-selected by Authorized Biologists or maintain the desert tortoises in their immediate possession until an Authorized Biologist assumes care of the animal. Monitors assist Authorized Biologists during surveys and often serve as "apprentices" to acquire experience. Monitors are not authorized to conduct presence/absence or clearance surveys unless directly supervised by an Authorized Biologist; "directly supervised" means the Authorized Biologist is direct voice and sight contact with the Monitor.

AUTHORIZED BIOLOGIST – Approved by the Fish and Wildlife Service to conduct all activities described in the previous section for Desert Tortoise Monitors, and to locate desert tortoises and their sign (i.e., conduct presence/absence and clearance surveys) and ensure that the effects of the project on the desert tortoise and its habitat are minimized in accordance with a biological opinion incidental take permit. Authorized Biologists must keep current with the latest information on U.S. Fish and Wildlife Service protocols and guidelines. An Authorized Biologist must have thorough and current knowledge of desert tortoise behavior, natural history, and ecology, physiology, and demonstrated substantial field experience and training to safely and successfully:

- handle and temporarily hold desert tortoises
- excavate burrows to locate desert tortoise or eggs
- relocate/translocate desert tortoises
- reconstruct desert tortoise burrows
- unearth and relocate desert tortoise eggs
- locate, identify, and record all forms of desert tortoise sign

GENERAL DESERT TORTOISE BIOLOGIST/MONITOR QUALIFICATIONS STATEMENT

This form should be used to provide your qualifications to agency officials if you intend to handle or survey desert tortoises during construction or other projects authorized under Sections 7 or 10 (HCPs) of the Endangered Species Act. If you seek approval to attach/remove/insert any devices or equipment to/into desert tortoises, withdraw blood, or conduct other procedures on desert tortoises, a recovery permit or similar authorization may be required.

Application for a recovery permit requires completion of Form 3-200-55, which can be downloaded at http://www.fws.gov/forms/3-200-55.pdf. Supplemental information for the recovery permit application should be provided with the form, *Statement of Skills and Experience with Specialized Desert Tortoise Procedures,* which is available from a U.S. Fish and Wildlife Service Field Office.

1. Contact Information:

Name	
Address	
City, State, Zip Code	
Phone Number(s)	
Email Address	

2. **Date of Statement:**

3. **States in which authorization is requested (check all that apply):**

☐ California ☐ Nevada ☐ Utah ☐ Arizona

4. **Please provide information on the project:**

USFWS BO or HCP Number		**Date:**
Project Name		
Federal Agency		
Proponent or Contractor		

5. **Specify project and/or activities anticipated that require authorization (e.g. capture/release, weigh, measure, attach and remove telemetry devices and other hardware, etc.). Specifically reference the relevant document and page numbers with authorizing statements (e.g., BO, page 19, terms and conditions 6, 7, and 8):**

6. **If you hold, or have held, any relevant state or federal wildlife permits, provide the following:**

Species	Dates	State (specify) or Federal Permit Number	Authorized Activities

7. **Education (provide up to three, listing most recent first):**

Institution	Dates attended	Major/Minor	Degree received
1.			
2.			
3.			

8. Desert Tortoise Training. Include numbers of animals handled under the Experience section (No. 9 below).

Name/Type of Training	Dates (From/To)	Location	Instructor/Sponsor
1.			
2.			
3.			
4.			

9. **Experience –** Complete for each position held, attach additional sheets as necessary. Include only those positions relevant to the requested work with desert tortoises. Distinguish between Mojave desert tortoise and other experience. Include only your experience, not information for the project you worked on (e.g. if 100 tortoises were handled on a project and you handled 5 of those tortoises, include only those 5). List most recent experience first.

General Field Experience:

Project Name & Job Title	Dates (From/To)	Job Duties & Responsibilities/ Skills Used or Acquired
1.		
2.		
3.		
4.		

Specific Desert Tortoise Field Experience:

a. **Number of hours or 8-hour days (specify) conducting desert tortoise-related activities (referenced above):**

b. **Number of miles/kilometers walked conducting survey transects:**

c. **Number of wild, free-ranging desert tortoises you encountered.** **<100 mm carapace length:**

≥100 mm carapace length:

d. **Number of wild, free-ranging desert tortoises you personally handled (circle one for each size category).**

<100 mm:	Zero	<10	10-50	50-100	100-200	>200
≥100 mm:	Zero	<10	10-50	50-100	100-200	>200

e. **Number of captive desert tortoises you personally handled (circle one for each size category).**

<100 mm:	Zero	<10	10-50	50-100	100-200	>200
≥100 mm:	Zero	<10	10-50	50-100	100-200	>200

f. **Number of transmitters or other devices (specify) you personally attached to or removed from wild, free-ranging desert tortoises (circle one for each size category).**

Attached:

<100 mm:	Zero	<10	10-50	50-100	100-200	>200
≥100 mm:	Zero	<10	10-50	50-100	100-200	>200

Removed:

<100 mm:	Zero	<10	10-50	50-100	100-200	>200
≥100 mm:	Zero	<10	10-50	50-100	100-200	>200

g. **Number of transmitters or other devices (specify) you personally attached to or removed from other relevant species or captive desert tortoises (circle one for each size category).**

Specify species or if captive desert tortoises:

Attached:

<100 mm:	Zero	<10	10-50	50-100	100-200	>200
≥100 mm:	Zero	<10	10-50	50-100	100-200	>200

Removed:

<100 mm:	Zero	<10	10-50	50-100	100-200	>200
≥100 mm:	Zero	<10	10-50	50-100	100-200	>200

h. **Number of blood samples that you personally collected from wild, free-ranging desert tortoises (circle one for each size category).**

<100 mm:	Zero	<10	10-50	50-100	100-200	>200
≥100 mm:	Zero	<10	10-50	50-100	100-200	>200

Specific Desert Tortoise Field Experience Continued:					
i. Number of blood samples that you personally collected from <u>other relevant species</u> or <u>captive</u> desert tortoises (circle one for each size category). <u>Specify species or if captive desert tortoises:</u> <u>Specify type of procedure:</u>					
<100 mm: Zero	<10	10-50	50-100	100-200	>200
≥100 mm: Zero	<10	10-50	50-100	100-200	>200
j. Experience conducting other procedures on <u>wild, free-ranging</u> desert tortoises (circle one for each size category). <u>Specify type of procedure:</u>					
<100 mm: Zero	<10	10-50	50-100	100-200	>200
≥100 mm: Zero	<10	10-50	50-100	100-200	>200
k. Experience conducting other procedures on <u>other relevant species</u> or <u>captive</u> desert tortoises (circle one for each size category). <u>Specify species or if captive desert tortoises:</u> <u>Specify type of procedure:</u>					
<100 mm: Zero	<10	10-50	50-100	100-200	>200
≥100 mm: Zero	<10	10-50	50-100	100-200	>200
l. Prior authorizations for desert tortoise under Biological Opinions or Habitat Conservation Plans (specify number, date, project name and location). <u>Do not reiterate "general field experience" information:</u>					

10. Provide at least 3 references that can verify your field qualifications and skills:

Name	Employer/Position	Address/Location	Phone Number	Email
1.				
2.				
3.				

I certify that the information submitted in this form is complete and accurate to the best of my knowledge and belief. I understand that any false statement herein may subject me to the criminal penalties of 18 U.S.C. Ch.47, Sec. 1001.

Signed: ______________________________ **Date:**____________________

SECTION 7 FEE PAYMENT FORM
Entire form is to be completed by project proponent

Biological Opinion File Number: 1-5-05-FW-536, Tier 2____

Fish and Wildlife Service Office that issued the Opinion:
Nevada Fish and Wildlife Office, Reno, Nevada

Project: _SNWA Pipeline- Coyote Spring Valley

Number of acres anticipated to be disturbed: 12.1 non-critical & 97.8 critical habitat

Fee rate (per acre): $723 non-critical habitat/$2,892 in critical habitat

Total payment required: __$291,586

Amount of payment received: ______________

Date of receipt: ____________________

Check or money order number: ________________________

Project proponent: _SNWA______ **Telephone number:** ___________

Authorizing agencies: Bureau of Land Management- Las Vegas Field Office

Make checks payable to: Clark County Treasurer

Deliver check to:
Clark County Desert Conservation Program
Dept. of Air Quality and Environmental Management
Clark County Government Center
500 S. Grand Central Parkway, first floor (front counter)
Las Vegas, Nevada 89106
(702) 455-5821

If you have questions, you may call the Southern Nevada Field Office of the U.S. Fish and Wildlife Service at (702) 515-5230.

AMENDED

ASSIGNED

Nº 46777

APPLICATION FOR PERMIT
TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF NEVADA

Date of filing in State Engineer's Office MAR 31 1983

Returned to applicant for correction APR 18 1983

Corrected application filed MAY 16 1983

Map filed MAY 16 1983

The applicant Nevada Power Company

P. O. Box 230 (Street and No. or P.O. Box No.), of Las Vegas (City or Town),

Nevada 89151 (State and Zip Code No.), hereby make.... application for permission to appropriate the public waters of the State of Nevada, as hereinafter stated. (If applicant is a corporation, give date and place of incorporation; if a copartnership or association, give names of members.) Incorporated in 1929 in State of Nevada

1. The source of the proposed appropriation is Underground (Name of stream, lake, spring, underground or other source)

2. The amount of water applied for is 55.0 cfs second-feet (One second-foot equals 448.83 gals. per min.)

   (a) If stored in reservoir give number of acre-feet

3. The water to be used for Industrial (cooling) (Irrigation, power, mining, manufacturing, domestic, or other use. Must limit to one use.)

4. If use is for:

   (a) Irrigation, state number of acres to be irrigated:

   (b) Stockwater, state number and kinds of animals to be watered:

   (c) Other use (describe fully under "No. 12. Remarks" (x)

   (d) Power:

      (1) Horsepower developed

      (2) Point of return of water to stream

5. The water is to be diverted from its source at the following point: SE ¼, SE ¼, Section 23, T. 13 S., R. 63 E, M.D.M. The SW corner of Section 23 bears S 88° 12' 27" W., 5103 feet from the point of diversion. (Describe as being within a 40-acre subdivision of public survey, and by course and distance to a section corner. If on unsurveyed land, it should be so stated.)

6. Place of use T. 17 S, R. 63 E, Sections 12 (portion), 13 (portion), 24, 25, 35 (portion), and 36; T. 17 S, R. 64 E, Sections 7 (portion), 18, 19, 30, and 31; T. 18 S, R. 63 E, Sections 1 (portion) and 2 (portion). (Describe by legal subdivision. If on unsurveyed land, it should be so stated.)

7. Use will begin about January 1 (Month and Day) and end about December 31 (Month and Day), of each year.

8. Description of proposed works. (Under the provisions of NRS 535.010 you may be required to submit plans and specifications of your diversion or storage works.) Drilled well, pump, piping and electrical power service. (State manner in which water is to be diverted, i.e. diversion structure, ditches and flumes, drilled well with pump and motor, etc.)

9. Estimated cost of works 1,000,000.

10. Estimated time required to construct works 9 years If well completed, describe works.

11. Estimated time required to complete the application of water to beneficial use 15 years

12. Remarks: For use other than irrigation or stock watering, state number and type of units to be served or annual consumptive use.

40,000 AF/year is the annual consumptive use. See Attachment for additional information on the water usage.

By s/James H. Zornes
James H. Zornes Vice President
Nevada Power Company
P. O. Box 230
Las Vegas, Nevada 89151

Compared js/ bl cl/cms

Protested Pro. 6/21/83 by William A. Molini; Pro. w/d 1/23/85
7/29/83 by US Fish and Wildlife Service

Pro. Overruled 6/19/97
See Ruling No. 4542

APPROVAL OF STATE ENGINEER

This is to certify that I have examined the foregoing application, and do hereby grant the same, subject to the following limitations and conditions:

This permit is issued subject to existing rights. It is understood that the amount of water herein granted is only a temporary allowance and that the final water right obtained under this permit will be dependent upon the amount of water actually placed to beneficial use. It is also understood that this right must allow for a reasonable lowering of the static water level. This well shall be equipped with a two (2) inch opening for measuring depth to water. If the well is flowing, a valve must be installed and maintained to prevent waste. A totalizing meter must be installed and maintained in the discharge pipeline near the point of diversion and accurate measurements must be kept of water placed to beneficial use. The totalizing meter must be installed before any use of water begins, or before the Proof of Completion of Work is filed. This source is located within an area designated by the State Engineer, pursuant to NRS 534.030. The State retains the right to regulate the use of the water herein granted at any and all times.

This permit does not extend the permittee the right of ingress and egress on public, private or corporate lands.

The issuance of this permit does not waive the requirements that the permit holder obtain other permits from State, Federal and local agencies.

(CONTINUED ON PAGE 2)

The amount of water to be appropriated shall be limited to the amount which can be applied to beneficial use, and not to exceed 10.0 cubic feet per second, but not to exceed 5,000.00 acre-feet annually.

Work must be prosecuted with reasonable diligence and be completed on or before October 7, 2000

Proof of completion of work shall be filed before November 7, 2000

Application of water to beneficial use shall be made on or before October 7, 2005

Proof of the application of water to beneficial use shall be filed on or before November 7, 2005

Map in support of proof of beneficial use shall be filed on or before N/A

Completion of work filed

Proof of beneficial use filed

Cultural map filed

Certificate No. Issued

218 (Rev.)

IN TESTIMONY WHEREOF, I R. MICHAEL TURNIPSEED, P.E. State Engineer of Nevada, have hereunto set my hand and the seal of my office, this 7th day of October, A.D. 19 97

R. Michael Turnipseed P.E.
State Engineer

Abrogated By: 70429 C.O
70430 4.2

(PERMIT TERMS CONTINUED)

This permit is subject to Items 4 and 5 of the Ruling under No. 4542 dated June 19, 1997.

The permittee shall obtain a right of way from the owner of the property on which the point of diversion of this permit is located. The agreement granting the right of way between the parties must be submitted to the State Engineer not later than December 31, 1997. Failure to provide the agreement by the above mentioned date will result in the cancellation of this permit.and the water granted herein will revert to the source.

No. 70429

AMENDED

APPLICATION FOR PERMISSION TO CHANGE POINT OF DIVERSION, MANNER OF USE AND PLACE OF USE OF THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

Date of filing in State Engineer's Office **SEP 24 2003**

Returned to applicant for correction **OCT 09 2003**

Corrected application filed **NOV 06 2003**

Map filed **NOV 06 2003**

****

The applicant **COYOTE SPRINGS INVESTMENT LLC** hereby makes application for permission to change the **Point of Diversion, Manner of Use, and Place of Use of a Portion** of water heretofore appropriated under **Permit 46777**

****

1. The source of water is **underground**

2. The amount of water to be changed **5.0 cfs, not to exceed 2,500 afa ("A" Water Right)**

3. The water to be used for **municipal and domestic**

4. The water heretofore permitted for **industrial (cooling)**

5. The water is to be diverted at the following point **in the SE¼ SW¼ of Section 14, T.13S., R.63E., M.D.B.&M., or at a point where the NW corner of Section 21, T.13S., R.63E., M.D.B.&M., bears South 89°13'53" West a distance of 12,470 feet.**

6. The existing permitted point of diversion is located within **in the SE¼ SE¼ of Section 23, T.13S., R.63E., M.D.B&M., or at a point where the SW corner of Section 23, T.13S., R.63E., M.D.B.&M. bears South 88°12'27" West, a distance of 5,103 feet.**

7. Proposed place of use **See Attachment "A" attached hereto and incorporated herein.**

8. Existing place of use **T.17S., R.63E., M.D.B.&M., Sections 12 (portion), 13 (portion), 24, 25, 35 (portion) and 36, T.17S., R.64E., M.D.B.&M., Section 7 (portion), 18, 19, 30, 31; T.18S., R.63E, Section 1 (portion) and 2 (portion), MDB&M**

9. Use will be from **January 1** to **December 31** of each year.

10. Use was permitted from **January 1** to **December 31** of each year.

11. Description of proposed works **Drilled well, pump and meter, piping, electric power service and distribution system.**

12. Estimated cost of works **$100,000.00**

13. Estimated time required to construct works **2 years.**

14. Estimated time required to complete the application of water to beneficial use **10 years.**

15. Remarks: **The annual consumptive use will be 2,500 afa. The water will be used for municipal and domestic purposes, including, without limitation, residential, commercial, industrial, mining, golf course, and landscape irrigation (until replaced by effluent), and wildlife and habitat development. The water will be comingled with water produced under other permits.**

By Peter G. Morros
s/ Peter G. Morros
1455 View Crest Court
Reno, Nevada 89521

Compared sg/gkl lb/cmf

Protested

****

APPROVAL OF STATE ENGINEER

This is to certify that I have examined the foregoing application, and do hereby grant the same, subject to the following limitations and conditions:

This permit to change the point of diversion, place of use and manner of use of a portion of the waters of an underground source as heretofore granted under Permit 46777 is issued subject to the terms and conditions imposed in said Permit 46777 and with the understanding that no other rights on the source will be affected by the change proposed herein. The well shall be equipped with a 2-inch opening and a totalizing meter must be installed and maintained in the discharge pipeline near the point of diversion and accurate measurements must be kept of water placed to beneficial use. The totalizing meter must be installed before any use of the water begins or before the proof of completion of work is filed. If the well is flowing, a valve must be installed and maintained to prevent waste. This source is located within an area designated by the State Engineer pursuant to NRS 534.030. The State retains the right to regulate the use of the water herein granted at any and all times.

This permit does not extend the permittee the right of ingress and egress on public, private or corporate lands.

The issuance of this permit does not waive the requirements that the permit holder obtain other permits from State, Federal and local agencies.

A monitoring program, prepared in conjunction with the study ordered in State Engineer's Order No. 1169 shall be completed and approved by the State Engineer prior to the diversion of any water under Permits 70429 and 70430.

The permittee is required to submit an annual report of the monitoring results. Upon review of the annual monitoring results, the State Engineer will retain the right to reduce the pumping from these wells or to take any action that may be necessary to protect the public interests or to prevent conflict with prior existing rights.

The well drilled under this permit shall produce water from the carbonate aquifer only.

(CONTINUED ON PAGE 3)

 70429
(PERMIT TERMS CONTINUED)

The amount of water to be appropriated shall be limited to the amount which can be applied to beneficial use, and not to exceed **5.0** cubic feet per second, **but not to exceed 2,500 acre-feet annually.**

Work must be prosecuted with reasonable diligence and be completed on or before:
April 22, 2006

Proof of completion of work shall be filed on or before:
May 22, 2006

Water must be placed to beneficial use on or before:
April 22, 2009

Proof of the application of water to beneficial use shall be filed on or before:
May 22, 2009

Map in support of proof of beneficial use shall be filed on or before:
NA

IN TESTIMONY WHEREOF, I, HUGH RICCI, P.E.,

State Engineer of Nevada, have hereunto set

my hand and the seal of my office,

this **22nd** day of **April**, A.D. **2004**

H. Ricci, P.E.
State Engineer

Completion of work filed ______________

Proof of beneficial use filed ______________

Cultural map filed **NA**

Certificate No. ________ Issued ________

ATTACHMENT A
Application 70429
Coyote Springs Investment LLC

TOWNSHIP	RANGE	SECTION	SUBDIVISION
11S	63E	13	S½
11S	63E	19	portion East of US Highway 93
11S	63E	20	ALL
11S	63E	21	ALL
11S	63E	22	ALL
11S	63E	23	ALL
11S	63E	24	ALL
11S	63E	25	ALL
11S	63E	26	ALL
11S	63E	27	ALL
11S	63E	28	ALL
11S	63E	29	ALL
11S	63E	30	portion East of US Highway 93
11S	63E	31	portion East of US Highway 93
11S	63E	32	ALL
11S	63E	33	ALL
11S	63E	34	ALL
11S	63E	35	ALL
11S	63E	36	W½
12S	63E	1	W½
12S	63E	2	ALL
12S	63E	3	ALL
12S	63E	4	ALL
12S	63E	5	ALL
12S	63E	6	portion East of US Highway 93
12S	63E	7	portion East of US Highway 93
12S	63E	8	ALL
12S	63E	9	ALL
12S	63E	10	ALL
12S	63E	11	ALL
12S	63E	12	W½ W½
12S	63E	13	W½
12S	63E	14	ALL
12S	63E	15	ALL
12S	63E	16	ALL
12S	63E	17	ALL

12S	63E	18	portion East of US Highway 93
12S	63E	19	portion East of US Highway 93
12S	63E	20	ALL
12S	63E	21	ALL
12S	63E	22	ALL
12S	63E	23	ALL
12S	63E	24	W½
12S	63E	25	ALL
12S	63E	26	ALL
12S	63E	27	ALL
12S	63E	28	ALL
12S	63E	29	portion East of US Highway 93
12S	63E	30	portion East of US Highway 93
12S	63E	32	portion East of US Highway 93
12S	63E	33	ALL
12S	63E	34	ALL
12S	63E	35	ALL
12S	63E	36	ALL
12S	64E	31	W½ SW¼
13S	63E	1	ALL
13S	63E	2	ALL
13S	63E	3	ALL
13S	63E	4	ALL
13S	63E	5	portion East of US Highway 93
13S	63E	8	portion East of US Highway 93
13S	63E	9	ALL
13S	63E	10	ALL
13S	63E	11	ALL
13S	63E	12	ALL
13S	63E	13	ALL
13S	63E	14	ALL
13S	63E	15	ALL
13S	63E	16	ALL
13S	63E	17	portion East of US Highway 93
13S	63E	20	portion East of US Highway 93 and North of NV Highway 168
13S	63E	21	portion North of NV Highway 168
13S	63E	22	portion North of NV Highway 168
13S	63E	23	portion North of NV Highway 168
13S	63E	24	ALL
13S	63E	25	portion North of NV Highway 168
13S	63E	26	portion North of NV Highway 168

13S	64E	6	W½
13S	64E	7	W½, W½ SE¼
13S	64E	18	ALL
13S	64E	19	ALL
13S	64E	30	portion North of NV Highway 168

No. 70430

AMENDED
APPLICATION FOR PERMISSION TO CHANGE POINT OF DIVERSION, MANNER OF USE AND PLACE OF USE OF THE PUBLIC WATERS OF THE STATE OF NEVADA HERETOFORE APPROPRIATED

Date of filing in State Engineer's Office **SEP 24 2003**

Returned to applicant for correction **OCT 09 2003**

Corrected application filed **NOV 06 2003**

Map filed **NOV 6 2003**

****

The applicant **COYOTE SPRINGS INVESTMENT LLC** hereby makes application for permission to change the **Point of Diversion, Manner and Place of Use of a portion.** of water heretofore appropriated under **Permit 46777**

****

1. The source of water is **underground**

2. The amount of water to be changed **4.2 cfs, not to exceed 2,100 afa ("B" Water Right).**

3. The water to be used for **municipal and domestic**

4. The water heretofore permitted for **industrial (cooling)**

5. The water is to be diverted at the following point **in the SW¼ SE¼ of Section 22, T.13S., R.63E., M.D.B.&M., at a point where the NW corner of Section 21, T.13S., R.63E., M.D.B.&M., bears North 63°42'47" West a distance of 10,010 feet.**

6. The existing permitted point of diversion is located within **in the SE¼ SE¼ of Section 23, T.13S., R.63E., M.D.B.&M., or at a point where the SW corner of Section 23, T.13S., R.63E., M.D.B.&M., bears South 88°12'27" West a distance of 5,103 feet.**

7. Proposed place of use **See Attachment "A" attached hereto and incorporated herein.**

8. Existing place of use **T.17S., R.63E., M.D.B.&M., Sections 12 (portion), 13 (portion), 24, 25, 35 (portion), and 36, T.17S., R.64E., M.D.B.&M., Section 7 (portion) 18, 19, 30, 31; T.18S., R.63E, Section 1 (portion) and 2 (portion), MDB&M**

9. Use will be from **January 1** to **December 31** of each year.

10. Use was permitted from **January 1** to **December 31** of each year.

11. Description of proposed works **Drilled well, pump and meter, piping, electric power service and distribution system.**

12. Estimated cost of works **$100,000.00**

13. Estimated time required to construct works **2 years.**

14. Estimated time required to complete the application of water to beneficial use **10 years.**

15. Remarks: **The annual consumptive use will be 2,500 afa. The water will be used for municipal and domestic purposes, including, without limitation, residential, commercial, industrial, mining, golf course, and landscape irrigation (until replaced by effluent), and wildlife and habitat development. The water will be comingled with water produced under other permits.**

By Peter G. Morros
s/ Peter G. Morros
1455 View Crest Court
Reno, Nevada 89521

Compared sg/gkl 1b/ cmf

Protested

****

APPROVAL OF STATE ENGINEER

This is to certify that I have examined the foregoing application, and do hereby grant the same, subject to the following limitations and conditions:

This permit to change the point of diversion, place of use and manner of use of a portion of the waters of an underground source as heretofore granted under Permit 46777 is issued subject to the terms and conditions imposed in said Permit 46777 and with the understanding that no other rights on the source will be affected by the change proposed herein. The well shall be equipped with a 2-inch opening and a totalizing meter must be installed and maintained in the discharge pipeline near the point of diversion and accurate measurements must be kept of water placed to beneficial use. The totalizing meter must be installed before any use of the water begins or before the proof of completion of work is filed. If the well is flowing, a valve must be installed and maintained to prevent waste. This source is located within an area designated by the State Engineer pursuant to NRS 534.030. The State retains the right to regulate the use of the water herein granted at any and all times.

This permit does not extend the permittee the right of ingress and egress on public, private or corporate lands.

The issuance of this permit does not waive the requirements that the permit holder obtain other permits from State, Federal and local agencies.

A monitoring program, prepared in conjunction with the study ordered in State Engineer's Order No. 1169 shall be completed and approved by the State Engineer prior to the diversion of any water under Permits 70429 and 70430.

The permittee is required to submit an annual report of the monitoring results. Upon review of the annual monitoring results, the State Engineer will retain the right to reduce the pumping from these wells or to take any action that may be necessary to protect the public interests or to prevent conflict with prior existing rights.

The well drilled under this permit shall produce water from the carbonate aquifer only.

(CONTINUED ON PAGE 3)

70430

(PERMIT TERMS CONTINUED)

The amount of water to be appropriated shall be limited to the amount which can be applied to beneficial use, and not to exceed **4.2** cubic feet per second, **but not to exceed 2,100 acre-feet annually.**

Work must be prosecuted with reasonable diligence and be completed on or before:
April 22, 2006

Proof of completion of work shall be filed on or before:
May 22, 2006

Water must be placed to beneficial use on or before:
April 22, 2009

Proof of the application of water to beneficial use shall be filed on or before:
May 22, 2009

Map in support of proof of beneficial use shall be filed on or before:
NA

IN TESTIMONY WHEREOF, I, HUGH RICCI, P.E.,

State Engineer of Nevada, have hereunto set

my hand and the seal of my office,

this **22nd** day of **April**, A.D. **2004**

H Ricci, P.E.

State Engineer

Completion of work filed ____________

Proof of beneficial use filed ____________

Cultural map filed **NA**

Certificate No. ________ Issued ____________

ATTACHMENT A
Application 70430
Coyote Springs Investment LLC

TOWNSHIP	RANGE	SECTION	SUBDIVISION
11S	63E	13	S½
11S	63E	19	portion East of US Highway 93
11S	63E	20	ALL
11S	63E	21	ALL
11S	63E	22	ALL
11S	63E	23	ALL
11S	63E	24	ALL
11S	63E	25	ALL
11S	63E	26	ALL
11S	63E	27	ALL
11S	63E	28	ALL
11S	63E	29	ALL
11S	63E	30	portion East of US Highway 93
11S	63E	31	portion East of US Highway 93
11S	63E	32	ALL
11S	63E	33	ALL
11S	63E	34	ALL
11S	63E	35	ALL
11S	63E	36	W½
12S	63E	1	W½
12S	63E	2	ALL
12S	63E	3	ALL
12S	63E	4	ALL
12S	63E	5	ALL
12S	63E	6	portion East of US Highway 93
12S	63E	7	portion East of US Highway 93
12S	63E	8	ALL
12S	63E	9	ALL
12S	63E	10	ALL
12S	63E	11	ALL
12S	63E	12	W½ W½
12S	63E	13	W½
12S	63E	14	ALL
12S	63E	15	ALL
12S	63E	16	ALL

12S	63E	17	ALL
12S	63E	18	portion East of US Highway 93
12S	63E	19	portion East of US Highway 93
12S	63E	20	ALL
12S	63E	21	ALL
12S	63E	22	ALL
12S	63E	23	ALL
12S	63E	24	W½
12S	63E	25	ALL
12S	63E	26	ALL
12S	63E	27	ALL
12S	63E	28	ALL
12S	63E	29	portion East of US Highway 93
12S	63E	30	portion East of US Highway 93
12S	63E	32	portion East of US Highway 93
12S	63E	33	ALL
12S	63E	34	ALL
12S	63E	35	ALL
12S	63E	36	ALL
12S	64E	31	W½ SW¼
13S	63E	1	ALL
13S	63E	2	ALL
13S	63E	3	ALL
13S	63E	4	ALL
13S	63E	5	portion East of US Highway 93
13S	63E	8	portion East of US Highway 93
13S	63E	9	ALL
13S	63E	10	ALL
13S	63E	11	ALL
13S	63E	12	ALL
13S	63E	13	ALL
13S	63E	14	ALL
13S	63E	15	ALL
13S	63E	16	ALL
13S	63E	17	portion East of US Highway 93
13S	63E	20	portion East of US Highway 93 and North of NV Highway 168
13S	63E	21	portion North of NV Highway 168
13S	63E	22	portion North of NV Highway 168
13S	63E	23	portion North of NV Highway 168
13S	63E	24	ALL
13S	63E	25	portion North of NV Highway 168
13S	63E	26	portion North of NV Highway 168
13S	64E	6	W½
13S	64E	7	W½, W½ SE¼
13S	64E	18	ALL
13S	64E	19	ALL
13S	64E	30	portion North of NV Highway 168
17S	63E	12	SE¼, portion of the E½ SW¼
17S	63E	13	S½, NE¼, portion of the NW¼
17S	63E	24	ALL
17S	63E	25	ALL
17S	63E	35	E½
17S	63E	36	ALL
17S	64E	7	S½
17S	64E	18	ALL
17S	64E	19	ALL
17S	64E	30	ALL
17S	64E	31	ALL
18S	63E	1	NW¼
18S	63E	2	NE¼

PLEASE STAND BY.PLEASE STAND BY.(WATER RECLAMATION DISTRICT BOARD)

LAS VEGAS VALLEY WATER DISTRICT MEETING OCTOBER 17, 2006

>> I'M GOING TO CALL THE MEETING TO ORDER.

>> MADAM CHAIRMAN, THE MEETING NOTICE HAS BEEN PROPERLY NOTICED AND POSTED, ALONG WITH THE MINUTES.

>> MOVE APPROVAL.

>> THERE IS A MOTION ON THE FLOOR, IF THERE ARE NO QUESTIONS, CAST YOUR VOTES.MOTION CARRIES.

>> ITEMS 2 THROUGH 8 COMPRISE YOUR CONSENT AGENDA, THESE MAY BE TAKEN AS ONE MOTION.

>> MOVE APPROVAL.

>> THERE IS A MOTION ON THE FLOOR.IF THERE ARE NO QUESTIONS OR COMMENTS, CAST YOUR VOTES.MOTION CARRIES.

>> ITEM 9 ASK THE BOARD AUTHORIZE THE ADDITION OF SEVEN NEW PROJECTS AND AUTHORIZE STAFF TO INITIATION FINANCE AND LEGAL ACTIVITIES.

>> MOVE TO FOLLOW STAFF RECOMMENDATION FOR APPROVAL.

>> THERE IS A MOTION ON THE FLOOR, ANY OTHER QUESTIONS OR COMMENTS?CAST YOUR VOTES.MOTION CARRIES.

>> THAT CONCLUDES YOUR POSTED AGENDA.

>> NOW IS THE TIME SET ASIDE FOR PUBLIC COMMENT, ANYONE WISHING TO BE HEARD, PLEASE STEP FORWARD.SEEING NO ONE, WE ARE ADJOURNED.(BOARD OF COUNTY COMMISSIONERS MEETING)

BOARD OF COUNTY COMMISSIONERS MEETING OCTOBER 16, 2006

>> I WILL CALL THE MEETING TO ORDER. PLEASE RISE WITH ME FOR THE INVOCATION, AFTER WHICH WE'LL HAVE THE PLEDGE OF ALLEGIANCE.

>> LET US PRAY. MOST HOLY GOD OF WISDOM AND DISCERNMENT, HEAR US. WE ASK FOR YOUR GUIDANCE AS WE EXERCISE OUR CIVIC RIGHT AND DUTY TO VOTE IN THE UPCOMING ELECTIONS.TODAY, ALSO, GIVE YOUR WISE COUNSEL TO THE HEART OF EACH COMMISSIONER THAT, AS WE GO ABOUT YOUR WORK IN YOUR NAME WE ARE ADVISED ON HOW TO CONFRONT THE DIFFICULT

DECISIONS.GRANT THEM THE OPTION TO WEIGH CAREFULLY AND WISELY IN THE COMMON GOOD AND GIVE THEM THE WISDOM TO DO THIS WITHOUT COMPROMISING THE RIGHTS OF INDIVIDUALS.TEACH THEM THE ARTS OF ALTERNATIVES WHEN IT'S ESPECIALLY DIFFICULT TO COME TO FAIR DECISIONS.GIVE THEM THE COURAGE OF MODERATION SO THAT IN SEEKING THE COMMON GOOD, INDIVIDUALS ARE NOT HARMED IN FAVOR OF A CORPORATE OR POLITICAL MINDSET.TEACH EACH OF US HERE TODAY TO PUT THE OTHER AHEAD OF THE SELF.WE ASK THIS IN YOUR MOST HOLY NAME.AMEN.

>> GOOD MORNING.

>> GOOD MORNING, MR. CHAIRMAN.ITEM ONE IS THE APPROVAL HAVE THE AGENDA.WE HAVE NO ITEMS REQUESTED FOR REMOVAL TODAY.

>> ANY DISCUSSION ON THE AGENDA.A MOTION TO APPROVE THE AGENDA.CAST YOUR VOTES.MOTION CARRIES.

>> ITEMS 2 THROUGH 19 COMPRISE YOUR CONSENT AGENDA.

>> ANY DISCUSSION ON THE CONSENT AGENDA?

>> I HAVE TO DISCLOSE I WILL ABSTAIN ON ITEM 50 BECAUSE OF WORK MY LAW FIRM DOES.

>> ANY OTHERS?

>> I HAVE TO DISCLOSE A RELATIONSHIP WITH G.C. WATERS BUT I WILL BE VOTING ON THE MATTER.

>> ANY OTHERS?CAST YOUR VOTES.MOTION CARRIES.

>> ITEM 120 IS TO ACKNOWLEDGE NATIONAL RESEARCH CORPORATION'S PUBLIC RECOGNITION OF UNIVERSITY MEDICAL CENTER OF SOUTHERN NEVADA AS ONE OF THE NATION'S TOP HOSPITALS AS A 2006 CONSUMER CHOICE AWARD WINNER.

>> WINNERS ARE NAMED IN CONSUMER HEALTH CARE MAGAZINE.N.R.C. WHICH ALSO MEASURES THE MEDICAL INDUSTRY'S PERFORMANCE THROUGH ITS MARKET GUIDE, AND THIS GUARANTEES PROMENENT PLACEMENT AMONG PLAN PROVIDERS AS WELL AS LOCAL AND STATE RECOGNITION.WE ARE PROUD OF OUR HOSPITAL THAT THEY'VE BEEN RECOGNIZED AS A CONSUMER CHOICE AWARD WINNER AND WE WANT MORE CONSUMERS TO GO THERE, OBVIOUSLY, AND LACEY IS HERE TO GLOAT.

>> THANK YOU, MR. CHAIRMAN. YOU GAVE HALF OF MY SPEECH ALREADY, WE

ARE VERY PROUD OF THIS AWARD.FOR UNIVERSITY MEDICAL CENTER TO ACHIEVE THIS DISTINCTION IN A MARKET FROM ACROSS THE COUNTRY MAKES US PROUD. AND WE HAVE WITH US THIS MORNING TERESA COSTELO TO PRESENT THE AWARD TO US.

>> THANK YOU.AS YOU'VE SAID, YOU EXPLAINED A LITTLE BIT ABOUT WHAT THIS IS ALL ABOUT.THE NATIONAL RESEARCH FOUNDATION DOES AN ANNUAL STUDY, AND WE RESEARCH 196 MARKETS ACROSS THE COUNTRY AND WE ASK CONSUMERS IN THOSE MARKETS WHICH IS THEIR FIRST CHOICE FOR BEST DOCTORS, BEST NURSES, BEST OVERALL QUALITY AND IMAGE AND BEST RECOMMENDATION.AS YOU KNOW, U.M.C. IS THE WINNER THIS YEAR FOR THE LAS VEGAS MARKET.SO CONGRATULATIONS!

>> THANK YOU VERY MUCH.(APPLAUSE)

>> IF THE ENGINEER WOULD SHOW LACEY'S NEW PAPER WEIGHT -- THERE YOU GO!CONGRATULATIONS.

>> THANK YOU.

>> SECTION 5 IS PUBLIC HEARINGS BUT SINCE IT IS NOT YET 10:00 WE'LL MOVE TO SECTION 6, INTRODUCTION OF ORDINANCES, BUT 124 CANNOT BE HEARD UNTIL 123, SO WE'LL MOVE ON TO THE BUSINESS AGENDA.THE LIST OF APPOINTEES IS NOTED IN THE BACKUP FOR THIS AGENDA ITEM.

>> ANY DISCUSSION?

>> MOTION A MOTION FOR APPROVAL.

>> THERE IS A MOTION FOR APPROVAL, CAST YOUR VOTES.MOTION CARRIES.

>> MR. CHAIRMAN.

>> COMMISSIONER MAXFIELD.

>> THANK YOU.I WANTED TO EXTEND MY APPRECIATION TO JOHN AND HIS EFFORT AND WORK ON THE TOWN BOARD AND WISH HIM WELL ON HIS FUTURE ENDEAVORS.I WOULD ALSO LIKE TO AT THIS TIME MOVE TO APPOINT TOM MAKITA TO FILL THAT POSITION BETWEEN NOW AND JANUARY.IS MR. MAKITA HERE?I'M SORRY, I SAID TOM, BUT IT'S TIM MAKITA.I KNOW HIM WELL.(LAUGHTER)

>> THERE IS A MOTION TO APPOINT, ANY OTHER DISCUSSION?CAST YOUR VOTES.MOTION CARRIES.
>> COMMISSIONERS,127 AND 128 WITH BE TAKEN TOGETHER.COMMISSIONERS, THESE ITEMS BOTH RELATE TO THE SAFE FUTURES PLAN.THE LIST OF POSITIONS

ARE INCLUDED IN YOUR BACKUP MATERIALS.THESE WILL CREATE AN ADDITIONAL 69 POSITIONS IN THE DEPARTMENT FOR THE RECRUITMENT OF FOSTER CARE AND OTHERS TO REDUCE CASE LOADS, FUNDED BY TANF-EA DOLLARS.THE 55 POSITIONS CREATED LAST MEETING AND THESE CREATED TODAY WILL BE FUNDED FOR SIX MONTHS FROM THE TANF-EA DOLLARS, BUT ADDITIONAL FUNDS WILL BE NEEDED TO FUND THESE BEGINNING IN THE '08 FISCAL YEAR.THE COUNTY WILL SEEK OUT FEDERAL AND STATE FUNDS TO FUND THE POSITIONS AND THE COUNTY WILL ALSO BE RESPONSIBLE FOR ALL CAPITAL COSTS INCLUDING VEHICLES, COMPUTERS, AND OFFICE SPACE.IN ADDITION, TWO ATTORNEYS AND LEGAL SUPPORT ARE BEING CREATED FOR THE SUPPORT OF PARENTS AND CHILDREN WHEN THEY ARE REMOVED.LAST MONTH THE COUNTY SENT A HIGH-LEVEL STAFF TEAM TO THE MEETING AND WHILE THEY WERE GENERALLY PLEASED WITH THE PLANS FOR IMPROVEMENTS, ONE AREA THAT IS WEEK IS THE SERVICE ARRAY.AS TOM MORTON NOTED, AN ARRAY OF SERVICES IS CRITICAL, AND ENHANCEMENTS TO THE STATE FAMILY AND RESOURCES AND MENTAL HEALTH AND OTHER DEPARTMENTS ARE SORELY NEEDED IN CLARK COUNTY.-- THE GOVERNOR'S BUDGET FOR THE NEXT FISCAL YEAR.

>> ANY QUESTIONS?

>> MOVE APPROVAL.

>> THERE IS A MOTION FOR APPROVAL.

>> ANY DISCUSSION ON THE MOTION? HEARING NONE, CAST YOUR VOTES.MOTION CARRIES.

>> THAT WAS APPROVAL OF 127 AND 128, THANK YOU.

>> ITEM 129.

>> MOVE APPROVAL.

>> DISCUSSION?CAST YOUR VOTES.MOTION CARRIES.

>> MOVE APPROVAL.

>> THERE IS A MOTION FOR APPROVAL, IF THERE IS NO DISCUSSION, CAST YOUR VOTES.MOTION CARRIES.

>> ITEM 131.

>> I WILL MOVE WE APPOINT CONSTANCE ACREAGE TO THAT COMMITTEE.ANY DISCUSSION ON THAT?HEARING NONE, CAST YOUR VOTES.MOTION CARRIES.IT'S NOT YET 10:00 A.M., I THINK WE ARE GOING TO TAKE A SHORT RECESS.

>> HE WOULD RECOMMEND YOU DO.

>> WE'LL RECONVENE AT 10:00 A.M.THE MEETING IS IN RECESS.

>> TO PUT THEIR ADDRESS BACK IN, AND THEY BE THE ONES THAT SHOULD HAVE TO PAY IT. ANY QUESTIONS AT THIS POINT? I HAVE A COUPLE OF OTHER THINGS I WOULD LIKE TO MENTION.

>> WHY DON'T YOU GO AHEAD AND COMPLETE YOUR REMARKS.

>> AS I MENTIONED THAT WOULD BE MY FIRST POSITION THAT WE AMEND TO PUT THE CORPORATION BACK ON THE ASSESSMENT AS THEY SHOULD BE LIABLE FOR IT'S. THEY ASSUMED THE CONTRACT IN THEIR AREA AND THEY SHOULD BE LIABLE FOR IT AS WELL. IF THE BOARD IS NOT WILLING TO CORRECT THE PROBLEM TODAY I WOULD ASK IT BE POSTPONED ON THE VOTE. I OBJECT TO THE PASSAGE OF APPROVAL AND I MOVE AS VIOLATION OF MY DUE PROCESS.

>> THIS SUB HEARING.

>> PLEASE STATE YOUR NAME AND ADDRESS FOR THE RECORD.

>> MY NAME IS CODY. I CONTACTED WITH CORINA HOMES IN JANUARY 2005 TO PURCHASE MY HOME. THINK DIDN'T NOTIFY ME OF ANY ASSESSMENTS THAT WERE GOING TO BE PLACED ON THE HOME. I NOTICED AT ABOUT FEBRUARY, MARCH THERE WAS NO CURB OR SIDEWALK OR ANYTHING LIKE THAT ON CRAIG ROAD. SO AT THAT TIME I APPROACHED TO ASK THEM IF THERE WOULD BE AN ASSESSMENT. THEY ASSURED ME WE WOULDN'T HAVE TO PAY ANY ASSESSMENTS AT THAT TIME. I DIDN'T GET IT IN WRITING FROM THEM BUT THERE WAS A VERBAL ASSURANCE. I RECEIVED NOTICE AS WELL IN OCTOBER OF 2006 REGARDING THE ASSESSMENTS. MY QUESTION IS, MAINLY, IN THE SAME NEIGHBORHOOD OTHER BUILDERS HAVE INSTALLED ALL THE IMPROVEMENTS AND I'M WONDERING WHY THEY WEREN'T REQUIRED TO. THAT WOULD BE MY MAIN QUESTION.

>> ALL RIGHT. THIS IS A PUBLIC HEARING. IS THERE ANYONE ELSE WISHING TO BE HEARD?

>> CAN I MENTION ONE MORE THING? IN MY REVIEW OF THE COMMISSION WHICH I WAS GIVEN ACCESS TO I FOUND A LETTER ADDRESSED TO THE DIRECTOR OF PUBLIC WORKS SIGNED BY R.H. McCARTY AND IN THE LETTER, FURTHERMORE, THE PROPOSED BID REPRESENTS A FINANCIAL BURDEN FOR CORINA WITHOUT SIGNIFICANT ADDED VALUE WHAT HAD BEEN GAINED BY THE PREVIOUS INVESTMENT. SO IT'S MY POSITION THAT CORINA ALL ALONG

HAS ASSUMED LIABILITY FOR THESE ASSESSMENTS AND THAT IS WHOSE NAME AND ADDRESS SHOULD BE INSERTED FOR THE ASSESSMENT.

>>> LAST CALL, IS THERE ANYONE ELSE WISHING TO COME FORWARD AND SPEAK? PLEASE COME FORWARD.

>> GOOD MORNING. I LIVE AT 8295 WEST CRANE ROAD. I BASICALLY LIKE TO DIRECT MY COMMENTS TO MR. MAXFIELD BECAUSE I AM IN HIS DISTRICT. I LIVED THERE FOR 14 YEARS AND I'VE HAD FOUR FLOODS, THAT HAVE FLOODED MY PROPERTY AND CUL-DE-SAC THAT I LIVE ON. BASICALLY $7300 IN ADDITIONAL AMOUNT TO MY PROPERTY TAXES BUT IF THAT IS THE CASE, I WILL PAY FOR THAT OVER THE NEXT TEN YEARS. BUT I WOULD LIKE ASSURANCE THAT THE STREET THAT IS BUTLER AVENUE DIRECTLY WEST WILL BE PACED AND THAT FLOOD CONTROL WILL DEFINITELY KEEP THE WATER OUT OF MY CUL-DE-SAC. I'VE LIVED IN CLARK COUNTY FOR 35 YEARS. I JUST BASICALLY WOULD LIKE THAT ASSURANCE. THAT MIGHT BE SOMETHING YOU CAN DO TODAY BUT ASK YOU TO LOOK INTO THAT AND GIVE ME A WRITTEN ASSURANCE THAT BUTLER WILL BE PAVED WEST OF MY PROPERTY AND THAT THE FLOOD CONTROL SHOULD MANAGE THE WATER AS IT FLOODS DOWN WEST CRAIG. THAT IS EAST OF DURANGO, THE WEST CRAIG AREA. TO MAKE IT EASIER, JANICE WHO SPEAKS FOR KIM BUSH HAS GIVEN ME THOSE ASSURANCES. I WOULD RATHER IT FROM HERE HEAR FROM YOU IN WRITING.

>> THANK YOU SO MUCH FOR YOUR TIME.

>> SEEING NO ONE, COMMISSIONER MAXFIELD THIS IS YOUR DISTRICT.

>> THANK YOU, MR. CHAIRMAN. THERE IS AN ISSUE MOVING FORWARD. RESIDENTS IN A COMMUNITY WHO HAVE STATED AND SHOWN THEY HAVE NOT BEEN NATIONWIDE FOR THE SID PUBLIC WORKS HAS BEEN WORKING ON, I'VE BEEN WORKING IN THE COMMUNITY FOR THE LAST COUPLE OF YEARS. I'M PERPLEXED THEY HAVEN'T BEEN NOTICED BECAUSE THEY USUALLY DO A PRETTY GOOD EFFORT. THERE HAS BEEN A LOT OF DISCUSSION THE LAST COUPLE YEARS ABOUT THE NEEDS FOR THE IMPROVEMENTS ON CIMARRON AND CRAIG ROAD, AS WELL. I THINK THE MATTER IS PART ONE, NOTIFICATION ISSUE THAT THEY HAVE AND THEY WANT SOME FULLY INFORMED OF WHAT IS OCCURRING IN THEIR NEIGHBORHOOD THAT DIRECTLY AFFECTS THEM. THE SECOND IS CIVIL MATTER AND DOESN'T HAVE A BASIS FOR CLARK COUNTY. BUT WITH THAT BEING SAID, I KNOW THEY ARE HOPING TO HAVE IT CONTINUED FOR A COUPLE OF WEEKS SO AT LEAST THEY HAVE A DIALOGUE WITH THE PUBLIC WORKS DEPARTMENT AS TO WHAT AS BEEN THAN AND HOW THE ASSESSMENTS WERE ESTABLISHED AND WHAT IMPROVEMENTS ARE TO BE DONE AND BENEFIT FOR THAT. I CAN UNDERSTAND AND APPRECIATE THAT. ONLY ON THAT BASIS SO THEY CAN HAVE AN UNDERSTANDING OF WHAT HAS BEEN DONE COULD I MOVE FOR A CONTINUATION FOR TWO WEEKS. I THINK THEY HAVE THAT RIGHT TO KNOW AS CITIZENS IN THE AREA. I WANT TO ALSO

SAY, AS JANICE, SHE IS GREAT LADY AND KIM IS A GREAT LADY. KIM IS VERY WELL VERSED AS OUR PUBLIC WORKS DIRECTOR ABOUT THE LOCALIZED DRAINAGE NEEDS. I CAN'T GIVE YOU AN ASSURANCE BUTLER WILL BE PAVED BECAUSE I DON'T KNOW IT'S PART OF THIS SID. SO I'M GOING TO LET NOW WITH A IMPROVEMENTS IS BEING DONE WITH THIS PROPOSED SID. ON THE SECOND NOTE, THERE IS A LOT OF LOCALIZED DRAINAGE AREAS IN THE ENTIRE COUNTY. WE CALL THEM HOT SPOTS WE'VE BEEN ADDRESSING IN THAT PARTICULAR AREA. BUTLER, ALEXANDER, CRAIG IN THAT AREA HAS BEEN TARGETED FOR SOME IMPROVEMENTS BECAUSE THERE IS A LOT OF DRAINAGE THAT COMES THROUGH THAT AREA. OVERALL A LOT OF PUBLIC WORKS DRAINAGE IMPROVEMENTS THAT HAVE BEEN DONE, CHANNELS CUT ACROSS. THEY ARE ELIMINATING THIS DRAINAGE THAT COMES FROM WEST TO THE EAST. I KNOW IT'S A BENEFIT AND EVERY TIME IT FLOODS AND WALKING THROUGH THE MUD AND SAYING WE NEED TO DO SOMETHING ABOUT IT. BUT IT'S BETTER FOR YOU TO TALK TO OUR PUBLIC WORKS DIRECTOR AND HE CAN EXPLAIN THE EFFORTS BEING DONE. WITH THAT, I APPRECIATE THE OPPORTUNITY. I WOULD ASK THAT WE HOLD THIS FOR, MARY, CAN WE HOLD IT FOR TWO WEEKS.

>> KEEP THE PUBLIC HEARING OPEN.

>> AND I'LL CLOSE IT AND OPEN IT BACK UP. WE'LL CONTINUE UNTIL THAT DATE.

>> THAT WOULD BE NOVEMBER 8th THE DAY AFTER THE ELECTIONS.

>> AND DENNIS HOPEFULLY YOU CAN GET IN TOUCH AND LET THEM KNOW WHY AND HOW. I WOULD APPRECIATE THAT.

>> A MOTION TO --

>> IT'S BEEN SUGGESTED THAT WE CLARIFY THAT TWO WEEKS IS ACTUALLY 13 DAYS BECAUSE IT WILL BE ON A WEDNESDAY INSTEAD OF A TUESDAY.

>> NOVEMBER THE 8th. IT'S CONTINUED UNTIL NOVEMBER 8th. CAST YOUR VOTES. MOTION CARRIES.

>> ITEM 123 COYOTO SPRINGS IMPROVEMENT DISTRICT, TAKE APPROPRIATE ACTION AND PROVIDE FOR OTHER MATTERS PROPERLY RELATED TO.

>> CAN YOU BE A PUBLIC HEARING AND PROVE ADOPT AND AUTHORIZE THE CHAIRMAN TO SIGN A RESOLUTION CONFIRMING THE ASSESSMENT ROLL, AND IF AN EMERGENCY EXISTS FOR SPECIAL IMPROVEMENT DISTRICT NUMBER 150.

>> WE'VE RECEIVED NO PROTESTS.

>> IS THERE ANYONE HERE TO BE HEARD ON THIS ITEM. THIS IS A PUBLIC HEARING. THIS IS A PUBLIC HEARING. SEEING NO ONE I'LL CLOSE THE PUBLIC HEARING.

>> MOVE FOR THE ADOPTION OF THE RESOLUTION.

>> MOTION FOR ADOPTION. CAST YOUR VOTES. MOTION CARRIES. I'LL ASK THAT, INTRODUCE THE ORDINANCE AND ASK IT BE READ BY TITLE.

>> AN ORDINANCE IMPROVEMENT DISTRICT 150 SILVERADO RANCH INTERCHANGE AND ASSESSMENTS AND BENEFITS BY SAID IMPROVEMENTS AND AUTHORIZE IT AS IF AN EMERGENCY EXISTS.

>> ANY DISCUSSION?

>> THIS IS VERY IMPORTANT SID TO HAVE THIS INTERCHANGE BUILT AT SILVERADO RANCH. WILL IT GREATLY IMPROVE THE MOVEMENT OF TRAFFIC IN THAT I-15 LAS VEGAS SOUTH AREA. I MOVE FOR ADOPTION.

>> MOTION FOR AN ADOPTION AS IF AN EMERGENCY EXISTS. MOTION FOR ADOPTION, CAST YOUR VOTES.

>>> ITEM 13 CONDUCT A PUBLIC HEARING TO CONSIDER THE CREATION OF THE CLARK COUNTY, COYOTE SPRINGS WATER RESOURCES GENERAL IMPROVEMENT DISTRICT AND TAKE APPROPRIATE ACTION AND PROVIDING FOR OTHER MATTERS PROPERLY RELATING THERETO. I WOULD LIKE TO GIVE YOU A BRIEF HISTORY OF COYOTE SPRINGS AND HARVEY WILL PRESENT THE PROJECT AND LATER WE'LL HAVE TWO OTHER PEOPLE TOO TALK ABOUT IT. I'LL TELL YOU ABOUT SOME OF THE INSTRUMENTS OF GID. AT THE CONCLUSION OF THE HEARING IF YOU CHOOSE TO GO FORWARD YOU MUST MAKE A FINDING THAT THE CREATION OF THE DISTRICT IS REQUIRED BY PUBLIC NEEDS AND NECESSITY AND IT WILL BE NECKLY SOUND AND FEASIBLE. SOME OF THE PREVIOUS ACTIONS INCLUDE THE COYOTE SPRINGS DEVELOPMENT AGREEMENT AND ALSO THE COYOTE GENERAL IMPROVEMENT SERVICE PLAN THAT WAS APPROVED MAY 2nd, 2006. SERVICE PLAN INFRASTRUCTURE AND OPERATION AND MAINTENANCE MATTERS. BOARD ADOPTED AN ORDINANCE TO INITIATE THE FORMATION OF GID AND SANITARY SERVICES FOR THE COYOTE SPRINGS COMMUNITY. ON JUNE 6 THEY OPENED A PUBLIC HEARING ON THE CREATION OF SPECIAL DISTRICT. THE COYOTE MASTER PLANNED COMMUNITY CONSISTS OF 12 13,100 ACRES AND THERE IS 16,000 TO 19,000 ACRES OF LAND UNDER DEVELOPMENT. THIS IS DIFFERENT FROM OTHER DEPARTMENTS. IT MUST REQUIRE AND SECURE ITS OWN WATER RESOURCES. THEY MUST PROCEED AT THEIR OWN RISK AND RESPONSIBLE FOR HUNDRED PERCENT OF MAINTENANCE COSTS AND CON CONSTRUCTION PERFORMANCE AND COST OVERRUNS FOR THE DEVELOPMENT AND OPERATION AND MAINTENANCE OF THESE FACILITIES. REIMBURSEMENT IS DISCRETION OF

THE GID BOARD. THERE IS NO EXISTING OR LANDOWNERS OTHER THAN THE DEVELOPERS. THIS GID IS NOT SUBSIDIZED BY THE WATER DISTRICT OR THE CLARK COUNTY RECLAMATION DISTRICT. IT'S COMPLETELY FINANCED FOR CUSTOMERS. THIS GID PROVIDES QUALITY WATER ASSISTANCE IMPORTANT THE COMMUNITY AND VIABILITY OF THE EXISTENCE IN THE FUTURE. THIS GID PLACES THE MANAGEMENT AND OPERATION IN THE HAND OF THE SAME AGENCIES THAT ARE RESPONSIBLE FOR THOSE SERVICES THROUGHOUT THE LAS VEGAS VALLEY. THE WATER DISTRICT HAD THE APPROVING AUTHORITY OVER THE CRITICAL DESIGNS AND MAINTENANCE RESPONSIBILITIES. PURSUANT TO THE CODE THEY MUST SHOW THE CREATION OF THE DISTRICT IS REQUIRED BY PUBLIC MEANS AND NECESSITY AND CREATION IS SOUND AND FEASIBLE. WITH THAT BACKGROUND WE COULD HAVE MR. WILLIAM MOORE MAKE A PRESENTATION FOR YOU.

>> GOOD MORNING.

>> GOOD MORNING. HARVEY WHITMORE. I'M CHAIRMAN OF THE COMPANY. WITH ME TODAY IS CLIFF ANDREWS, CLIFF IS GOING TO MAKE A GENERAL PRESENTATION AND THEN I WILL WALK THE BOARD THROUGH THE REQUIRED FINDINGS THROUGH 317.070.

>> I AM CLIFF ANDREWS. PRESIDENT OF PARTY HOMES OF NEVADA. OUR POSITION IN THIS DEVELOPMENT IS REALLY ACTING AS CO-DEVELOPER WITH HARVEY'S GROUP. WE HAVE BEEN A PARTY TO THE NEGOTIATIONS AND THE AGREEMENT PROCESS THAT IS ATTEMPTING TO FORM THIS DISTRICT. OUR POSITION IN COYOTE SPRINGS AS THE BUILDING OF THE RESIDENTIAL MASTER PLAN. AS STAFF POINTED OUT THERE IS OVER 6,000 ACRES FOR RESIDENTIAL AND COMMERCIAL DEVELOPMENT. WE ARE ALSO ALONG WITH CSI AND THE DESIGNER AND INCLUDING THE WATER AND SEWER FACILITIES THAT ARE CONTAINED AS PART OF THE AGREEMENT IN THE GID. I GUESS MY PERSPECTIVE THIS HAS BEEN A LENT THINK AND DIFFICULT PROCESS TO ATTEMPT TO FORM THE GID TO WORK WITH THE WATER DISTRICT AND THE WATER RECLAMATION DISTRICT. WE THINK AT THE END OF THE DAY WE HAVE A VERY GOOD AND WORKING AGREEMENT TO PROVIDE THE WATER AND THE SEWER FACILITIES FOR THIS FUTURE LARGE MASTER PLANNED COMMUNITY. STAFF POINTED OUT IT'S THE DEVELOPERS WHO ARE ASSUMING ALL OF THE RISK UNDER THIS GID AND UNDER THIS AGREEMENT. WHETHER IT'S FOR ACQUISITION OF WATERED RIGHTS, SUBSIDY OF THE OPERATING COSTS. CERTAINLY THE COST OF THE INFRASTRUCTURE THEMSELVES, THAT IS REALLY BORNE BY OURSELVES AND US AND DEVELOPERS. I THINK WE HAVE NOT ONLY A VERY GOOD AGREEMENT BUT A VERY GOOD PLAN FOR HOW WATER AND SEWER SERVICE WILL BE PROVIDED FOR FUTURE RESIDENTS OUT ON THE EDGE OF CLARK COUNTY. I ALSO FEEL LIKE IT'S IMPORTANT TO POINT OUT THE WATERY SOURCE THAT WE ARE EXPECTING TO USE OUT HERE IS ONE THAT IS OUTSIDE OF EXISTING ALLOCATIONS WITHIN CLARK COUNTY. WE ARE LIVING ON OUR OWN WATER RESOURCES THAT DON'T HAVE TO TAKE AWAY FROM ANY OF THE WATER

RIGHTS THAT WOULD OTHERWISE BE USED FOR THE REST OF CLARK COUNTY RESIDENTS.

>> IF I CAN FOLLOW UP A LITTLE BIT. WITH ME TODAY AND I WOULD LIKE TO RECOGNIZE A NUMBER OF PEOPLE THAT HAVE PUT THIS WILL PROJECT TOGETHER TO BRING IT BEFORE THIS BOARD. FIRST OF ALL, TO ANSWER ANY QUESTIONS THAT WE HAVE, WE HAVE OUR SENIOR EXECUTIVE STAFF WITH BOND COUNSEL, ADVISORS AND FINANCIAL ADVISORS THAT PUT ALL THE MODELS TOGETHER. IF THERE ARE ANY PARTICULAR QUESTIONS THAT THE BOARD HAS WITH RESPECT TO A PARTICULAR MATTER WE MAY BE ABLE TO CALL SOMEBODY UP. AT THE OUTSET I WOULD LIKE TO THANK COUNTY STAFF, LED BY VIRGINIA VALENTINE. I'M REMINDED THAT WE STARTED THIS PROCESS IN 1996. WE STARTED THE ACQUISITION OF COYOTE SPRINGS AND WE CLOSED IN 1998. THOSE ON THE BOARD ARE EARLY NEGOTIATIONS WITH RESPECT TO THIS, I'VE NOW CALCULATED JUST THE HOURS THAT HAVE BEEN PUT WITH RESPECT TO THIS PRONG, OVER 250,000 HOURS HAVE BEEN SPENT. IF YOU CAN IMAGINE NEGOTIATIONS WITH CLARK COUNTY. WITH LINCOLN COUNTY, U.S. FISH AND WILDLIFE. BLM. LAS VEGAS WATER DISTRICT. CLARK COUNTY RECLAMATION CONTRADICT ALL THE VARIOUS AGENCIES. EPA. WE'RE PROUD WE'RE AT THE POINT WE'VE RECEIVED DESIGNATIONS FROM ENVIRONMENTAL SENSITIVITY WITH RESPECT TO THE MASTER PLAN THAT WE'VE PRODUCED WITH RESPECT TO PROTECTION THAT WE'RE OFFERING. WITH RESPECT TO THE 404 PERMIT. IT IS OUR OBLIGATION TO SHOW THERE IS PUBLIC CONVENIENCE AND NECESSITY WITH RESPECT TO THIS PROJECT AND WE HAVE THE FINANCIAL CAPACITY TO OPERATE THE FUND THE GID AND MOST IMPORTANTLY IT'S ON A STABLE AND FIRM FOOTING FOR THE FUTURE. WHERE DID YOU GET THE STANDARD PUBLIC VENTS AND NECESSITY? IT'S VERY SIMILAR TO THE STANDARD UNDER CHAPTER 271 ABOUT RESPECT TO IMPROVEMENT DISTRICTS. IT'S FROM THE 19th CENTURY WHEN YOU ISSUED PUBLIC CONVENIENCE AND NECESSITY CERTIFICATES TO PEOPLE WHO ARE GOING TO ENTER INTO THE TELECOMMUNICATIONS OR UTILITY INDUSTRY WHEN THERE WAS A PROVIDER OF SERVICE. YOU HAD WILL PRIVATE CAPITAL NECESSARY TO SHOW THIS WAS CAPABLE OF BEING HANDLED IN AN APPROPRIATE WAY. THE STANDARD THAT IS BEFORE YOU TODAY IS THERE IS NEED? THERE IS CERTAINLY A NEED. WE HAVE AN APPROVED DEVELOPMENT AGREEMENT THAT ALLOWS US TO BUILD 49,000 UNITS IN CLARK COUNTY. SO THE QUESTION OF WHETHER THERE IS A NEED OR NOT, IS THERE A DEMAND FOR SERVICES AND ARE THERE INCUMBENT PROVIDERS OF THOSE SERVICES IN THAT AREA. AS EVERYONE KNOWS, IT'S A RURAL LOCATION THAT DOESN'T HAVE ACCESS TO EXISTING UTILITY SERVICES. IT'S NOT NEXT TO THE NEXT MAINLINE FOR THE WATER DISTRICT. IT'S NOT NEXT TO THE MAINLINE FOR THE SEWER TREATMENT FACILITY WE HAVE OUR OWN ISSUES WITH RESPECT TO POWER WE'RE RESOLVING WITH NEVADA POWER AND LINCOLN COUNTY POWER. WE HAVE OUR OWN FIBER OPTICS THAT IS GOING TO ALLOW US TELECOMMUNICATION SERVICES. BUT WE WANT TO MAKE SURE THAT THE PROVISION OF SERVICES ASSOCIATED WITH WATER AND WASTE WATER IS

DONE PURSUANT TO STANDARDS THE BOARD CAN BE COMFORTABLE WITH. THAT IS WHAT THIS PROCESS HAS BEEN ABOUT AND REST OF STAFF LED BY THESE PEOPLE RICHARD MENDEZ HAS DONE A TREMENDOUS JOB OF HOLDING CLIFF AND MY FEET TO THE FIRE WITH RESPECT TO THINGS THAT STAFF WANTED AS REFLECTED BY COMMENTS BY YOUR BOND COUNSEL AND YOUR COUNTY COUNSEL. SO AGAIN COLLECTION OF HUNDRED PERCENT OF THESE PEOPLE HAVE PUT FORWARD AN EFFORT THAT IS REFLECTED IN MULTIPARTY AGREEMENTS. I'M REMIND THAT HAD MULTIPARTY AGREEMENT WAS STARTED ALMOST EIGHT MONTHS AGO. IT'S THE CONCEPT WHAT WILL YOU DO TO ENSURE THE QUALITY OF SERVICE IN COYOTE SPRINGS. WHAT WE SAID WE WANTED A STANDARD THAT IS COMPARABLE TO ANY THAT EXISTS IN THE VALLEY. IT'S GOING TO IMPROVE AS THE SIZE OF THE COMMUNITY GROWS. WILL IT GROW TO A STANDARD THAT EXCEEDS THE STANDARDS IN THE COMMUNITY OF NEVADA AND WHAT HAVE WE DONE ON OUR PROMISES. AND WHAT WE HAVE WE ARE VERY PROUD OF. AS CLIFF SAID, THERE WAS SOME KICKING AND SCREAMING BUT WE GOT TO THE POINT WHERE WE NEEDED TO. AGAIN I'M VERY HAPPY TO ANSWER ANY QUESTIONS THAT THE BOARD HAS WITH RESPECT TO THIS. I DO WANT TO LET YOU KNOW WHAT IS HAPPENING. I WAS SURPRISED BUT LAST NIGHT, NBC NEWS CLOSED ONE SEGMENT OF NEWSCAST AS REPORTING LIVE FROM COYOTE SPRINGS, NEVADA. MANY PEOPLE DON'T REALIZE THAT THE U.S. EXCEEDED THE 300 MILLION MARK IN AMERICA. THAT THEY WERE PREDICTING WHERE ARE ALL THESE PEOPLE GOING TO LIVE. AND TO MOVE TO THE SOUTH LAND, PEOPLE ARE GOING TO MOVE TO THE SOUTHWEST AND MOVE TO NEVADA AND MORE PARTICULARLY, THEY PICKED A LOCATION THAT SUGGESTED THAT WHERE WE WERE GOING TO LIVE IN THE NEXT TEN, 20, 30 YEARS AND LIVING IN COMMUNITIES THAT ARE ADJACENT TO THIS WONDERFUL COMMUNITY. WHAT IT SAID WAS HERE IS WHAT IS HAPPENING. SHOWED THE GOLF COURSE, SHOWED ALL THE CONSTRUCTION EQUIPMENT. FACILITIES THAT WE'RE DOING RAILROADS TO THE INFRASTRUCTURE. I WOULD LIKE THE RECORD TO REFLECT, WE'RE ASKING THAT THIS BOARD RECOGNIZE AS PART OF THE ADMINISTRATIVE RECORD ALL THE MATERIAL THAT WAS SUBMITTED TO STAFF. ADVERTISE FOOT AFTER FOOT THAT HAS BEEN PROVIDED BUT WE NEED TO DO THAT SO I THERE IS A RECORD. MORE IMPORTANTLY IF YOU HAVE QUESTIONS WITH RESPECT TO THE FINANCIAL STANDARD I'LL BE HAPPY TO ANSWER. WE'VE RUN LOTS OF MODELS. THEY SHOW IT'S ECONOMICALLY SOUND AND FEASIBLE. THE COMPANIES THAT ARE BEHIND THIS PROJECT, PARTY HOMES OF NEVADA. YOU CAN TAKE A LOOK AT WHAT THEIR FINANCIAL CAPACITY IS. WE HAVE PROVIDED ON A CONFIDENTIAL BASIS SO HE CAN REVIEW THE RECORDS. BUT WE'RE COMFORTABLE WE HAVE THE FINANCIAL WHEREWITHAL TO MAKE IT FEASIBLE AND MORE IMPORTANTLY THE MODEL SHOWS THAT IT RUNS AT CHARGES THAT ARE VERY REASONABLE IN THE MARKETPLACE. MOST IMPORTANT THING WE ARE DOING THIS BY OURSELVES, WE ARE UNIQUE. THIS IS UNIQUE CIRCUMSTANCE, WE KNOW THAT AND MADE PRESENTATIONS FOR OVER EIGHT YEARS TO THIS BOARD. MR. WIMMER I THINK IS NEXT AND MR. MENDEZ, AS WELL.

>> RICHARD WIMMER WITH WATER RECLAMATION DISTRICT.

>> WE THINK IT'S IMPORTANT TO POINT OUT KIND OF STRUCTURE THAT IS IN PLACE AND INSTRUMENTS THAT HAVE BEEN WORKED ON VERY DILIGENTLY BY COUNTY STAFF BY THE LAS VEGAS STAFF AND DEVELOPERS TO ENSURE THAT THE THINGS THAT HAVE BEEN REPRESENTED TO YOU THIS MORNING IF YOU DECIDE TO GO FORWARD WITH THE GID THAT WE HAVE ENOUGH STRUCTURE AND DECISIONS AND THE INSTRUMENTS THAT GUARANTEE THAT THOSE THINGS HAPPEN IN PLACE. YOU CAN MAKE THAT KIND OF INFORMED DECISION BEFORE YOU GO FORWARD. SOMEONE MENTIONED ABOUT THE MULTIPARTY AGREEMENT. THERE ARE A NUMBER OF THINGS THAT ARE THINGS THAT ARE REQUIRED BEFORE IT CAN BROUGHT TO THIS POINT. IT'S AN AGREEMENT AMONG ALL OF THE DEVELOPMENT CANDIDATE AS WELL AS THE RECLAMATION DISTRICT AND THE GENERAL IMPROVEMENT DISTRICT IF THE BOARD CHOOSES TO FORM THE GENERAL IMPROVEMENT DISTRICT. THE THIS IS REALLY THE GROUND RULES OF HOW THIS GID WILL OPERATE. IT WILL BE BROUGHT BACK TO THE BOARD IF IT CHRIS IT. KEY ISSUES ARE MAINTENANCE AND OPERATION FACILITIES AND CONTEMPLATES MAINTENANCE OF GID AND RECLAMATION DISTRICT. SO CURRENT EXPERTS WILL PROVIDE THAT MANAGEMENT. IT PROVIDES FOR MANAGEMENT AND COST REIMBURSEMENT WHEN YOU START A WHOLE NEW COMMUNITY. WE'RE NOT GOING TO HAVE SUFFICIENT CONTROVERSIES COVER OPERATING COSTS UNTIL THERE IS ENOUGH CUSTOMERS TO BE PAYING IN. THIS PROVIDES THE DEVELOPER TO UP FRONT THOSE COSTS WITHOUT REIMBURSEMENT. AS ULTIMATELY RIGHT TO IMPLEMENT IT AND AT SOME POINT IN TIME THE COMMUNITY IS VIABLE ENOUGH IT CAN PICK UP WATER REVENUES ENOUGH AS IT GOES FORWARD. IT PROVIDES A STRUCTURE FOR THE WATER AND WASTE WATER APPROVAL PROCESS. SO THE FACILITIES THAT ARE BEING BUILT ARE FACILITIES THAT CAN PROVIDE THE LEVEL OF SERVICE THAT YOU CAN GET YOUR CONSTITUENTS IN THAT AREA. IT'S BEEN MENTIONED THAT THIS IS UNIQUE IN COYOTE SPRINGS WITH YOUR OWN WATER RESOURCES. AND IT'S IN THIS MULTIPARTY AGREEMENT THEY TURN OVER IT TO THE GID WHEN IT'S FORMED SO THERE CURRENTLY IS A SUPPLY TO CARRY SOME NUMBER OF YEARS DEPENDING ON HOW THINGS DEVELOP. BUT FUTURE WATER SUPPLIES TO BRING THOSE SUPPLIES INTO THE VALLEY NEEDED TO BE PROVIDED BY COYOTE SPRINGS. SO THE BOARD NEED TO KNOW WHAT THOSE ARE IN SUFFICIENT DETAIL TO GO FORWARD IN THE FUTURE. THIS HAYES THE PROVISIONS OF WATER SUPPLIED PLANNING PROCESSION, SOMEWHAT SIMILAR TO WHAT THE NEVADA WATER AUTHORITY DOES FOR THE VALLEY. AND REVIEW OF THAT BY THE GID BOARD. THE ESTABLISHES THE SERVICE COMMITMENT PROCESS WATER ISN'T COMMITTED TO PROPERTIES UNTIL THE WATER IS NEEDED. THERE ARE ISSUES WITH REGARD TO THE USE OF TREATED WASTE WATER. THIS IS A UNIQUE CIRCUMSTANCE WHERE THE DEVELOPER IS PROVIDING THE WATER. SO THERE IS ISSUES WITH TREATED WASTE WATER AFTER THE FACT. THOSE ARE ADDRESSED IN THERE. THEN THERE IS A WHOLE

SECTION WITH REGARD TO CAPITAL COSTS AND FINANCING OF FACILITIES. IT DOES PROVIDE IN THE FUTURE FOR THE ABILITY TO USE PUBLIC FINANCING TO PAY FOR STRUCTURE BUT UP FRONT AND PROBABLY THE INITIAL AMOUNT OF INFRASTRUCTURE FOR WASTE WATER IS IN THE NEIGHBORHOOD OF $116 MILLION TO GET THINGS STARTED IS NOT FRONT BY THE GID OR PUBLICLY FINANCED IN ANY WAY. GOVERNMENT IS NOT AT RISK OR WATER DISTRICT THE DEVELOPMENT RISK IS ASSUMED ABILITY DEVELOPER. IF IT'S NOT SUPPORTING ENOUGH THEN THE BOARD WILL BE ABLE TO FINANCE THE WAY THEY DO MOUNTAIN VALLEY. ONE THING IT CONTEMPLATES THE IMPOSITION OF A WATER INFRASTRUCTURE SURCHARGE. THAT IS IN LIEU OF CONNECTION CHARGE THAT WOULDN'T BE INSTALLED FOR SOME PERIOD OF TIME THERE. IT'S IMPORTANT THAT BE PUT IN PLACE BEFORE THE FIRST CUSTOMER BUYS A PROPERTY OUT THERE SO THE DISCLOSURE OCCURS SO THE PUBLIC KNOWS WHAT THEY ARE PAYING FOR. THE PROVISIONS FOR THAT ARE IN HERE, AS WELL. THEN THE BOARD CAN USE THAT FUND TO REIMBURSE THE INFRASTRUCTURE THAT WAS PREVIOUSLY PUT IN BY THE DEVELOPER WITHIN CERTAIN PARAMETERS. THE OTHER IMPORTANT INSTRUMENT THAT HAS BEEN PUT IN PLACE, FACILITY PHASING AGREEMENT. THERE ARE A LOT OF DETAILS THAT NEED TO BE WORKED OUT. AND MR. WHITTAKER MORE THE FINANCIAL MODELS THAT WILL BE EXERCISED IN THE FUTURE. THE PURPOSE OF THAT IS TWO THINGS. TO DEMONSTRATE THE FINANCIAL VIABILITY AND WOULD ALSO TO SERVE THE FINANCIAL ISSUES THAT NEED TO BE IN THE AGREEMENTS. WE HAVE A DRAFT OF SERVICE RULES WELL AHEAD WHEN THE FIRST CUSTOMER WILL HAVE IT. THAT WILL HAVE TO COME BACK IN THE NEXT SEVERAL MONTHS. THERE IS A WELL SHARING AGREEMENT WHICH DEMONSTRATE HOW LIMITED RESOURCES IS. SOUTHERN VALLEY WATER AUTHORITY HAS A SIGNIFICANT AMOUNT OF WATER RIGHTS. THERE NEEDED TO BE A WELL SHARING AGREEMENT WHERE THE OPERATION OF WELLS WOULD BE ALLOWED TO BE DEVELOP AND TO MANAGE THOSE RESOURCES GOING FORWARD. AND THEN ONE OF THE AGREEMENTS THAT WILL HAVE TO COME BACK TO THE BOARD IN A FUTURE IS OPERATIONS AND MAINTENANCE AGREEMENT WHICH IS PRIMARILY BETWEEN THE GID AND RECLAMATION DISTRICT AND WATER DISTRICT. THOSE ARE THE BASIC STRUCTURES AND IMPLEMENTS TO BE PUT IN PLACE TO MAKE SURE THINGS COME DOWN THE WAY IT'S BEEN REPRESENTED THIS MORNING.

>> I WOULD ADD ONLY ONE ITEM. EVEN THOUGH THERE ARE NO CUSTOMERS WE TRIED TO APPROACH THIS FROM CUSTOMER EXPERIENCE.

>> I'M FROM THE WATER RECLAMATION DISTRICT. WE TRIED TO PURSUE THIS THAT WOULD BE SEAMLESS FROM THE CUSTOMER'S PERSPECTIVE. THERE WILL BE ONE PERSON OF CONTACT AND COLLABORATION BETWEEN THE WATER RECLAMATION DISTRICT AND THERE ARE MANY ISSUES THAT BACK MODEL FOR OTHER APPLICATIONS.

>> BEFORE WE TURN THIS OVER TO THE THE BOARD. THIS IS A PUBLIC

HEARING. IS THERE ANYONE ELSE WISHING TO SPEAK. I WOULD SUPPORT FOR THEM TO GO FORWARD WITH THIS PROJECT. BUT I WOULD LIKE TO PUBLIC TRANSPORTATION TO AND FROM THE FACILITIES. I WOULD LIKE THEM TO INCLUDE MEDICAL FACILITIES WITHIN THE MASTER PLAN. LIKE SCHOOL HOUSES AND HOSPITALS, ALSO COURT HOUSES AND ALL THE GOVERNMENT FACILITIES LIKE WELFARE. HAVE ALL THOSE PUT IN THE MASTER PLAN SO THEY CAN HAVE TRANSPORTATION TO GET BACK AND FORTH TO THOSE PARTICULAR FACILITIES WITHIN THE NEW COMMUNITY. I ALSO WANT TO POINT OUT IF THEY ALSO WOULD INCLUDE FALLOUT SHELTERS JUST IN CASE AN EMERGENCY MIGHT BE NEEDED FOR RADIATION BUT WE NEED TO THAN PREPARED AND ALSO WATER STORAGE FACILITIES FOR EMERGENCIES LIKE THAT. ALSO LIKE TO POINT OUT THAT GAS STORAGE TANKS. TO MAKE SURE THAT ALL YOUR DEVELOPERS WHO WORK FOR THE DEVELOPMENT AGENCY THEY HAVE ADEQUATE MEDICAL CARE AND TRANSPORTATION BACK AND FORTH. THANK YOU.

>> ANYONE ELSE?

>> GLEN CAMPBELL I'M A CHILD WELFARE ACTIVIST BUT BELIEF IT OR NOT I KNOW ABOUT COYOTE SPRINGS. I PROBABLY SPENT MORE TIME THAN ANYONE IN THIS ROOM THERE. I WANT TO INTRODUCE A LITTLE PERSPECTIVE INTO THIS DEBATE. IT'S A BIG VALLEY. IT IS A HUGE EMPTY VALLEY THE REASON I KNOW COYOTE SPRINGS AND I USED TO LIVE IN LINCOLN COUNTY AND THERE WAS A BIG GAP. SO I SPENT WAY MORE TIME IN COYOTE TIME. ONE OF REASONS THAT IS WHERE THEY DUMPED THE BODIES VERY OFTEN WHEN A BODY TURNED UP IN THE DESERT IT WOULD BE OFTEN COYOTE SPRINGS. I WOULD FIND THE LOCATION OF THE BODY. AS THEY BREAK GROUND HERE THEY'LL COME UP WITH A FEW MORE BODIES FROM PERHAPS WAY BACK. WHAT IS PRESSING ABOUT THIS PLACE IT'S EMPTY. ONE SIGN THAT YOU PASS WHEN YOU ARE COMING TO LAS VEGAS, LAS VEGAS, 49 MILES. RECENT BORDER IS ABOUT 60 MILES FROM HERE. THAT IS WAY OUT IN THE MIDDLE OF NOWHERE. NOW, I WANT TO CAUTION THE BOARD THAT YOU MAKE SURE THAT EVERYTHING IS ON DEVELOPERS, ALL THE RISK IS ON DEVELOPERS BECAUSE YOU MIGHT BE BUILDING A GHOST TOWN OUT THERE. THE MOHAVE DESERT IS LITTERED WITH THAT. CALIFORNIA CITY, TO LAID OUT TO BE A PERFECT COMMUNITY AND IT NEVER HAPPENED. YOU ARE FACING ENORMOUS RISK HERE. THE WHOLE DEVELOPMENT IS BASED ON THE NOTION OF INFINITE GROWTH IN CLARK COUNTY IN THE VALLEY. IT'S ASSUMED WE'RE BURSTING AND PROPERTY VALUES IS GOING TO BE WAY UP AND PEOPLE WANT TO GO OUT HERE AND LIVE IN A VERY REMOTE LOCATION. THIS IS WHAT THE CHAPS THE DEVELOPERS ARE TAKING. I WANT TO MAKE SURE THAT CLARK COUNTY ISN'T TAKEN TAKING THE CHANCE. RIGHT NOW PROPERTY VALUES ARE COMING DOWN. WE HAVE MORE HOUSES ON THE MARKET THAN WE'VE HAD IN A LONG TIME. WHAT IF IT TURNS INTO A BIGGER DIP. PROPERTY VALUES IS GOING TO BE MORE AFFORDABLE IN VALLEY. MAYBE OUR GROWTH DOES NOT GO ON INDEFINITELY AND WHO IS GOING TO DRIVE 60 MILES IN THE MIDDLE OF

NOWHERE. IF YOU ARE GOING TO CREATE A COMMUNITY IN THE MIDDLE OF NOWHERE, YOU'VE GOT TO REACH A CERTAIN LEVEL. YOU'VE GOT TO REACH A CERTAIN LEVEL WHERE IT'S SUSTAINABLE. YOU DON'T NEED THOUSAND OF FAMILIES, YOU NEED THOUSANDS OF FAMILIES TO BRING IN GROCERY STORES AND ATTRACTIVE TO ANYONE. THERE IS ENORMOUS RISK IN THIS PROJECT. I DON'T KNOW ANYTHING ABOUT THIS WATER PROPOSAL BUT I THINK THE BOARD HAS TO BE VERY SURE THAT YOU ARE NOT EXPOSED TO GREAT RISK IF THIS ALL GOES BELLY-UP. YOU COULD BE BUILDING A GHOST TOWN OUT THERE. YOU HAVE TO BE CAREFUL. THANK YOU.

>> IS THERE ANYONE ELSE WISHING TO SPEAK. I'LL CLOSE THE PUBLIC HEARING. TURN THIS OVER TO THE BOARD. ARE THERE COMMENTS OR QUESTIONS.

>>> JUST LIKE TO RESPOND TO THE LAST SPEAKER. AS PRESIDENT OF LAS VEGAS VALLEY WATER DISTRICT FOR 12 YEARS I CAN TELL YOU THAT I WAS CONCERNED ABOUT WHAT, JUST ABOUT RISK. I AM CONVINCED AFTER GOING THROUGH ALL THE CONTRACT AND RESEARCH THAT THERE IS NO RISK FOR CLARK COUNTY TAXPAYERS. THAT THIS IS ALL THE RISK AND LIABILITY LIES WITH THE PROJECT DEVELOPERS. I CERTAINLY HOPE THAT IT IS A SUCCESSFUL ENDEAVOR. I THINK IT PROBABLY WILL BE. I DID SEE MR. WHITTAKER MORE ON TELEVISION LAST NIGHT. AND THERE WAS HARVEY. SO I SHARE, I SHARE THE CONCERNS BUT I FEEL SATISFIED THAT WE WILL NOT HAVE RISK.

>> COMMENTS? COMMISSIONER MAXFIELD.

>> THANK YOU, MR. CHAIRMAN. I WANT TO MAKE SURE I UNDERSTAND BUT TO REITERATE FIRST, WITH REGARD TO THE CLARK COUNTY RECLAMATION DISTRICT. SERVICE AREA THAT SERVES THE POPULATION IN THE GREATER CLARK COUNTY HERE IS COMPLETELY SEPARATE SERVICE DISTRICT THAN WITH THE COUNTY SPRINGS DISTRICT WILL BE?

>> YES, THAT'S CORRECT.

>> AND LAS VEGAS WATER DISTRICT THAT SERVES THE GREATER COMMUNITY HERE IN CLARK COUNTY. AND IT'S DETACHED FROM THE WATER SERVICE THAT WOULD BE CREATED IF THERE IS A GID FORMED FOR COYOTE SPRINGS?

>> YES, THE ONLY INVOLVEMENT WOULD BE TO MANAGE IT.

>> AND THE NEXT POINT WHICH IS A VERY IMPORTANT POINT. I WITH WANT TO USE THE HISTORICAL PERSPECTIVE TO GRUELING DISCUSSIONS BEFORE US TODAY. WE'LL HAVE THE CITIZENS OF CLARK COUNTY THAT CHOOSE TO LIVE IN COYOTE SPRINGS AND WATER SERVICE DISTRICT A LITTLE HOT FACILITIES. BUT PUBLIC FACILITIES OF NATURE OF WHAT WAS SAID AND CONSTRUCTED AND INSPECTED AND MAINTAINED WILL BE AT THE HIGHEST LEVEL OF THE

PUBLIC FACILITIES WE HAVE IN BOTTOM THE WATER RECLAMATION AND WATER DISTRICT OVERSEE AND MANAGED. SO THAT IS THE SECOND THING. THEY ARE BEING CONTRACTED BY COYOTE SPRINGS TO OVERSEE THE OPERATIONS AND MAINTENANCE OF THOSE FACILITIES. SO YOU HAVE A HIGHER LEVEL OF PUBLIC FACILITY BEING CONSTRUCTED WHICH IS HIGHER COSTS. AND THEY ARE SMALLER EXAMPLES BUT STILL IMPORTANT. WE HAVE IN THIS COMMUNITY PRIVATE SYSTEMS THAT WERE CONSTRUCTED THAT OPERATED BY A PRIVATE SERVICE. THOSE SYSTEMS WE HAD TO TAKE OVER BECAUSE IT WAS IN THE SERVICE DISTRICT OF THE WATER RECLAMATION DISTRICT. BUT WE HAD NO CHOICE AND TO TAKE OVER A PRIVATE SYSTEM AND I FOUND IN ALL CASES PRIVATE SYSTEMS HAVE BEEN RUBBER BANDED AND PUT TOGETHER TO HOLE THEM. IT'S PUT A TREMENDOUS BURDEN ON NOT ONLY THE COMMUNITIES WHICH HAVE TO FIND A WAY TO PAY FOR THOSE IMPROVEMENTS BUT ALSO THE RATE PAIRS WITHIN THE COMMUNITY HAVE TO SUBSIDIZE THE IMPROVEMENTS TO THOSE INDIVIDUALS. WE DON'T HAVE IT HERE THAT THE DEVELOPER AT THEIR RISK HAS TA TO INSTALL THOSE TO THE GREE DEGREE BY THE PUBLIC HERE AND OVERSIGHT WILL NOT BE BY THE PRIVATE SECTOR BUT THE PUBLIC SECTOR TO ENSURE THE PUBLIC GOOD FOR A LONG TIME MINIMIZING THE RISK OF TAKING OVER A SYSTEM THAT WOULD PERHAPS BE CONSTRUCTED. THAT AN IMPORTANT MATTER. THE SECOND, WITH THAT, THEY'LL BE OWN ASSESSMENTS FOR THE RESIDENTS THAT LIVE THERE TO PAY FOR THE FACILITIES AT POINT IN TIME, EITHER THROUGH A CONNECTION CHARGE OR SPECIAL ASSESSMENT ON A MONTHLY BASIS, THAT IS PART OF THE FINANCIAL PLAN. THE INDIVIDUAL THAT LIVED THERE HAS THE RESPONSIBILITY TO MAINTAIN AND PAY FOR FACILITIES THAT WILL BE THERE TODAY AN IN THE FUTURE. SO RISK IS EVALUATED FOR THE GENERAL PUBLIC AND RATE PAIRS WITHIN THE WATER DISTRICT. CAN YOU AFFIRM THAT?

>> YES, THAT'S CORRECT.

>> THEN, I THINK ANOTHER IMPORTANT ASPECT OF THIS THE GID IS FORMED THOSE WHO GOVERNOR THE GID WILL BE THE BOARD OF COUNTY COMMISSIONERS OR THE BOARD WHO OPERATES AND OVERSEES THE WATER RECLAMATION DISTRICT WHICH IS THE BOARD OF COUNTY COMMISSIONERS, IS THAT CORRECT?

>> YES IT WILL BE BOARD OF COUNTY COMMISSIONERS FOR THE GID. I BELIEVE SINCE WE CAN PHYSICALLY SEPARATE COYOTE SPRINGS DEVELOPMENT FROM THE USES HERE IN CLARK COUNTY, WE CAN ESTABLISH THERE IS A PUBLIC NECESSITY AND NEED IF WE FOLLOW THROUGH AND CREATE THIS GID BECAUSE WE HAVE THESE AGREEMENTS THAT ARE IN PLACE THAT ASSURE US AND THE COMMUNITY HERE IN LAS VEGAS THAT THEY WILL NOT BE BURDENED BY SUBSIDIZING OR TAKING OVER THE DEVELOPMENT PHYSICALLY DETACHED FROM THIS VALLEY. WE FIND THAT INFORMATION IN THE AGREEMENTS, IS THAT CORRECT?

>> YES, IT IS.

>> THANK YOU.

>> THANK YOU, MR. CHAIRMAN. I WANT TO MAKE SOME OF THE COMMENTS THAT MR. MAXFIELD SAID. WE DO HAVE HISTORICAL EXAMPLES, BLUE DIAMOND AND PRIVATE PURVEYORS OF THE WATER DISTRICT HAD TO COME IN AT ALARM EXPENSE, MILLIONS OF DOLLARS TO UPGRADE TO THE STANDARD THAT WE WOULD REQUIRE ON THEM. SO IN MANY WAYS, WE'RE DISCUSSING THE PUBLIC CONVENIENCE AND NECESSITY THAT IT'S BEST TO BE PRO-ACTIVE IN THESE MATTERS RATHER THAN REACT I HAVE. ONE OF THE QUESTIONS I HAVE WE'VE COVERED A LOST GROUND. MAYBE DICK COULD STATE IT PROBABLY BEST. BUT I THINK JUST FOR A CITIZEN WHO MAY LIVES IN SPRING VALLEY, CAN YOU EXPLAIN AGAIN THROUGH THE MODELING, THROUGH THE SURCHARGES OR ALL OF THE ABOVE. HOW N AN URBAN CLARK COUNTY RESIDENT BE INSULATED FROM ANY POTENTIAL RATE INCREASES OF SOMETHING WERE TO GO SOUTH IN COYOTE SPRINGS.

>> THE WAY THIS WILL WORK THE BOARD FORMS THE GENERAL IMPROVEMENT DISTRICT AND WITHIN 90 TO 120 CASE WE'LL COME FORWARD WITH A SET OF SERVICE RULES. A SET OF SERVICE RULES WILL BE COMBINED FOR WATER AND WASTE WATER. WHAT THEY'LL DO IS ESTABLISH THE RULES FOR HOOKING UP AND ESTABLISH THE RULES WITH CUSTOMER SERVICE INCLUDING RATES. THAT IS WHERE RATES ARE ESTABLISHED. THE BOOKS WILL BE SEPARATE FOR THE ORGANIZATIONS. WHAT HAPPENS THEN IT BECOMES THE RESPONSIBILITY OF GENERAL IMPROVEMENT DISTRICT TO SET RATES AND BE ABLE TO COVER THE COST OF OPERATIONS. IN THAT OTHER THAT I MENTIONED EARLIER, THE SURCHARGE THAT WOULD BE INCLUDED IN THOSE SERVICE RULES AT THE BOARD'S DISCRETION AND COULD BE INCREASED OR DI DECREASED. BUT THOSE CHARGES THEN WOULD BE CHARGED NEW CUSTOMERS IN COYOTE SPRINGS. THE PROBLEM IS BETWEEN NOW AND THE TIME THAT THAT IS GOING TO BE A CONCERN OF THE COMMUNITY. WAIT OF THE AGREEMENT THE DEVELOPER HAS TO ASSUME EXPENSES. SINCE THERE ARE NO CUSTOMERS TO BILL AND THEY'LL NEED TO PAY FOR IT UNTIL IT'S SELF-SUFFICIENT.

>> THIS IS HELPFUL FOR THE PUBLIC TO HEAR THAT. THE ONLY OTHER QUESTION I WOULD HAVE IS THIS PROJECT, OF COURSE, IS IN ITS ENTIRETY CLARK COUNTY AS WELL AS LINCOLN COUNTY, HAVE THERE BEEN ANY DISCUSSIONS WITH LINCOLN COUNTY AS TO RATES OF THE GID THAT WE'RE DISCUSSING TODAY?

>> THERE HAVEN'T BEEN AT THINK TH POINT IN TIME. LINCOLN WILL HAVE TO ADDRESS IT MUCH THE WAY YOU HAVE HERE. WHETHER THEY WANT TO SHARE RESOURCES OR CONTRACTS WITH ANYBODY FOR HELP. THAT IS UP TO

LINCOLN COUNTY AT THIS JUNCTURE BUT THERE HAS BEEN NO DISCUSSIONS WITH REGARD TO THAT.

>> THANK YOU.

>> THANK YOU, MR. CHAIRMAN. IT'S FUNNY THERE WOULD BE ANOTHER GHOST TOWN IN NEVADA AND I GUESS THERE MIGHT BE SOMEWHERE. PEOPLE ARE MOVING TO THE SOUTHWEST BECAUSE OF THE JOBS AND CLIMATES AND GOOD LAWS AND GOOD GOVERNMENT THAT IS AVAILABLE. WE LOOK AT PEOPLE, BRIGHAM YOUNG THAT COLONIZE HAD AND HUNDRED YEARS, WILLIAM CLARK CAME DOWN HERE AND THAT IS WHAT GOT LAS VEGAS GOING. GONE OUT HERE AND VAST EMPTY VALLEY AND HERE COMES ALL THESE PROPOSED 49,000 HOMES AND CLARK COUNTY AND WHO KNOWS HOW MANY MORE. TALKING TO THE PEOPLE UP IN LINCOLN COUNTY, A LOT OF FOLKS ARE LOOKING FORWARD TO IT. JOBS AND IMPROVEMENTS FROM LINCOLN COUNTY FROM FOLKS DOWN THERE. ONE GUYS WIFE DOESN'T HARDLY GET TO SEE HIM BECAUSE WITH ALL THIS STUFF. THE GID, WE'VE GOT THEM AND SO I FEEL COMFORTABLE WITH THIS FROM HAVING WORKING IN THE LEGISLATURE ON GIDs IN ELKO AND DOUGLAS COUNTY AND DIFFERENT PLACES THROUGHOUT THE STATE THAT HAVE GOOD GIDs. BUT I THINK THE COMPLIMENT GOES TO THE DETAILS THAT OUR STAFF AND THE COYOTE SPRINGS AND THE WATER DISTRICT AND THE RECLAMATION DISTRICT HAVE PUT IN TO MAKING THIS SO COMPLETE, SO PROTECTIVE OF THE TAXPAYERS. JUST LIKE WE DO IN THE WASTE BOUGHT. FOLKS IN LAUGHLIN AND FOLKS OUT IN THE NORTHEAST. DIFFERENT AREAS. (PAUSE IN CAPTIONING)

>> PERSONAL CHARACTER AND TOIMPROVE OUR OWN IMAGE AS BEINGCITIZENS TO ELEVATE TO A HIGHERLEVEL STATE OF MIND.ALSO LIKE TO POINT OUT THAT ONEOF DIFFERENCES THAT I SAW LASTNIGHT ON T.V.NO ONE MENTIONED ABOUT IMPROVINGBANKING RULES TO GIVE MINORITIESA BREAK WHO HAVE OWN BUSINESSESTO TRY TO DEVELOP A BUSINESSEVEN THOUGH WE HAVE URBANCHAMBER OF COMMERCE WHICH ISCONSTANTLY RISING WHICH WE HAVENOW COMING BACK TO RELEASE ANDBE MORE IN WEST SIDE AND NORTHSIDE AND SOUTH EAST SIDE,SOUTHWEST SIDE FOR BLACKS ANDMINORITIES LOOKING FORWARD TOIMPROVE THEIR LIFESTYLE ALSO.TAP IN TO BANKING FACILITIES TOGIVE EASEMENT ON THAT.POINT OUT THAT MONEYS THAT WEQUALIFY FOR AS GRANTS, LET IT BEMORE LENIENT OR LOT EASIER TOGET INSTEAD OF ALL THIS REDTAPE.WE KNOW YOU HAVE TO FILL OUTAPPLICATIONS, RIGHT?BUT WE ARE ALL CITIZENS OFUNITED STATES, BORN HERE, BIRTHCERTIFICATE.REARED IN SYSTEM.KNOW INTELLIGENCE NO. 1 KEY TOEDUCATION.LET'S NOT FORGET THAT WE ARECOVENANT CHURCH OF GOD.ONE OTHER THING I LIKE TO POINTOUT IS THIS.ON A SOFTER NOTE.IS THAT LAND WE HAVE, LET'SDEVELOP IT WHERE EVERYBODY CANUSE IT IN ORDER TO BECOMEBLESSED IN GOD'S KINGDOM.GOD BLESS YOU.

>> ANYONE ELSE HERE TO ADDRESS?SEEING NO ONE, WE -- I'M SORRY.PLEASE

COME FORWARD.STATE NAME AND ADDRESS FOR THERECORD.

>> MY NAME IS BARBARA.I'M FROM SANDY VALLEY NEVADA.I'M IN LYNETTE BOGGS DISTRICT.I'M HERE TO DISCUSS SITUATIONTHAT IS HAPPENING IN OURDISTRICT.CONCERNS REGARDING SANDY VALLEYMOTOCROSS LOCATED INSAN BERNARDINO COUNTY.SINCE OPENING MARCH 2004, IT HASBEEN THE SITE OF NUMEROUSINJURIES AS WELL AS NINE DEATHS.WHEN THEY ACQUIRED INSURANCEWITH PROVISION THEY PROVIDEONSITE AMBULANCE AT ALL RACINGTIMES, THEY ARE USING NEVADA 911AS SOLE MODE OF EMERGENCYRESPONSE.AFTER PLACING INJURED PARTY ANDMEDIC WEST AMBULANCE 911ALERTED.CLARK COUNTY DISPATCHES ONLYSANDY VALLEY AMBULANCE MANNED BYTEAM OF LOCAL VOLUNTEERS TOSAN BERNARDINO LOCATION.MAKE NOTE THAT ONSITE AMBULANCEREMAINS ON TRACK SO THAT RACINGCAN CONTINUE TO.FURTHER COMPLICATE THESITUATION, INJURED PARTYSHUFFLED FROM MEDICS TO CLARKCOUNTY AMBULANCE.THEN TRANSPORTS TO CLARK COUNTYHOSPITAL OR SKY RANCH AIRPORT TOBE AIR LIFTED BY MERCY AIR.LATEST DEATH MAY 31ST, 2006.JURIED PARTY TRANSPORTED BY 911NEVADA.CLARK COUNTY TRANSPORTED FROMNEVADA SKY RANCH.PERSON PRONOUNCED DEAD.AMBULANCE STAYED AT SKY RANCHWAITING FOR SAN BERNARDINOCORONER TO ARRIVE AND PRONOUNCETHE PERSON DEAD.AMBULANCE TIED UP FOR HOURSWHILE CORONER WAS IN ROUTE.WHAT IF ONE OF SANDY VALLEYRESIDENTS WHO RIGHTFULLY PAYSTAX DOLLARS FOR THIS SERVICENEEDED EMERGENCY TRANSPORT ITWOULD NOT BE AVAILABLE BECAUSEOF MISAPPROPRIATION BYSAN BERNARDINO DISTRICT ONE.UNFAIR, UNETHICAL, TOTALDISREGARD FOR RESIDENTS OF SANDYVALLEY AND NEVADA.AMONG NUMEROUS ATTEMPTS TOCORRECT ONGOING PROBLEMINCLUDING CALLS TO STATE ANDVARIOUS SAN BERNARDINO COUNTYAGENCY I HAD A CONVERSATION WITHDIANE FISHER, INLAND COUNTYEMERGENCY MEDICAL AGENCY.SHE STATES HER OFFICE WAS NEVERCONTACTED ON THE APPROVAL OFMOTOCROSS.APPROVAL SHOULD NEVER HAVE BEENGIVEN WITHOUT THEIR APPROVAL.THEY ALSO STATES THEY SHOULD BEUSING BAKER AMBULANCE SERVICE.I REPEAT.NO MUTUAL AID EXISTS BETWEENSAN BERNARDINO COUNTY AND CLARKCOUNTY.COMPLETE FAILURE TO COMPLY WITHOWN POLICIES AND PROCEDURES FORFRANCHISE AGREEMENT.WHEN I SPOKE WITH TRACY LAND USESENIOR PLANNER SHE STATED SHEWOULD DO SOMETHING.EVERYTHING SHE COULD TO GET ASANDY VALLEY MOTOCROSS APPROVED.TRACY HAS BEEN KNOWN ABOUT ALLTHE DEATHS AND PARALYZED RIDERS.ONLY COMMENT REGARDINGSAN BERNARDINO COUNTY LIABILITYWAS WE HAVE LAWYERS ON STAFF FORTHAT.ONE MORE PARA GRAPH.CONDITIONAL APPROVAL ISSUEDFEBRUARY 10TH, 2005.MOTOCROSS GIVEN 180 DAYS TOCOMPLY.AS OF SEPTEMBER 11TH, 2006 ONLYCONDITION MET UNSHIELDEDLIGHTING.SUPPOSED TO BE SHIELDED.CONFERRING PER SAN BERNARDINOCODE ENFORCEMENT.NOT SURE WHAT HE IS SUPPOSED TOLOOK FOR.WE CANNOT AFFORD TO HAVE OURAMBULANCE REMOVED OUT OF OURVALLEY.

>> THANK YOU.ANYONE ELSE HERE TO SPEAK?

>> GOOD MORNING COMMISSIONERS.MY NAME JOHN.I RESIDE AT 2700 CHEROKEE.SANDY VALLEY NEVADA.READ LETTER TO YOU THAT WAS READAND PRESENTED OF SAN BERNARDINOCOUNTY SUPERVISOR'S MEETING ONSEPTEMBER 13TH, 2006 CONCERNINGUSE OF THE ONLY A.T.M. IN SANDYVALLEY BY A FOR PROFITCALIFORNIA MONTH TO CROSS --MORE MOTOR CROSS CORPORATION.SANDY VALLEY EMT'S AND AMBULANCEHAVE TO BE AT THE RACEWAY INSAN BERNARDINO COUNTY.OUR UNDERSTANDING THEY HAVETHEIR OWN AMBULANCE AND EMT.IF SOME ONE GETS HURT, AMBULANCEHAS TO LEAVE FROM THE TRACK WILLSHUT DOWN.THEREFORE HAVE AMBULANCE FROMSANDY VALLEY COVER ANYEMERGENCY.WHAT HAPPENS TO RESIDENTS OFSANDY VALLEY IF THERE IS NEEDED?DO WE CALL LAS VEGAS AND WAITFOR AMBULANCE THAT WILL APPEARHERE IN HOUR, HOUR AND A LAUGH?WHICH SEEMS CRAZY TO US.WE FEEL EMT'S AND AMBULANCESHOULD STAY IN SANDY VALLEYWHERE IT BELONGS.RACEWAY FOR PROFIT AND THEY HAVETHEIR OWN EMT'S AND AMBULANCESTHAT CAN LEAD.CONCERN SANDY VALLEY CITIZENS.TERESA PRESIDENT.SINCE 2004 NEVADA RESIDENTSDISCUSSED CONCERN ABOUT SANDYVALLEY MOTOCROSS USING CLARKCOUNTY SANDY VALLEY FIREDEPARTMENT EMT INSTEAD OF USINGCALIFORNIA CERTIFIED EMT WHICHIS REQUIRED BY CONDITIONS PLACEDUPON THEM BY SANDY VALLEY.AT SEPTEMBER 12TH CLARK COUNTYCITIZENS OF ADVISORY COUNCILVALLEY RESIDENTS EXPRESSED THEIRCONCERNS WE WOULD BE WITHOUTEMT'S WHILE OUR AMBULANCESATTENDED TRACK VICTIMS.EVEN THOUGH THE TRACK ISREQUIRED TO HAVE LICENSEDAMBULANCE.CHIEF STEVE MCCLINTOCK TOLD USAMBULANCE SERVICES ARE REQUIRED.SANDY VALLEY RESIDENTS, THEYWOULD HAVE TO WAIT FORAMBULANCES FROM GOOD SPRINGS,JEAN AND EVEN LAS VEGAS WHICHWOULD TAKE UP TO HOUR AND AHALF.QUOTE, THAT'S THE LUCK OF THEDRAW, UNQUOTE.DURING A RECENT INCIDENTMAY 31ST, OUR AMBULANCE WAS TIEDUP FOR HOURS BECAUSE THEY HAD ABODY OF A TRACK VICTIM THAT WASAT THE SAN BERNARDINO CORNER.THAT MEANT IF BY GOD, THECITIZENS OF OUR VALLEY NEEDEDSERVICES WOULD HAVE TO WAIT FORAMBULANCE RESPONSE FROM OUTSIDETHE VALLEY BECAUSE OUR SERVICEWAS ATTENDING A DEAD PERSON.THIS IS UNACCEPTABLE BECAUSETHEY ARE REQUIRED TO HAVECERTIFIED CALIFORNIA AMBULANCESAND EMT'S.SAN BERNARDINO OFFICIALS HAVETOLD US REPEATEDLY MUST HAVE --I'M GOING TO CLOSE WITH ONETHING.MY MOTHER IS 97 YEARS OLD.HAD A HEART ATTACK.IF SHE NEEDS AN AMBULANCE ANDSERVICES FOR AMBULANCE ARE ATTHE TRACK, COMMENT BY CHIEFMCCLINTOCK THAT QUOTE, THAT'STHE LUCK OF THE DRAW, UNQUOTE ISINSUFFICIENT ANSWER BY COUNTYEMPLOYEES AND STAFF.I COULD GO ON WITH THE LASTCOMMENT MADE BY -- AS OFYESTERDAY BY SAN BERNARDINOOFFICIAL STATED WHEN THEY ASKEDABOUT THE SAN BERNARDINO -- THEMOTOCROSS AMBULANCE, THEIRANSWER WAS WHAT'S THE CONCERN?THEY HAVE THE SANDY VALLEY FIREDEPARTMENT AMBULANCE.

>> ANYONE ELSE?

>> YES.GOOD MORNING.BETH, SANDY VALLEY, NEVADA.DISTRICT F.SANDY VALLEY MOTOCROSS HASGENERATED 189 AIR LIFTS TOMEDICAL FACILITIES BY MERCY AIR.THERE HAVE BEEN A MINIMUM OF 32GROUND EVACUATIONS SINCEAUGUST 2004.THESE ARE KNOWN AND DOCUMENTEDBY FIRE DEPARTMENT AS RESPONDERSTO NEVADA 911 CAMS FROM SANDYVALLEY MOTOCROSS.THIS DOES NOT INCLUDE INJUREDPARTIES BEING TRANSPORTED BYFRIENDS.DOES NOT INJURIES, DEATHS WHICHOCCUR WHILE SANDY VALLEY FIREDEPARTMENT AMBULANCES ON SITEPRIOR TO AUGUST 2004.THEY WERE USING THIS OPPORTUNITYAS A FUND RAISER FOR THE FIREDEPARTMENT.HEY HAVE A LETTER HERE.WHICH DOES NOT SHOW UN.ANYWAY, A LETTER DATEDSEPTEMBER 21ST, 2006 GIVINGINSTRUCTIONS ON RECORD-KEEPINGOF INJURY TREATMENT,VERIFICATION OF CALIFORNIA ANDSAN BERNARDINO COUNTYCERTIFICATION OF EMT'S ANDAMBULANCE COVERAGE.WE CAN'T BELIEVE IT TOOKSAN BERNARDINO COUNTY UNTILSEPTEMBER 2006 TO GENERATE ALETTER LIKE THIS WHEN THISFACILITY HAS BEEN OPEN SINCEAPRIL 2004.SANDY VALLEY MOTOCROSS OPERATEDBY ASW ENTERPRISES, L.L.C. HASNOT BEEN IN COMPLIANCE WITHCALIFORNIA REGULATIONS SINCEOPENING AND STILL IS NOT.THERE WERE INJURIES ONOCTOBER 7TH WITH A CLARK COUNTYAMBULANCE TRANSPORT.SANDY VALLEY AMBULANCE.INJURIES ON OCTOBER 8TH AND 12THREQUIRING MERCY AIR TRANSPORT.AS OF YESTERDAY, MONDAY THE16TH, OPERATOR HAD NOT PROVIDEDAUTHORITIES WITH THE LOGREQUESTED IN THIS LETTER.FIRST DEATH WAS ON AUGUST 2ND,2004.16-YEAR-OLD BOY AS POSTED ON THESANDY VALLEY MOTOCROSS WEBSITE.DOES NOT SHOW UP TOO WELLEITHER.A DEATH ON MEMORIAL DAY WEEKENDWAS ONLY DEATH RECORDED BY ACALIFORNIA CORONER.ALL OTHERS HAVE BEEN PROCESSEDIN CLARK COUNTY.WE ARE IN CONTACT WITH CLARKCOUNTY CORONER FOR INFORMATIONREGARDING THESE OTHER DEATHS.AS A RESULT OF INVESTIGATION BYSAN BERNARDINO COUNTY CODEENFORCEMENT WHICH WAS COMPLETEDON SEPTEMBER 19TH, IT WASREPORTED THAT ONE DEATH HADOCCURRED AND THEY WERE 8 MEDICALTRANSPORTS.ON SEPTEMBER 12TH AT COMMUNITYADVISORY COUNCIL MEETINGOPERATOR TOLD US ON RECORD THATHAD BEEN ON SITE THIS YEAR 123TIMES AND 11 EVACUATIONS, HALFOF THEM BY AIR.PROBABLY HALF OF THE NUMBER.THIS IS INTOLERABLE ESPECIALLYWHEN THIS TRACK IS NOT INCOMPLIANCE WITH SAN BERNARDINOCOUNTY AND STATE OF CALIFORNIAREQUIREMENTS.THANK YOU.

>> I'M ROGER FROM SANDY VALLEY.MOTOCROSS OPERATES IN PECULIARWAY IN IT USES 911 FOR ITSPRIMARY EMERGENCY EVACUATIONSAND SERVICES.THEY ARE TOLD THEY CAN CALL 911DISPATCHER FOR WHATEVER THEYNEED.FOR MEDICAL EVACUATION BYHELICOPTER, IT IS HAZARDOUSESPECIALLY AT NIGHT.AIRPORTS WHERE EVACUATIONS OCCURIS NOT CERTIFIED NIGHT-OPERATINGAIRPORT.USE TRUCK LIGHTS AND

WHATEVER.THERE IS A LOT -- POWER POLESAND WIRES AND BUILDINGS.WHERE IS LIABILITY IF HELICOPTERSHOULD HAPPEN TO CLIP ONE OFTHESE?LO IS LIABLE?CLARK COUNTY FIRE DEPARTMENT.CITIZENS THAT OWN AIRPORT?I DON'T KNOW.IT HAS NOT BEEN DETERMINED.WHEN OUR PERSONNEL RESPOND TOCALIFORNIA, WHO IS LIABLE?AS A CITIZEN, I DON'T KNOW.THIS IS COMMERCIAL RACINGOPERATION AND AS SUCH IS NOT THEUSE FOR WHICH 911 SYSTEMCREATED.EXHIBITION VENUE THAT I KNOW OFUSES 911 ON A REGULAR BASIS TOSOLVE THE CASUALTY PROBLEMS.THEY ARE REQUIRED TO PROVIDESUFFICIENT EQUIPMENT AND TRAINEDEMERGENCY RESPOND PERSONNEL TOHANDLE ALL MISHAPS.ALL OTHER VENUES PROVIDE THESERESOURCES.WHY IS SANDY VALLEY MOTOCROSSANY DIFFERENT?THEY DO NOT HAVE TO PROVIDE ALLTHEIR OWN.WHEN 911 RESOURCES USED BY SANDYVALLEY MOTOCROSS, DEPRIVINGCITIZENS OF SANDY VALLEY OFCOVERAGE FOR WHICH THESERESOURCES WERE INTENDED.THE CLARK COUNTY COMMISSIONERSMUST MEET WITH SAN BERNARDINOCOUNTY BOARD OF SUPERVISORS TORESOLVE THIS SITUATION.THIS MUST ASSURE THAT ABUSE OF'91 1 SYSTEM BY SANDY VALLEYMOTOCROSS OPERATORS NOT BEALLOWED TO CONTINUE.TRACK OPERATORS MUST PROVIDERESOURCES ON SCENE WITHOUT USEOF 911.AS A CITIZEN OF CLARK COUNTY,HOMEOWNER OF SANDY VALLEY,NEVADA, I URGE YOU TO HEED THISPROBLEM AND RESOLVE IT TO THEBENEFIT OF THE CITIZENS OF CLARKCOUNTY, NEVADA AND SANDY VALLEY.THANK YOU.

>> ANYONE ELSE?

>> HELLO.MY NAME IS JIM JOHNSON.SANDY VALLEY RESIDENT ANDLAS VEGAS NATIVE.I DON'T THINK I NEED TOELABORATE ON WHAT HAS BEEN SAID.SOMETHING NEEDS TO BE DONE.I'M SERIOUS.SOMETHING NEEDS TO BE DONE.ALL I ASK IS FOR YOU TO PUT YOUAND YOUR FAMILY IN OUR SHOES.OKAY.HONESTLY AND THINK THIS THROUGH.THANK YOU.

>> THANK YOU VERY MUCH.ANYONE ELSE?

>> I WILL BE VERY BRIEF.MY NAME DAWN.LONG TIME RESIDENT OF SANDYVALLEY.I ALSO URGE THE CLARK COUNTYCOMMISSION AS I FEEL IT IS THEPROPER VENUE TO VIGOROUSLY ANDAGGRESSIVELY ADDRESS A PACK WITHSAN BERNARDINO COUNTY AS THIS ISNOT THE ONLY ISSUE.A PRECEDENCE IS NOW NEEDED ANDWILL BE NEEDED EVEN MORE IN THEFUTURE.YOU HEARD HORROR STORIES ANDABSOLUTELY TRUE.IT HAS TO BE STOPPED.WE URGE YOU TO SPEAK ON OURBEHALF.THANK YOU.

>> THANK YOU.ANYONE ELSE?OKAY.

>> MADAM CHAIRMAN -- MADAMCHAIR, I KNOW THIS IS NOT ON GENDA BUT I WOULD LIKE TO ASK THATSTAFF DO FOLLOW UP.MYSELF, CHIEF AND CHRIS DID GOTO SAN BERNARDINO COUNTY --ACTUALLY KIND OF INITIAL REASONFOR

THE MEETING WAS TO DISCUSSWATER ISSUES, BUT AS WE WEREDOWN THERE, THERE WAS A MEETINGOF CLARK COUNTY, SAN BERNARDINOCOUNTY AND INYO COUNTY, WHOLEDISCUSSION OF FIRE SERVICES CAMEUP.IT WAS NOT UNTIL THAT MEETINGDID I REALIZE THAT CLARK COUNTYFIRE JUST LAST CALENDAR YEARRESPONDED TO MORE THAN 350,SOMEWHERE BETWEEN 300 AND 350CALLS FOR SERVICE WHERE YELLOWTRUCKS WERE GOING ACROSSCALIFORNIA AND RESPONDING TOEMERGENCY SITUATIONS.I KNOW THAT -- I BELIEVE WASJUST LAST WEEK NEW FIRE STATIONWAS OPEN IN BAKER.DEDICATED BRAND NEW FIRESTATION.POINT REMAINS THERE NEEDS TO BESOME TYPE OF PACK AGREEMENT,MEMORANDUM OF UNDERSTANDING ASIT RELATES TO NOT ONLY THE FIRESERVICES BUT ALSO POLICESERVICES BECAUSE METROREPRESENTATIVE THAT ACCOMPANIEDUS TO CALIFORNIA FOR SAMEMEETING MENTIONED THE EXACT SAMESITUATION.NOT ONLY RIGHT AT SANDY VALLEYBUT MANY INSTANCES WHERESOUTHERN HIGHLANDS FIRE STATIONCLOSEST RESPONDER GOING OUT INEMERGENCY SITUATION INCALIFORNIA ACROSS THE LINE.SO I KNOW CHIEF QUORUM HAD SAIDSOME CONVERSATION -- NEW FIREHEAVE IN SAN BERNARDINO COUNTY.HE KNOWS HIM FOR MANY YEARS, BUTI THINK A LEGITIMATE CONCERN ANDIT NEEDS -- THAT CIRCLE NEEDS TOBE CLOSED BECAUSE -- NOT JUSTSOUTHERN NEVADA IN TOCALIFORNIA.THE SAME SITUATION IN SOME OFBRUCE'S AREAS AND TOM AREASWHERE CLARK COUNTY IS CLOSERRESPONDER GOING IN TO SOME AREASOF CALIFORNIA AND SOME AREAS OFUTAH.THAT IS THE SITUATION.I THINK TIME IS OF THE ESSENCE.VERY TIMELY WE FOLLOW UP WITHTHAT.

>> THANK YOU.

AMENDED AND RESTATED COYOTE SPRINGS WATER AND WASTEWATER MULTI-PARTY AGREEMENT

THIS AMENDED AND RESTATED COYOTE SPRINGS WATER AND WASTEWATER MULTI-PARTY AGREEMENT ("Agreement") is made as of this 7th day of July, 2015, by and among the Coyote Springs Water Resources General Improvement District, ("CSWRGID"), a political subdivision of the State of Nevada created pursuant to Nevada Revised Statute Chapter 318, the Las Vegas Valley Water District, a political subdivision of the State of Nevada created pursuant to Chapter 167, Statutes of Nevada 1947 ("LVVWD"), the Clark County Water Reclamation District, a political subdivision of the State of Nevada organized pursuant to Chapter 318, Statutes of Nevada ("CCWRD"), Weyerhaeuser NR Company, a Washington Corporation ("WNR"), Coyote Springs Land Development Corporation, a Nevada corporation ("CSLD"), and Coyote Springs Investment LLC, a Nevada limited liability company ("CSI"), and Coyote Springs Nevada, LLC, a Nevada limited liability company ("CSN"); (CSLD, CSI, and CSN are collectively the "Developers"). CSWRGID, LVVWD, CCWRD, WNR, CSI, CSLD, and CSN are referred to individually as "Party" and collectively as "Parties".

RECITALS

WHEREAS, CSLD through an option agreement has purchased, or has an option to purchase property from CSI to be the master developer of the Coyote Springs Master Planned Community containing 6,881 acres of fee land and approximately 6,219 acres of leased land in Clark County ("Clark County Development");

WHEREAS, pursuant to the terms of that certain Development Agreement (as amended) by and between Clark County and CSI approved on August 4, 2004, a general improvement district may be utilized for providing water and wastewater services within the Clark County Development (the terms wastewater and sewer shall be synonymous and interchangeable herein);

WHEREAS, Developers will finance the design and construction of the water and wastewater treatment, distribution and collection facilities at the Clark County Development ("Facilities"), which facilities will be acquired by the CSWRGID at a time and in a manner allowed by Nevada law and approved by the CSWRGID;

WHEREAS, CSI is the owner of Permit Nos. 46777, 70429, 70430, 74094, and 74095 which authorizes the appropriation of 4,140 acre feet per year (AFY)[1] from the carbonate aquifer at locations within the Clark County Development ("Potential CSWRGID Water Supply") to serve the water needs within the Clark County Development;

WHEREAS, CSI uses, and shall continue to use until the water is committed by CSWRGID, the Potential CSWRGID Water Supply (and will use other water rights to be dedicated in the future to CSWRGID), for irrigation, construction, dust control, construction-related fire and health-safety, and construction-related operation facilities, to develop the Clark County Development and to prove beneficial use of such water rights;

WHEREAS, CSI has a contract right to purchase water appropriated within Lincoln County by the Lincoln County Water District for use within the Clark County Development and is seeking to acquire additional sources of water for the purpose of service to (or servicing) the Clark County Development ("Additional Water Rights");

WHEREAS, CSWRGID is the authorized water purveyor and provider of wastewater services for the Clark County Development;

WHEREAS, LVVWD and CCWRD are willing and able to manage and operate the Facilities;

WHEREAS, CSWRGID recognizes that it does not presently have engineering or operational staff that are appropriately qualified to address the review of design and engineering plans, or construction, operation and maintenance activities related to water and wastewater facilities;

WHEREAS, CSWRGID recognizes that LVVWD and CCWRD have the engineering and operational staff that are appropriately qualified to address the review of design and engineering plans, and construction, operation and maintenance activities related to water and wastewater facilities;

WHEREAS, CSWRGID desires to engage LVVWD as the general manager of the CSWRGID water and wastewater facilities and system and LVVWD agrees to be the general

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[1] CSI is the owner of Permit Numbers 46777, 70429, 70430, 74094, and 74095 for the appropriation of 4600 acre feet, however by Memorandum of Agreement dated April 20, 2006, CSI dedicated 10 percent of these rights (or an equivalent amount of other rights acceptable to the United States Fish & Wildlife Service) to the recovery of the Moapa dace.

manager of the CSWRGID water and wastewater facilities and system upon the terms and conditions set forth herein;

WHEREAS, on December 5, 2006, CSWRGID, LVVWD, CCWRD, CSI, CLSD, and Pardee Homes of Nevada, a Nevada corporation ("Pardee") entered into the Coyote Springs Water and Wastewater Multi-Party Agreement ("2006 Agreement");

WHEREAS, a dispute arose between Developers and Pardee with regard to the 2006 Agreement resulting in litigation amongst Developers, Pardee, and CSWRGID;

WHEREAS, in or about June, 2014, Pardee assigned all of its rights and obligations under the 2006 Agreement to WNR, to which assignment all of the parties to the 2006 Agreement consented; and

WHEREAS, Developers, WNR, and CSWRGID have resolved their disputes, resulting in a separate agreement between Developers and WNR which provides for an assignment of all of WNR's rights and obligations under the 2006 Agreement to CSN, to which assignment the CSWRGID, LVVWD, and CCWRD have agreed to consent, and a separate agreement regarding the payment of the attorneys' fees and costs incurred by CSWRGID relating to the dispute by the Developers and WNR.

NOW, THEREFORE, in consideration of the recitals set forth above and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, CSWRGID, LVVWD, CCWRD, WNR, and Developers mutually agree as follows:

1. **Consent to Assignment**. Each of the Parties to this Agreement hereby consents to the assignment to CSN of all of the rights and obligations under the 2006 Agreement held by WNR, which holds those rights and obligations as assignee of Pardee, and agrees that, as a result and effect of such assignment, neither WNR nor Pardee shall have any further rights or obligations under the 2006 Agreement or this Agreement and both WNR and Pardee are released from any liabilities they may have to the CSWRGID, the LVVWD, or the CCWRD, except as set forth in the separate Settlement Agreement and Release between CSWRGID, CSLD, CSI, Pardee, and WNR, dated June 12, 2015. This assignment and release shall take effect upon the Effective Date, as defined below.

2. **General Manager**. CSWRGID hereby engages LVVWD to serve as the general manager ("GM") of the CSWRGID water and wastewater facilities. The GM shall serve as the manager of the CSWRGID water and wastewater facilities.

3. **Term**. The term of this Agreement commenced on December 5, 2006 and shall expire after fifty (50) years ("Initial Term"). This Agreement will automatically renew for additional periods of ten (10) years unless written notice is given by one Party to the other Parties of the intent not to renew not less than one (1) year before the expiration of the Initial or subsequent renewed Terms.

4. **Duties of LVVWD**. The LVVWD shall (1) prepare an annual budget for adoption by the CSWRGID, (2) review and approve the design and engineering drawings of the water facilities for consistency with the LVVWD or CSWRGID standards, as applicable (3) review and approve a water system master plan ("Water System Master Plan") for consistency with the LVVWD or CSWRGID standards, as applicable, (4) review and approve the type of material for the proposed pipelines and related appurtenances for consistency with the LVVWD or CSWRGID standards, as applicable, (5) require the dedication by Developers to the CSWRGID of any necessary right of way or easements for water facilities, (6) inspect and approve construction of any water facilities, (7), assist CSWRGID in preparing area specific service rules governing water service within the Clark County Development and specifically for adoption by the CSWRGID, (8) sign tentative and final subdivision and parcel maps on behalf of CSWRGID when such maps meet the requirements of Clark County and Nevada law, and (9) assign staff to the CSWRGID project as necessary to ensure LVVWD's timely performance of its obligations under this Agreement in accordance with the standards set forth in the CSWRGID service rules.

5. **Duties of CCWRD**. The CCWRD General Manager shall (1) cooperate with the LVVWD in assisting with the overall management of the CSWRGID, including the preparation of an annual wastewater system budget for adoption by the CSWRGID, (2) review and approve the design and engineering drawings of the wastewater facilities for consistency with the CCWRD standards or the CSWRGID standards, as the case may be (3) review and approve the Wastewater System Master Plan for consistency with CCWRD standards or CSWRGID standards, as the case may be (4) review and approve the type of material for the proposed pipelines and related appurtenances for consistency with the CCWRD standards or CSWRGID standards, as the case may be (5) require the dedication by Developers to the CSWRGID of any necessary right of way or easements for wastewater facilities, (6) inspect and approve construction of any wastewater facilities, (7), assist CSWRGID in preparing area specific service

rules governing wastewater services within the Clark County Development and specifically for adoption by the CSWRGID, (8) suggest for adoption by CSWRGID treatment standards sufficient to meet all applicable federal and state laws and regulations, as now or hereafter amended, for the discharge of treated effluent to the Pahranagat Wash, Muddy River or Lake Mead, and adopt temporary treatment standards in accordance with Paragraph 14 below, and (9) assign staff to the CSWRGID project as necessary to ensure CCWRD's timely performance of its obligations under this Agreement in accordance with the standards set forth in the CSWRGID service rules.

6. **Operation and Maintenance Duties**. On August 21, 2007, CSWRGID, CCWRD and LVVWD entered into an Operations and Maintenance Agreement that, among other things, imposes the following obligations on CSWRGID, LVVWD and CCWRD:

a. LVVWD shall be responsible for the operation, maintenance and repair of the water system which, for purposes of this Agreement, will include both potable and raw water systems ("Water System"). The initial permitting of the Water System is being pursued by the Developers, and all such initial permits and applications necessary to comply with all applicable federal, state and local laws, ordinances, regulations, codes, orders and permit conditions have been submitted to the appropriate governing body or agency. Permits will be issued to CSWRGID, and CSWRGID shall be responsible for ensuring that each facility constituting part of the Water System is properly permitted (including preparing and processing permit renewal applications) and that each facility is operated in compliance with all applicable federal, state and local laws, ordinances, regulations, codes, rules, orders, and permit conditions and its own service rules. CSWRGID may perform its permitting responsibility through LVVWD, as CSWRGID's manager and facility operator, under the operations and maintenance agreement referenced above.

b. LVVWD shall be responsible for ordering and maintaining a parts and equipment inventory sufficient to ensure that routine maintenance, scheduled and emergency repairs can be made to the Water System in a timely manner.

c. LVVWD shall be responsible for all customer relations, including billing and collection activity on behalf of CSWRGID related to water and wastewater service provided by CSWRGID.

d. CSWRGID shall be responsible for the operation, maintenance and repair of the wastewater system through the GM, in conjunction with CCWRD. CSWRGID shall be responsible for ensuring that each facility is properly permitted (including preparing and processing permit renewal application) and that each facility is operated in compliance with all applicable federal, state and local laws, ordinances, regulations, codes, rules, orders, and permit conditions and its own service rules. CSWRGID may perform its permitting responsibility through CCWRD, as CSWRGID's manager and facility operator, under the operations and maintenance agreement referenced above.

e. CCWRD shall be responsible for ordering and maintaining a parts and equipment inventory sufficient to ensure that routine maintenance, scheduled and emergency repairs can be made to the wastewater system in a timely manner.

f. LVVWD shall timely prepare an annual budget for consideration and adoption by CSWRGID in conformance with the provisions of the Local Government Budget and Finance Act (NRS ch. 354).

7. **<u>Reimbursement of Costs</u>**. CSWRGID shall reimburse LVVWD an amount equal to the actual costs incurred by LVVWD and CCWRD in performing their duties under this Agreement. The reimbursement shall be invoiced monthly, in arrears, and shall be due and payable on the thirtieth (30th) day after the date of the invoice. LVVWD will thereafter reimburse CCWRD as set forth the August 21, 2007 Operations and Maintenance Agreement. Costs for which LVVWD and CCWRD shall be reimbursed will include, but are not limited to, the following, which are set forth as examples only:

a. Actual administration costs exclusively attributable to the management and operation of the CSWRGID, including but not limited to accounting, personnel, legal, and purchasing.

b. All salaries and salary costs of those employees assigned exclusively to the management and operation of CSWRGID and the proportionate salaries and salary costs for those employees whose assignment and operation includes a proportionate responsibility for management and operation of CSWRGID.

c. Any repairs, maintenance or construction of water or wastewater systems of the CSWRGID.

d. Design review, construction management, construction inspection, pretreatment inspection and any permitting.

e. Attorneys' fees and costs incurred in defending litigation arising out of this Agreement or LVVWD's and CCWRD's performance of their duties under this Agreement.

LVVWD's invoices will be supported by such copies of payrolls, ledgers and other documents or proof as may be required by the Board of Trustees of CSWRGID. Developers shall reimburse CSWRGID for all operating, maintenance and other expenses, including any expenses CSWRGID is required to pay to Clark County, CCWRD and LVVWD, to the extent that rates and charges for water and sewer service, not including any Infrastructure Surcharge fee as described in Paragraph 13, are insufficient to pay those expenses. Within 60-days after the execution date of this Agreement, LVVWD will provide Developers with an estimate of such incurred expenses that are a responsibility of Developers for the current budget year, and for subsequent budget years shall include Developers in a budget preparation advisory role until such time that Developers are no longer responsible for incurred expenses in the operation and maintenance of CSWRGID facilities.

Developers shall also reimburse CSWRGID all expenses incurred by Clark County, CCWRD and LVVWD prior to forming CSWRGID that were incurred as a result of reviewing plans for, and inspecting, the construction of water and sanitary sewer facilities and infrastructure within the Service Plan Area, and shall pay all of CSWRGID's operating, maintenance and other expenses incurred prior to commencement of collection of rates and charges, including any expenses CSWRGID is required to pay to Clark County, CCWRD and LVVWD.

8. **<u>Application and Approval Process</u>**. Concurrently with the negotiation of this Agreement, LVVWD and CCWRD staff reviewed certain preliminary plans for water and wastewater facilities for the Developers' water supply and treatment operations under construction. LVVWD and CCWRD will approve and accept those previously reviewed preliminary plans after completion of construction, on the condition that said construction is in full accordance with the previously submitted plans, and on the condition that the construction is in full compliance with all applicable law, including but not limited to, all statutes, code provisions and regulations. Immediately, and on execution of this Agreement, Developers must submit any and all plans for additional anticipated water and wastewater facilities. Notwithstanding the agreement regarding facilities under construction upon execution of this Agreement, LVVWD and CCWRD must review and approve all plans for water and wastewater facilities prior to any commencement of construction. Constructed facilities will only be accepted, and cost of such will only be eligible for consideration for reimbursement if actual construction comports with plans approved by LVVWD and CCWRD, and the actual construction meets all applicable legal requirements, including but not limited to, all statutes, code provisions and regulations.

9. **Water Supply**. Developers shall dedicate 4,140 AFY to CSWRGID (the "Initial Dedication") from Permit Nos. 46777, 70429, 70430, 74094, and 74095, or any permits to change the manner of use, point of diversion, or place of use of such permits, for municipal use within the Clark County Development area. On March 29, 2007, CSI dedicated 1,000 AFY of the Initial Dedication to the CSWRGID and, on August 30, 2007, CSI dedicated an additional 1,000 AFY of the Initial Dedication to the CSWRGID. The Developers shall dedicate to CSWRGID the remaining 2,140 AFY of the Initial Dedication no later than thirty (30) days after there are 1,300 AFY of Commitments (as defined in Paragraph 11) in the aggregate. Annually after the full Initial Dedication has been made, Developers shall meet with staff of the CSWRGID and provide detailed information concerning future water resources and facilities available for use at the Clark County Development area. Subject to the Commitment Process in Paragraph 11 and in consultation with CSI, the CSWRGID staff will use this information to prepare a water resource and supply plan in accordance with Paragraph 10 below. Developers shall at all times, through dedication of water appurtenant to and for the benefit of the Clark County Development, maintain with the CSWRGID an uncommitted water rights balance of not less than 700 AFY to enable an uninterrupted water commitment process. The Initial Dedication and any subsequent Developer dedicated water rights shall be committed by CSWRGID in accordance with Paragraphs 10 and 11 of this Agreement. Developers shall, concurrently with any request for a Commitment that would, if granted, cause the balance of uncommitted water

rights held by the CSWRGID to fall below 700 AFY, dedicate additional water rights to CSWRGID in an amount sufficient to maintain the 700 AFY of uncommitted water availability. Developers shall be responsible for all costs of transporting the Initial Dedication and any additionally dedicated water to a location satisfactory to the CSWRGID. Developers shall have the right to use, without charges or costs imposed by the CSWRGID, any and all of these water rights for construction or irrigation purposes, but only until the water is committed by the CSWRGID pursuant to Paragraph 11, or until Developers seek any reimbursement of costs for the raw water system, whichever event is earlier in time, at which point in time Developers shall be charged for water used for construction or irrigation. If Developers permanently cease development of the Clark County Development, Developers shall have the right to receive back from the CSWRGID any and all water rights previously dedicated by the Developers to CSWRGID that are not Committed and are not otherwise necessary to support existing development.

10. **Water Resource & Supply Plan**. The Board of Trustees of the CSWRGID shall adopt, and thereafter annually review, a water resource and supply plan. The water resource and supply plan shall identify present water usage, projected future use and identify water resources and facilities necessary to meet future demands.

CSWRGID and LVVWD agree that initial water usage shall be determined as follows:

a. 0.71 AFY per single-family residential lot or 3.17 AFY per acre of development, whichever is greater;

b. 5.5 AFY per net usable acre for multi-family residential development that contains 1 – 10 units per acre (including apartments, condominiums, townhouses, time share units, golf and resort villas);

c. 7.07 AFY per net usable acre for multi-family residential development that contains 11 – 20 units per acre (including apartments, condominiums, townhouses, time share units, golf and resort villas);

d. 8.50 AFY per net usable acre for multi-family residential development that contains 21 or more units per acre (including apartments, condominiums, townhouses, time share units, golf and resort villas);

e. 4.31 AFY per net usable acre for commercial development;

f. 9.2 AFY per net usable acre for hotel/motels;

g. Allocation for golf courses will be determined when connected to the CSWRGID water system; and

h. Allocation for any industrial, light industrial, office, medical, hospital, warehouse, collection and treatment of wastewater, treatment and distribution of potable water, or any other non-residential use not contemplated above will be determined when connected to the CSWRGID water system.

On an annual basis, as a part of the water resource and supply plan, water usage for existing development will be adjusted as needed by CSWRGID based upon three years of actual historical water use. Once the Clark County Development has a representative sample of any of the development types enumerated in this Paragraph 10 which have been in service, uninterrupted, for a minimum of three years of use and which accurately represent the actual water usage of the Coyote Springs Water System for any of the enumerated development types below, Developers and CSWRGID staff will review the actual water use and adjust the amount of water committed to those existing uses, up or down, accordingly to match actual usage. Any water that is no longer committed to an existing use as a result of a downward adjustment to match actual usage shall become available for future commitment by the CSWRGID.

11. **Commitment Process**. LVVWD, on behalf of CSWRGID, shall certify to the State of Nevada Division of Water Resources, through endorsement of final maps (a "Commitment"), that there is a sufficient quantity of water available to serve any area covered by a final map so long as CSWRGID has enough water available to serve the mapped area (calculated pursuant to Paragraph 10), and still have at least 700 AFY of uncommitted water rights dedicated by Developers available. CSWRGID staff shall not issue Commitments at any time the CSWRGID has less than 700 AFY of uncommitted water remaining without specific authorization from the CSWRGID Board of Trustees.

12. **Treated Wastewater**. CSWRGID, CCWRD and LVVWD expressly acknowledge and agree that Developers shall be required to take and reuse (without any additional charge) all treated wastewater. The treated wastewater will be used for landscape and golf course irrigation, dust control, man-made lakes as permitted by law, exchanges and mitigation purposes. The point of delivery of treated wastewater, at which point CSWRGID's responsibilities associated with the treated wastewater terminate and Developers' obligation commence, shall be the property line of the parcel of property on which the wastewater treatment plant is located. Notwithstanding the entitlement and requirement of Developers to take and reuse all treated effluent from the Wastewater Treatment Plant; whenever, if in the reasonable determination of CCWRD staff, the transmission of effluent to Developers could exceed the capacity of the reclaimed water storage and distribution system, the CCWRD will provide written notice thereof to Developers and enter into negotiations as to the appropriate measures to be taken with any such effluent in excess of the reclaimed water storage and distribution system. CSWRGID or CCWRD will not authorize or approve any additional hook-ups to the wastewater collection system after providing written notice as described above, until such time as, in the reasonable judgment of CSWRGID or CCWRD appropriate measures have been taken to provide adequate storage for or disposal of excess effluent. Developers, as the operator of the reclaimed water storage and distribution system, shall be responsible for the resolution of any such situation and of all such reclaimed water storage and distribution system administration. Developers shall be responsible for complying with all applicable federal, state and local laws, regulations and ordinances governing its reuse of treated wastewater. Developers will defend, indemnify and hold harmless CSWRGID, LVVWD and CCWRD for any regulatory or legal violations, or any third-party damages arising from the delivery, storage, conveyance or use of treated effluent by Developers at or beyond the designated delivery point. The Parties further acknowledge and agree that they will use their best efforts to negotiate and execute an agreement, which would provide for the utilization of any unused treated wastewater for the benefit of the Southern Nevada Water Authority.

13. **Capital Costs of Facilities**.

a. LVVWD, CCWRD and CSWRGID acknowledge and agree that Developers will construct the water and sewer facilities at the Developers' sole cost. The water and sewer facilities to be constructed include the facilities initially constructed by Developers and all water and sewer facilities CSWRGID reasonably determines are necessary or desirable for the CSWRGID at any subsequent time or times. Ownership of all such facilities will be transferred to CSWRGID by appropriate instrument immediately after completion, inspection and acceptance by LVVWD, Operating Manager for CSWRGID, at no cost to CSWRGID, once the approval required by NRS 318.170(2), if needed, is obtained.

b. Developers are entitled to request from the CSWRGID reimbursement for the costs paid by Developers of the following major Community Water Facilities (as defined below) and Community Sewer Facilities (as defined below) constructed and transferred in accordance with Paragraph 13(a) above to the extent the cost of those facilities can legally be reimbursed to the Developers by CSWRGID under Nevada law:

   i. "Community Water Facilities" shall mean water treatment plants, storage facilities, pumping stations, pipelines 12-inches in diameter and larger, and related appurtenances, raw water pumps, raw water wells, raw water storage facilities and raw water transmission pipelines insofar as said facilities are necessary for and used to provide water service to the Clark County Development community and customers of the CSWRGID under terms of this Agreement; and

   ii. "Community Sewer Facilities" shall mean sewer treatment plants, sewer pump stations, sewer force mains, sewer interceptors 15-inches in diameter or greater, and arterial sewers 8-inches in diameter or greater, treatment improvements and related appurtenances, insofar as said facilities are necessary for and used to provide sewer service to the Clark County Development community and customers of the CSWRGID under terms of this Agreement,

   (collectively, the Community Water Facilities and the Community Sewer Facilities shall be referred to as the "Developers Reimbursable Costs").

Developers' Reimbursable Costs will not include design, engineering or similar costs and do not include any costs paid by Developers pursuant to Paragraph 7 other than the actual cost of construction of facilities described in Paragraph 13(b) (i) or (ii) above. Further, "Developers' Reimbursable Costs" will not include costs of construction deemed necessary to address pipelines that were initially installed by Developer but are inadequate to serve the systems' needs and must be bolstered, require additional looping or parallel pipes to meet the required hydraulic pressure and flow criteria associated with obtaining plan approval.

Similarly, "Developers' Reimbursable Costs" will not include costs of construction for subsequent corrective measures necessary to address inadequately-sized sewer interceptors/collectors, including but not limited to, bolstering or parallel piping to meet the required hydraulic flow and velocity criteria associated with obtaining plan approval. In addition, to the extent permitted by law, Developers' Reimbursable Costs may, at the option of CSWRGID, include interest actually paid by Developers to finance the costs of facilities described in (i) and (ii) above from the date the costs are paid by Developers until they are reimbursed at an interest rate not exceeding the weighted average annual interest rate of LVVWD's capital indebtedness (excluding any such indebtedness secured by the revenues of the Southern Nevada Water Authority) determined as of June 30 of each year in such manner as CSWRGID may reasonably determine. Requests for reimbursements of Developers' Reimbursable Costs may be made and will be considered by CSWRGID only as specifically provided in Paragraph 13(e) below and only to the extent those costs are not paid or reimbursed from any other source.

c. Subject to applicable law and hearing requirements, CSWRGID agrees to consider imposing, not later than the date service rules are adopted for CSWRGID as provided herein, a monthly infrastructure surcharge which will not initially exceed Forty-Five Dollars ($45) per month, per single-family residence (or in the case of structures or improvements other than single-family residences, a reasonable amount [scaled from such $45 per single-family residence] as determined by CSWRGID). This surcharge (the "Infrastructure Surcharge") will be periodically reviewed by the CSWRGID and may be adjusted in recognition of changes in CSWRGID's infrastructure costs, if deemed reasonably prudent for the long-term viability of CSWRGID's water and sewer system, provided that such adjustment is otherwise made in accordance with the provisions of Nevada law. The Infrastructure Surcharge will be made for payment of water and sewer system infrastructure costs by the CSWRGID and may also be pledged for repayment of revenue bonds sold for water and sewer system infrastructure and associated costs. The Infrastructure Surcharge will be a part of the water and sewer revenues of CSWRGID and may be used for all purposes for which such revenues may be used including, but not limited to (i) operation and maintenance costs of the water and sewer system, (ii) any other purpose required for prudent operation of the water and sewer system and (iii) any purpose required by the resolutions authorizing the issuance of, or relating to, bonds or other obligations of CSWRGID (or the County) in order to comply with the covenants in those resolutions.

d. It is understood, however, that the Parties intend to use commercially reasonable efforts to establish water and sewer revenues (including Developer contributions pursuant to Paragraph 7 other than the Infrastructure Surcharge), that are adequate for the purposes specified in Paragraphs 13(c) (i) through (iii) of this Agreement and that the Infrastructure Surcharge be used to pay the capital and associated costs of infrastructure for CSWRGID, including the principal of and interest on bonds issued to pay those costs. The availability of the Infrastructure Surcharge does not relieve Developers of their obligation to pay operation, maintenance and other expenses as provided in Paragraph 7.

e. At the request of the Developers, CSWRGID agrees to consider issuing its first series of revenue bonds payable from the Infrastructure Surcharge after CSWRGID has 1,000 customers of its water and sewer system. After CSWRGID issues its first series of revenue bonds and after CSWRGID has more than 1,000 customers (or such number of customers as CSWRGID, in its discretion, determines to be appropriate), if in any fiscal year both:

    i. Water and sewer system revenues in that fiscal year, including the Infrastructure Surcharge, are fully sufficient to pay all amounts required to be paid by these water and sewer revenues in that fiscal year, including, without limitation operation and maintenance expenses of the water and sewer system, amounts for any necessary reserves and replacements, amounts required to be deposited in any funds and accounts created under the resolutions authorizing the issuance of bonds or other obligations, and debt service on all bonds and other obligations issued for the water and sewer system, and

ii. The Infrastructure Surcharge in that fiscal year exceeds 140% (or such other coverage percentage as CSWRGID, in its discretion, determines to be appropriate) of the maximum annual amount of principal and interest due on the then outstanding bonds and other obligations in that and any future fiscal year,

CSWRGID may apply the Infrastructure Surcharge revenue received in that fiscal year in excess of 140% (or such other coverage percentage as CSWRGID, in its discretion, determines to be appropriate) of the maximum annual principal and interest due on the then outstanding bonds and other obligations in that and any future fiscal year to reimbursement of the Developers' Reimbursable Costs, if so requested by the Developers. Developers recognize that they have no contractual right to be reimbursed for any of the Developers' Reimbursable Costs by CSRWGID, LVVWD, or CCWRD, but if a request for reimbursement is made by Developers and the circumstances described in this Paragraph 13 exist, CSWRGID agrees that the request will be forwarded to the Board of Trustees for consideration. In no event will reimbursement exceed the actual cost paid by the Developers of the Developers' Reimbursable Costs as reasonably determined by CSWRGID, which have not been reimbursed from any other source. Any reimbursements made under this Paragraph shall be made to the Developers. The Developers shall be responsible for agreeing among themselves as to the disbursement of those reimbursements among the Developers, and for transmitting the amount reimbursed in the appropriate amount to the appropriate Developer. The Parties hereto other than the Developers shall have no responsibility for determining how much of any such reimbursement will be made to any particular Developer or for making or assisting in making any such individual Developer disbursement.

f. CSWRGID agrees not to impose connection or impact fees for the water or sewer system before the date which is ten (10) years following the first residential or commercial customer that is not an affiliate of any of the Developers and who connects to the Facilities to be operated by the CSWRGID at the Clark County Development, and CSWRGID agrees at the time any such fees are imposed, the individual fees will not exceed the then-current levels of local connection fees imposed by LVVWD and CCWRD. This limitation on the imposition of connection and impact fees will expire 20 years after the date on which the first residential or commercial customer that is not an affiliate of any of the Developers connects to the Facilities to be operated by the CSWRGID at the Clark County Development, or begins to receive service from such Facilities. However, in the event that CSWRGID determines, after consultation with Developers, that there is a need for extraordinary capital improvements to the system which were unanticipated as of the date of this Agreement and that all or a portion of the cost of those extraordinary capital improvements is best retired through a connection charge, impact fee, or combination thereof, CSWRGID may then impose a connection charge, impact fee, or combination thereof, without regard to the foregoing provisions of this clause (f).

g. CSWRGID's obligation (but not its right) to impose the Infrastructure Surcharge expires on July 1, 2051, and any repayments of costs pursuant to Paragraph 13 (e) (if any are made) will cease to be made on and after July 1, 2051, unless either or both of these dates is extended by CSWRGID, in its discretion.

h. Developers must make an apparent and obvious written disclosure of the Infrastructure Surcharge and the terms of its imposition to each 3rd party:

   i. Who purchases or otherwise acquires real property within the CSWRGID or the Clark County Development from Developers, or

   ii. To whom an offer to sell property in CSWRGID or the Clark County Development is made by Developers,

and Developers shall obtain from any transferee who is known to a Developer to be acquiring a parcel for development and resale a covenant to make a similar apparent and obvious disclosure to each person to whom an offer to sell property in CSWRGID or the Clark County Development is to be made and to each subsequent transferee of property in CSWRGID or the Clark County Development. In addition, on January 3, 2007, Developers recorded in the office of the County Recorder a notice of this covenant and of the Infrastructure Surcharge and the terms of its imposition as Document No. 20070103-0003256, so such notice will be a part of the title records for each parcel of property in CSWRGID or the Clark County Development. Developers agree not to sell or otherwise transfer any property in CSWRGID or the Clark County Development until this notice has been recorded. These notice requirements are not intended by the Parties to create any third-party beneficiaries. Developers shall obtain a written acknowledgement of receipt of the disclosures required hereunder from each recipient of such disclosures and shall furnish to CSWRGID a copy of each such written acknowledgement. The recorded notice is attached hereto as Exhibit A, and the form of the written disclosure and acknowledgment of receipt is attached as Exhibit A-1.

i. Other than the limit on connection and impact fees in Paragraph 13(f), this Agreement does not limit the amount of any rates, fees or charges of any type that may be imposed by CSWRGID for any purpose. The connection or impact fees limited by Paragraph 13(f) are only one-time fees charged to a customer to initially connect to the CSWRGID's system to obtain service. The imposition and collection of other rates, fees, and charges, including, without limitation, on-going rates, fees and charges; standby rates, fees or charges; and one-time rates, fees or charges that become due because of an action or event other than initially connecting to CSWRGID's system to obtain service are not limited by this Agreement.

14. **Additional Documents**. CSWRGID, CCWRD and LVVWD may enter into separate management agreements (a copy of any such management agreement shall be delivered to Developers at least thirty (30) days prior to any effective date thereof), which will also address system maintenance and operation issues. The CSWRGID Service Rules described above shall also constitute an additional document. CSWRGID shall, in cooperation with LVVWD, adopt its own specific governing rules, regulations, policies and procedures with respect to water, including the water commitment process. CSWRGID shall, in cooperation with CCWRD, adopt its own specific governing rules, regulations, policies and procedures with respect to wastewater. CSWRGID shall follow all governing rules, regulations, policies and procedures of the LVVWD with respect to water, except for the water commitment process as amended from time to time, until the CSWRGID, adopts different rules, regulations, policies and procedures. CSWRGID shall follow all governing rules, regulations, policies and procedures of the CCWRD with respect to wastewater, as amended from time to time, until the CSWRGID adopts different rules, regulations, policies and procedures. Notwithstanding any provision to the contrary in Paragraph 5(8) above, CSWRGID shall adopt initial wastewater treatment standards sufficient to meet all applicable federal and state laws and regulations, each as now or hereafter amended, for the reuse of treated effluent as golf course irrigation water. The initial wastewater treatment standards shall expire when the maximum daily flow at the wastewater treatment plant exceeds 3.15 MGD after equalization, and from and after such date the standards set forth in Paragraph 5(8) above shall govern all treated effluent discharges from all CSWRGID treatment facilities; provided, however, the Parties hereto shall cooperatively analyze other potential mechanisms and means to economically achieve the standards set forth in Paragraph 5(8) of this Agreement prior to an expansion of the wastewater treatment plant to allow the expense of plant modification to be delayed as long as reasonably possible.

15. **Assignment**. This Agreement may not be assigned, either in whole or in part, by any Party hereto without the prior written consent of the other Parties, which consent shall be in each Party's sole discretion. In the event of any such an assignment, the assignee shall assume such assignor's obligations under this Agreement in writing as though such assignee had been an original party to this Agreement and such assignor shall be released from its obligations hereunder.

The Board of Trustees of CSWRGID hereby delegates to the General Manager of the LVVWD the same powers as have been delegated to the General Manager by the LVVWD Board with purchasing authority to that extent where monies have been appropriated for that purpose in the approved budget for the CSWRGID.

16. **Miscellaneous**.

a. **Notices**.

i. Any and all notices and demands by any Party hereto to any other Party, required or desired to be given hereunder shall be in writing and shall be validly given or made only if personally delivered or deposited in the United States mail, certified or registered, postage prepaid, return receipt requested, if made by Federal Express or other similar delivery service keeping records of deliveries and attempted deliveries, or by facsimile transmission. Service shall be conclusively deemed made upon receipt if personally delivered or sent by facsimile, or if delivered by mail or delivery service, on the first business day delivery is attempted or upon receipt, whichever is sooner.

ii. Any notice or demand to Developers shall be addressed to Developers at:

Coyote Springs Investment LLC or
Coyote Springs Land Development Corporation, or
Coyote Springs Nevada LLC
Attn: Albert D. Seeno, Jr.
4021 Port Chicago Highway
Concord, CA 94520
Fax: (925) 671-0856

With a copy to:

Coyote Springs Investment LLC or
Coyote Springs Land Development Corporation, or
Coyote Springs Nevada LLC Attn: Emilia K. Cargill, Esq.
3100 SR 168, PO Box 37010
Coyote Springs, NV 89037
Fax: (702) 422-1419

iii. Any notice or demand to CSWRGID shall be addressed to CSWRGID at:

c/o Las Vegas Valley Water District
1001 S. Valley View Blvd. Mail Stop 480
Las Vegas, NV 89153
Fax (702) 862 - 7444
Attn: General Manager

With a copy to: General Counsel
1001 S. Valley View Blvd.
Las Vegas, NV 89153
Fax (702) 259 - 8218

iv. Any notice or demand to LVVWD shall be addressed to LVVWD at:

1001 S. Valley View Blvd., Mail Stop 480
Las Vegas, NV 89153
Fax (702) 862 - 7444
Attn: General Manager

With a copy to: General Counsel
1001 S. Valley View Blvd.

Las Vegas, NV 89153
Fax (702) 259 - 8218

v. Any notice or demand to CCWRD shall be addressed to CCWRD at:

5857 E. Flamingo Rd.
Las Vegas, NV 89122
Fax (702) 435 - 5435
Attn: General Manager

With a copy to: Marty Flynn
5857 E. Flamingo Rd.
Las Vegas, NV 89122
Fax (702) 435 – 5435
Attn: Assistant to the General Manager

vi. The Parties may change their address for the purpose of receiving notices or demands as herein provided by a written notice given in the manner aforesaid to the others, which notice of change of address shall not become effective, however, until the actual receipt thereof by the others.

b. **Service Plan Approval**. Developers agree to that certain Service Plan approved by the Board of County Commissioners of Clark County on May 2, 2006 ("Service Plan"), and agree to take all actions and perform all duties and obligations which the Service Plan contemplates Developers or all of them to take or perform.

c. **Parties Bound**. Subject to the provisions of Paragraph 15 above, this Agreement shall be binding upon and inure to the benefit of the Parties to this Agreement and their respective heirs, executors, administrators, legal representatives, successors and assigns. Developers shall be jointly and severally liable for the performance of any provision of this Agreement or the Service Plan that is required to be performed by the Developers.

d. **Severability**. If any of the terms and conditions hereof shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability, shall not affect any other of the terms and conditions hereof and the terms and conditions hereof thereafter shall be construed as if such invalid, illegal, or unenforceable term or conditions had never been contained herein.

e. **Entire Agreement**. The terms and conditions hereof relating to the subject matter described herein (i) constitute the entire Agreement and understanding between CSWRGID, CCWRD, LVVWD, and Developers, (ii) supersede all prior agreements, and understandings, written or oral, between the CSWRGID, CCWRD, LVVWD and Developers, and (iii) may not be modified or amended except by an instrument mutually executed and delivered by the CSWRGID, CCWRD, LVVWD and Developers, except that CSWRGID, CCWRD and LVVWD may enter into one or more interlocal or cooperative agreements as reasonably necessary to implement this Agreement concerning the subject matter hereof without the consent of Developers; provided, that any such interlocal agreement does not contain terms or provisions contrary to or in conflict with this Agreement; and further provided that a copy of any such interlocal agreement is given to Developers at least 30-days prior to the effective date thereof.

f. **Time**. Time is of the essence to the performance of any provision of this Agreement. If the date for performance of any provisions of the Agreement is a Saturday, Sunday, or banking holiday (in the State of Nevada), the date for performance shall be extended until the next day that is not a Saturday, Sunday or banking holiday.

g. **Interpretation**. Words of any gender used in this Agreement shall be held and construed to include any other gender, and words in the singular number shall be held to include the plural, and vice versa, unless the context requires otherwise. This Agreement was jointly negotiated and will not be construed against any of the Parties hereto.

h. **Waiver**. Any Party hereto may specifically waive in writing any breach of the terms and conditions hereof by any other Party, but no waiver specified in this Paragraph 16(h) shall constitute a continuing waiver of similar or other breaches of the terms and conditions hereof. All remedies, rights, undertaking, obligations, and agreements contained herein shall be cumulative and not mutually exclusive.

i. **Attorneys' Fees**. In the event that any Party commences an action to enforce or interpret this Agreement, or for any other remedy based on or arising from this Agreement, the prevailing Party therein shall be entitled to recover its reasonable and necessary attorneys' fees and costs incurred. For the purposes of this provision, the "prevailing Party" shall be that Party which has been successful with regard to the main issue, even if that Party did not prevail on all issues.

j. **Waiver of Damages**. Except as expressly stated in this Agreement, the Parties shall not be liable for any indirect, special, punitive, incidental, exemplary, or consequential loss or damage of any nature arising out of the Parties' performance or nonperformance under this Agreement, except that the Developers shall be liable for monetary damages for any failure to pay costs as provided in Paragraph 7 and the Service Plan.

k. **Governing Law**. The terms and conditions hereof shall be governed by and construed in accordance with the laws of the State of Nevada, without reference to its conflict of laws provisions. The Parties hereto consent to the jurisdiction of the Clark County, Nevada, District Court in connection with any proceeding related to this Agreement.

l. **Headings**. The headings herein are for reference purposes only and shall not affect the meaning or interpretation of the terms and conditions hereof.

m. **Effective Date**. The "Effective Date" of this Agreement shall be the date that the Agreement has been executed by all Parties.

n. **Cooperation**. CSWRGID, CCWRD, LVVWD and Developers shall cooperate with and assist each other in the preparation of CSWRGID Service Rules which will be adopted as expediently as possible using best efforts, the drafting and approval of the Management Agreement, and any other instrument deemed necessary or desirable by the Parties hereto in implementing the provisions and fulfilling the purpose of this Agreement.

o. **Capitalized Terms**. Capitalized terms used in this Agreement shall, unless otherwise clearly indicated, have the meaning as so defined.

p. **Counterparts**. This Agreement may be executed in any number of counterparts, each of which when duly executed and delivered shall be an original, but all such counterparts shall constitute one and the same Agreement. Any signature page of this Agreement may be detached from any counterpart without impairing the legal effect of any signatures, and may be attached to another counterpart, identical in form, but having attached to it one or more additional signature pages.

q. **Non-appropriation Clause**. Any monetary obligations of CSWRGID, LVVWD, or CCWRD in this Agreement, including but not limited to damages, are subject to the governing body of the entity involved in making an appropriation to pay the same, and nothing in this Agreement obligates any governing body to make any such appropriation.

r. **Third-Party Beneficiaries**. This Agreement is not intended to benefit anyone other than the Parties hereto and does not create any third-party beneficiary rights or causes of action.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the date first written above.

Coyote Springs Water Resources General Improvement District, a political subdivision of the State of Nevada

John J. Entsminger

By: John J. Entsminger
Its: General Manager

Las Vegas Valley Water District, a political subdivision of the State of Nevada

John J. Entsminger

By: John J. Entsminger
Its: General Manager

Approved as to form:

Dana Walsh

Dana R. Walsh, Esq., Director of Legal Services

Clark County Water Reclamation District, a political subdivision of the State of Nevada

By: Thomas A. Minwegen
Its: General Manager

Approved as to form:

Leslie Nielsen, Esq.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the date first written above.

Coyote Springs Water Resources General Improvement District, a political subdivision of the State of Nevada

By: John J. Entsminger
Its: General Manager

Las Vegas Valley Water District, a political subdivision of the State of Nevada

By: John J. Entsminger
Its: General Manager

Approved as to form:

Dana R. Walsh, Esq., Director of Legal Services

Clark County Water Reclamation District, a political subdivision of the State of Nevada

Thomas A. Minwegen

By: Thomas A. Minwegen
Its: General Manager

Approved as to form:

Leslie A. Ni

Leslie Nielsen, Esq.

Coyote Springs Investment LLC, a Nevada limited liability company

By: Albert D. Seeno, Jr.
Its: Manager

Coyote Springs Land Development Corporation, a Nevada corporation

By: Albert D. Seeno, Jr.
Its: President

Coyote Springs Nevada, LLC, a Nevada limited liability company

By: Albert D. Seeno, Jr.
Its: Manager

Approved as to form:

Emilia K. Cargill, Esq.

Weyerhaeuser NR Company, a Washington Corporation

By: Thomas R. Stocks
Its: Vice President

Approved as to form:

Conrad J. Smucker, Esq.

Coyote Springs Investment LLC, a Nevada limited liability company

____

By: Albert D. Seeno, Jr.
Its: Manager

Coyote Springs Land Development Corporation, a Nevada corporation

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Emilia K. Cargill

Emilia K. Cargill, Esq.

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Approved as to form:

Emilia K. Cargill, Esq.

Weyerhaeuser NR Company, a Washington Corporation

By: Thomas R. Stocks
Its: Vice President

Approved as to form:

6/25/15

Conrad J. Smucker, Esq.

BRIAN SANDOVAL
Governor

STATE OF NEVADA

BRADLEY CROWELL
Director

JASON KING, P.E.
State Engineer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
901 South Stewart Street, Suite 2002
Carson City, Nevada 89701-5250
(775) 684-2800 • Fax (775) 684-2811
http://water.nv.gov

May 16, 2018

Gregory Walch, Esq.
General Counsel
Las Vegas Valley Water District
1001 South Valley Blvd.
Las Vegas, NV 89153

Re: Coyote Spring Valley Water Supply

Dear Mr. Walch:

The Nevada Division of Water Resources (NDWR) is in receipt of your letter dated November 16, 2017, on behalf of the Las Vegas Valley Water District (LVVWD). In that letter, you provided background on groundwater supply in the Coyote Spring Valley based on existing water rights and related hydrologic data from the NDWR, including Order 1169 pumping test results and the subsequent issuance of Ruling 6255. Your letter concluded by asking the State Engineer, as Administrator of the NDWR, for an opinion regarding the extent to which subdivision maps for the Coyote Springs Development Project (Project) "predicated on the use of groundwater owned by the Coyote Springs Water Resources General Improvement District (CSWRGID) or developers in Coyote Spring Valley" would be executed by the NDWR.[1]

As you are aware, the development of groundwater resources in Coyote Spring Valley, Muddy River Springs Area, California Wash, Hidden Valley and Garnet Valley (*five-basin area*), are inextricably connected and can influence the flows in the Muddy River Springs and the Muddy River. Although your question is specific to the use of existing water rights

[1] Your letter identified the developers as Coyote Springs Land Development Corporation (CSLD), Coyote Springs Investment LLC (CSI), and Coyote Springs Nevada LLC (CSN), whom are developing the Coyote Springs development project.

held by the CSWRGID or the Project developers, it is necessary to address your inquiry within the broader context of appropriately managing and developing groundwater resources within the larger *five-basin area.*

1169 Pumping Test Background

During the Order 1169 pumping test conducted from November 2010 through December 2012, approximately 8,500 acre-feet per year of water was pumped from the carbonate aquifer, and 3,700 acre-feet per year was pumped from the alluvial aquifer within the larger *five-basin area.* Almost all of the alluvial pumping came from the Muddy River Springs Area. Results of the 2-year test clearly indicate that pumping at that level from the carbonate aquifer caused unprecedented declines in groundwater levels and flows in the high-altitude springs. These springs have a direct connection to the fully appropriated Muddy River and are part of the source of water for the endangered Moapa Dace, a fish federally listed as an endangered species since 1967, and the decreed senior rights of the Muddy River.

Post 1169 Pumping Test Considerations

Monitoring of pumpage and water levels has continued since the completion of the pumping test on December 31, 2012. This additional data provides NDWR a better understanding of the amount of groundwater pumping that may be sustainable in the *five-basin area* carbonate aquifer. Since completion of the pumping test, groundwater levels and spring flows have remained relatively flat while precipitation has been nearly average and the five-basin carbonate pumping has been about 6,000 afa.

Adding to the consideration as to how much groundwater can be sustainably pumped from the *five-basin area* is the Memorandum of Agreement (MOA) that was entered into on April 20, 2006, between the Southern Nevada Water Authority, the United States Fish and Wildlife Service, Coyote Springs Investment, the Moapa Band of Paiute Indians, and the Moapa Valley Water District. The purpose of the MOA was "to make measurable progress toward protection and recovery of the Moapa dace and its habitat concurrent with the operation and development of water projects for human use." Analysis of the Order 1169 pumping test and the observed correlation between pumping and spring flow indicates that MOA-required curtailment thresholds could be rapidly triggered should carbonate pumping exceed its current rate.

Future Groundwater Development

Ultimately, the amount of groundwater pumping that will be allowed in the *five-basin area* will be limited to the amount that will not conflict with the Muddy River Springs or the Muddy River as they are the most senior rights in the *five-basin area* and, by law must be protected. Moving forward, in order to not conflict with the senior decreed rights and negatively impact the Moapa Dace, carbonate pumping will have to be limited to a fraction of the 40,300 acre-feet already appropriated in the *five-basin area* as demonstrated by the hydrologic data and analysis from Order 1169 and Ruling 6255.

Therefore, specific to the question raised in your November 16, 2017, letter, considering current pumping quantities as the estimated sustainable carbonate pumping limit, **pursuant to the provisions found in Nevada Revised Statutes Chapter 278, 533 and 534, the State Engineer cannot justify approval of any subdivision development maps based on the junior priority groundwater rights currently owned by CWSRGID or CSI unless other water sources are identified for development.**

In closing, as outlined in this letter, the matter you're inquiring about is part of a much broader need to appropriately manage groundwater resources across the *five-basin area*. As such, it is incumbent upon the NDWR to work with all the water right holders on a conjunctive management plan for the *five-basin area*.

Sincerely,

P.E.

Jason King, P.E.
State Engineer

cc: Albert Seeno III, Coyote Springs Investments, LLC

IN THE OFFICE OF THE STATE ENGINEER
OF THE STATE OF NEVADA

IN THE MATTER OF APPLICATION 46777)
FILED TO APPROPRIATE THE PUBLIC WATERS)
FROM AN UNDERGROUND SOURCE WITHIN THE) **RULING**
COYOTE SPRINGS GROUNDWATER BASIN (210))
CLARK COUNTY, NEVADA.)

#4542

GENERAL

I.

Application 46777 was filed on March 31, 1983 by Nevada Power Company (NPC) to appropriate 55.0 cubic feet per second (cfs), 40,000 acre feet annually (afa), from the underground waters of the Coyote Springs Groundwater Basin, Clark County, Nevada for industrial (cooling) purposes within Sections 12, 13, 24, 25, 35 and 36, T.17S., R.63E., and Sections 7, 18, 19, 30 and 31, T.17S., R.64E., and Sections 1 and 2, T.18S., R.63E., M.D.B.&M.[1] The proposed point of diversion is described as being located within the SE¼ SE¼ of Section 23, T.13S., R.63 E., M.D.B.&M. The proposed manner of use is for the planned 2,000 megawatt Harry Allen Power Plant located in the Dry Lake region approximately 25 miles northeast of Las Vegas, Nevada.

II.

Application 46777 was timely protested by the Nevada Department of Wildlife (NDOW) on the grounds that the granting of the permit would not be in the best public interest as it would have a detrimental impact on the wildlife values of the Muddy River drainage including the Moapa Dace (Moapa Coriacea) which is classified as an endangered species; and, as past studies have indicated that Coyote Springs Valley supplies a major portion of the groundwater recharge for the Muddy River springs,[1] which lie in the Muddy River Springs Groundwater Basin (#219), located south and east and down gradient of Coyote Springs Valley.

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[1] File No. 46777, official records in the office of the State Engineer.

III.

Application 46777 was timely protested by the United States Fish and Wildlife Service (FWS) on the grounds that the granting of this permit would not be in the best public interest as it would have a diminishing effect on the springs supplying the Muddy River; thereby, having an adverse impact on the fish and wildlife living in the drainage, including the Moapa Dace (Moapa Coriacea) classified as an endangered species. The FWS alleges that studies indicate water moves through the Coyote Springs Valley area discharging from the Muddy River springs; therefore, the appropriation would intercept the water discharging at the Muddy River springs which would not be in the best public interest.[1]

IV.

The State Engineer initially described and designated the Coyote Springs Valley Groundwater Basin on August 21, 1985, under the provisions of Nevada Revised Statute § 534.030, as a basin in need of additional administration.[2]

V.

After a meeting with the applicant and the Division of Water Resources, NDOW withdrew its protest on the basis that a detailed monitoring plan be established, and on the understanding that groundwater pumping would be stopped should the project adversely affect the water table in the Muddy River Springs Area.[1]

FINDINGS OF FACT

I.

When the State Engineer analyzes whether water is available for appropriation in a groundwater basin the first analysis addresses the perennial yield of the particular groundwater basin. The perennial yield of a hydrologic basin is the maximum amount of water of usable chemical quality that can be consumed economically each year for an indefinite period of time. Perennial yield cannot exceed the natural replenishment to an area indefinitely, and

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[2] State Engineer's Order No. 905, dated August 21, 1985, official records in the office of the State Engineer.

ultimately is limited to the maximum amount of natural recharge that can be salvaged for beneficial use. If the perennial yield is continually exceeded groundwater levels will decline until the groundwater reservoir is depleted.[3] Withdrawals of groundwater in excess of the perennial yield contribute to adverse conditions such as water quality degradation, storage depletion, diminishing yield of wells, increased economic pumping lifts, land subsidence and possible reversal of groundwater gradients which could result in significant changes in the recharge-discharge relationship.

Presently, scientists can estimate the perennial yield of a groundwater basin by two distinct methods, recharge to the groundwater basin from precipitation, and discharge from the groundwater basin by spring/surface discharge, interbasin flow, consumption by plants tapping the groundwater and consumption by man. The State Engineer finds that in the Coyote Springs Valley Groundwater Basin the perennial yield (recharge) as a direct result of precipitation above the 6,000 foot elevation in the basin's watershed is estimated at 1,900 afa.[4]

II.

Another method for estimating the total quantity of water available for appropriation uses interbasin flow and discharge flow as the method by which to approximate the annual safe yield. Ground water is discharged from Coyote Springs Valley by the natural processes of transpiration of vegetation, evaporation from the soil and free-water surfaces, and to a greater extent by underflow from the Coyote Springs Valley to the Muddy River Springs Area Groundwater Basin. The majority of the underflow from Coyote Springs Valley can be best estimated by the amount of water

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[3] State Engineer's office, WATER FOR NEVADA, STATE OF NEVADA WATER PLANNING REPORT NO. 3, Nevada Water Resources, p. 13, Oct. 1971.

[4] Eakin, Thomas E., GROUND-WATER RESOURCES - RECONNAISSANCE SERIES REPORT 25, GROUND-WATER APPRAISAL OF COYOTE SPRING AND KANE SPRING VALLEYS AND MUDDY RIVER SPRINGS AREA, LINCOLN AND CLARK COUNTIES, NEVADA, Nevada Department of Conservation and Natural Resources, pp. 22-26, Feb. 1964.

discharged by the Muddy River Springs. This amount is estimated to be in the range of 33,700 to 36,000 afa.[4] In using a discharge analysis, any influence of the carbonate aquifer is taken into consideration because the analysis looks at the total quantity of water flowing through the system and not at precipitation. Based on the underflow, it has been estimated that the perennial yield of the Coyote Springs Groundwater Basin is 18,000 afa.[5] The State Engineer finds that there are no permitted groundwater rights in Coyote Springs Valley Groundwater Basin; therefore, there is unappropriated water in the Coyote Springs Valley Groundwater Basin.[6]

III.

The State Engineer finds that NPC has both ground water and surface water rights in the Muddy River Springs Area Groundwater Basin.[7]

IV.

The point of diversion under Application 46777 is within Coyote Springs Valley Groundwater Basin and just up gradient of the Muddy River Springs Area Groundwater Basin. However, Application 46777 does not seek water from the alluvial aquifer, but rather seeks to appropriate water from a deep regional groundwater flow system referred to as the carbonate aquifer. The carbonate aquifer is part of a regional interbasin groundwater flow system identified as the White River System.[8]

Several thousand feet of saturated carbonate-rock aquifers are believed to lie under portions of this region, and carbonate-rock

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[5] Nowlin, Jon, GROUND-WATER QUALITY IN NEVADA - A PROPOSED MONITORING PROGRAM, OPEN FILE REPORT 78-768, U.S.G.S., p. 203.

[6] Official records in the office of the State Engineer.

[7] Official records in the office of the State Engineer.

[8] Eakin, Thomas E., A REGIONAL INTERBASIN GROUNDWATER SYSTEM IN THE WHITE RIVER AREA, SOUTHEASTERN NEVADA, Water Resource Bulletin No. 33, Nevada Department of Conservation and Natural Resources, 1966.

aquifers also transmit a regional flow of water, in this case, to the Muddy River Springs Area.[9] The regional distribution of carbonate rocks has hydrologic significance because they transmit a flow of ground water in regional groundwater systems beneath topographic divides.[10]

The State Engineer finds that the carbonate aquifer is the source of water for the Muddy River, springs in the Muddy River Springs Area Groundwater Basin, and is an additional source of recharge, from beyond the drainage area, to the underground source of water known as the alluvial aquifer in the Muddy Springs Area Groundwater Basin. The State Engineer finds that the regional groundwater flow system known as the carbonate system provides an additional ground water supply available for appropriation. The State Engineer further finds that the quantity of water available in the carbonate aquifer may be more important as a water source than the availability of unappropriated water within the alluvial aquifer.

V.

Since the quantity of water available for appropriation in the carbonate aquifer is unknown, the issue is one of whether the additional diversion requested under Application 46777 from the carbonate aquifer in the Coyote Springs Groundwater Basin would reduce the spring flow and the inflow to the alluvial aquifer in the Muddy River Springs Area Groundwater Basin in an amount that would interfere with existing water rights within the Muddy River Springs Area Groundwater Basin.

An aquifer test of the carbonate system was conducted by the Moapa Valley Water District (MVWD) in support of their water right Applications 55450 and 58269. Applications 55450 and 58269 were

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[9] Eakin, Thomas E., GROUND-WATER RESOURCES - RECONNAISSANCE SERIES REPORT 25, GROUND-WATER APPRAISAL OF COYOTE SPRING AND KANE SPRING VALLEYS AND MUDDY RIVER SPRINGS AREA, LINCOLN AND CLARK COUNTIES, NEVADA, Nevada Department of Conservation and Natural Resources, p. 20, Feb. 1964.

[10] Rush, supra note 9, at 7.

filed to appropriate water from the carbonate aquifer in the Muddy River Springs Area Groundwater Basin.

A public administrative hearing was held in 1995 concerning Applications 55450 and 58269.[11] These two applications are supplemental to one another and have the same point of diversion from a well completed in the carbonate aquifer in the Muddy River Springs Area Groundwater Basin. This point of diversion is referred to as the Arrow Canyon Well. Application 46777 is similar to these applications in that it is also to be completed to the regional carbonate aquifer system in the White River System.

Protests to Applications 55450 and 58269 were submitted by NPC, FWS and the National Park Service. Representatives of the office of the State Engineer conducted seven (7) days of hearings and received eighty-nine (89) exhibits into evidence. The State Engineer heard testimony from expert witnesses and received extensive evidence regarding the effects of pumping a well completed in the carbonate aquifer on the springs and the alluvial aquifer in the Muddy River Springs Area Groundwater Basin. The State Engineer finds that testimony and evidence from that hearing is of great value in the consideration of Application 46777.

The State Engineer further finds that evidence from the 1995 Moapa Valley Water District hearings on Applications 55450 and 58269 indicates that the historical estimates of the quantity of water flowing from the carbonate aquifer in Coyote Springs Valley to the springs in the Muddy River Springs Area has been estimated at 51 cfs or 37,000 afa.[12] During the MVWD hearing, MVWD estimated the range of quantity of carbonate water underflow to the springs in the Muddy River Springs Area to be from 51,000 afa to 63,900

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[11] Transcript and exhibits, public administrative hearing before the State Engineer, January/February, 1995, official records of the office of the State Engineer.

[12] Transcript, pp. 1282-1286, and Exhibit Nos. MWD 15 and NPC 20, public administrative hearing before the State Engineer, January/February, 1995, official records in the office of the State Engineer.

afa, an amount greater than the total of existing water rights from all sources from the alluvial aquifer (45,260 afa).[13]

VI.

The aquifer test conducted from December 1993 to April 1994 under Applications 55450 and 58269, pumped 1,550 acre feet of water at a rate of 2,900 gallons per minute (gpm) (6.46 cfs) for 121 days.[14] This is equivalent to an average annual pumping rate of 2.14 cfs. Water levels in several carbonate and alluvial wells were monitored throughout the test and selected data are shown in Table A.[12]

Table A. Maximum Drawdown in Several Wells

Well Name	Aquifer	Distance from Arrow Canyon well, ft.	Maximum Drawdown, ft.
EH-4	Carbonate	14,000	0.50
EH-5B	Carbonate	1,800	0.50
MX-6	Carbonate	16,000	0.30
Dahlberg East	Alluvial	200	0
Lewis North	Alluvial	1,800	0
Lewis Farm	Alluvial	2,700	0

Discharge rates from certain springs within the Muddy River Springs Area Groundwater Basin were also measured during the test. The State Engineer finds that the discharge rates for the springs were unchanged.[15] The State Engineer further finds that the data

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[13] Transcript, pp. 899-900, public administrative hearing before the State Engineer, January/February, 1995, official records in the office of the State Engineer.

[14] Exhibit No. NPC-1, public administrative hearing before the State Engineer, January, February, 1995, Applications 55450 and 58269.

[15] Exhibit Nos. NPC-1 and MWD-23, public administrative hearing before the State Engineer, January, February, 1995, Applications 55450 and 58269.

based on the observations from the monitoring wells from the 121-day pump test shows little or no impact to either the alluvial or carbonate aquifers. The State Engineer finds that the proposed well under Application 46777 is approximately 9 miles further away to the north and west of the Arrow Canyon well used in that pump test; therefore, it would be expected that even less impact would be seen to either the alluvial aquifer or the springs in the Muddy River Springs Area Groundwater Basin.

VII.

As a result of a search for a testing ground for the MX missile, the United States Air Force, Ballistic Missile Office contracted with the Earth Technology Corporation, ERTEC, to investigate potential sites for water resources.[16] As a result of this search, aquifer tests were conducted on a well (CE-DT-5) completed in the carbonate aquifer and located in the same 40 acre piece of land (SE¼ SE¼ of Section 23, T.13S., R.63E., M.D.B.&M) as the proposed point of diversion under Application 46777.[17] The well was pumped at a constant discharge of 3,400 gpm (7.58 cfs) for thirty (30) days.[18] The maximum well yield is not known because the yields obtained were at the limit of the pump capability used for the test, not the yield of the carbonate aquifer.[19] The

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[16] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing, Coyote Springs Valley, Nevada, p. 1, official records in the office of the State Engineer.

[17] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing, Coyote Springs Valley, Nevada, pp. 1-2, official records in the office of the State Engineer.

[18] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing, Coyote Springs Valley, Nevada, p. A-23, official records in the office of the State Engineer.

[19] Ertec Western, Inc., MX Siting Investigation Water Resources Program, Preliminary Water Management Report, Volume 1, p. 84, official records in the office of the State Engineer.

aquifer test yielded drawdowns in the test well itself of 11 to 12 feet.[20] The only other well seeing any response due to the test was a monitor well, CE-DT-4, drilled 330 feet away and in the same formation as CE-DT-5. CE-DT-4 showed no response during the first 500 minutes of the aquifer test and yielded a maximum drawdown of 0.38 feet after 12,000 minutes (8.3 days). During maintenance shutdowns or pump failures, the water levels in CE-DT-4 recovered fully to prepumping levels within three minutes.[21] At the end of the thirty (30) day test, the drawdown measured in CE-DT-4 was measured at 0.22 feet.[22] Monitoring of the springs in the Muddy River Springs Basin found no changes in discharge rates.[23]

It was concluded from the aquifer test of the CE-DT-5 well that the carbonate aquifer is capable of a long-term, sustained yield in excess of 3,400 gpm and that the long-term, constant discharge testing of the well resulted in no detectable impacts upon either the discharge rate or water quality of the regional springs in the Muddy River Springs area.[24] Clearly there is high transmissivity and storativity associated with this aquifer. The

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[20] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing, Coyote Springs Valley, Nevada, pp. A-31-A-47.

[21] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing, Coyote Springs Valley, Nevada, p. 35.

[22] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing, Coyote Springs Valley, Nevada, p. A-67, official records in the office of the State Engineer.

[23] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing, Coyote Springs Valley, Nevada, pp. 34-38, official records in the office of the State Engineer.

[24] Ertec Western, Inc., MX Siting Investigation Water Resources Program; Results of Regional Carbonate Aquifer Testing. Coyote Springs Valley, Nevada, p. 62, official records in the office of the State Engineer.

State Engineer finds that there is sufficient system yield and system storage for new water right appropriations.

VIII.

Data to address the question of interference with existing water rights in Muddy River Springs Area Groundwater Basin from appropriations in Coyote Springs Valley Groundwater Basin is currently being sought through a monitoring plan conducted by Moapa Valley Water District under Permits 55450 and 58269.[25] The State Engineer finds that if, at some future time, it is determined that pumping the proposed well under Application 46777 in Coyote Springs Valley Groundwater Basin has adverse effects on the springs and the alluvial aquifer in the Muddy River Springs Area Groundwater Basin, then those effects would be detected early on by the reduction of water inflow from the carbonate aquifer to the alluvial system. If on the other hand, no adverse effects are indicated then there must be unappropriated water available for appropriation from the carbonate aquifer.

IX.

The State Engineer finds there are adequate safeguards in place by way of the monitoring sites to give an early warning before any environmental damage is done or before pumping from the carbonate aquifer in Coyote Springs Valley Groundwater Basin would decrease the flow of springs in the Muddy River Springs Area Groundwater Basin.

X.

The State Engineer previously stated, in the ruling under Applications 55450 and 58269, that the only way to know whether or not long term pumping of the carbonate aquifer at high diversion rates will affect the alluvial aquifer, springs, Muddy River and water right holders is to allow pumping to occur and monitor the aquifers, springs and river through a comprehensive monitoring program. Such a program already exists in the Muddy Springs area

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[25] File Nos. 55450 and 58629, monitoring plan, official records in the office of the State Engineer.

and some monitoring is being done in Coyote Springs Valley. The successful implementation of the monitoring plan requires the cooperation of at least four parties: Nevada Power Company, Moapa Valley Water District, U.S. Fish and Wildlife Service, and Nevada Division of Water Resources.

The State Engineer finds it to be prudent to merge the separate monitoring plans in existence today into one all encompassing, monitoring plan that will accurately show the hydrologic health of the separate aquifer systems. It is imperative that the comprehensive plan have the following objectives:

1. provide an "early warning" so that any negative impact can be mitigated or reversed by decreasing or ceasing pumping;
2. protect the groundwater table in the alluvial aquifer;
3. protect the groundwater table in the carbonate aquifer;
4. protect the flow from the springs in the Muddy Springs area;
5. protect the flow in the springs which supply water to the Moapa Dace habitat; and
6. protect the flow in the Muddy River.

XI.

Correspondence dated April 25, 1996, from the State Engineer to Nevada Power Company, asked the following questions or clarifications from NPC:

1. Do you have access to the lands where the points of diversion are located? If the answer to that question is yes, and the land is in private holdings, please provide a copy of the access agreement.

2. There is a great deal of distance between points of diversion and the place of use and I assume there are Federal lands that have to be crossed in order to get the water from the points of diversion to the place of use. What type of arrangements have been made for easements or rights of way across Federal lands and please provide copies of the various permits or applications needed to cross the subject lands and whatever environmental work is required for those permits.

3. Application 46777 was protested. What work has been completed to date, in the way of negotiations, or resolutions in order to resolve the protests?

4. It is my understanding that the intended use of the water was for the Harry Allen Power Plant. Is the Harry Allen Power Plant still in the capital improvement/resources plans filed with the PSC and if so, what is the time intended to put this water to beneficial use?

Nevada Power Company responded to the April 25, 1996, letter with correspondence dated May 22, 1996, with answers as to their plans for the Harry Allen Power Plant:[1]

1. NPC has obtained a right-of-way grant for 6,200 acres from the Bureau of Land Management for well sites and a pipeline to deliver the water to the plant;

2. NPC's air quality permit was modified to allow the construction of up to eight (8) combustion turbine units rather than coal fired units at the Harry Allen Power Plant;

3. NPC has spent over a million dollars on groundwater monitoring and inventory studies in order to better understand any hydrogeological connection between Coyote Springs Valley and the groundwater, springs and river flow in the Muddy River Springs Area Groundwater Basin;

4. NPC's best estimate for putting all of the water to beneficial use is between 5 and 8 years, depending on growth in southern Nevada. A copy of the 1994 Resource Plan was submitted to the State Engineer to show these plans;

5. NPC may amend its applications to show a total water need of approximately 5,000 acre-feet for the Harry Allen Station instead of the 40,000 acre-feet requested.

Correspondence dated December 19, 1996, from the State Engineer to Nevada Power Company, asked for clarification on land access to the proposed well sites given that Aerojet is now the owner of the well site proposed under Application 46777. Additionally, the State Engineer asked for clarification on the amount of water sought by NPC for the Harry Allen Power plant.[1] At the time Application 46777 was filed, the State Engineer understood the proposal to be industrial cooling in a 500 megawatt coal fired power plant. The Harry Allen Power plant now consists of a 70 megawatt natural gas fired power plant.

Nevada Power Company responded to the December 19, 1996, letter with correspondence dated January 28, 1997. This letter stated that NPC has contracted with an engineering firm to conduct exploratory drilling at other sites to establish realistic diversion points that can be included in its amended applications. NPC has also contracted with an engineering firm to model the groundwater system in Coyote Springs Valley, and has not determined the actual amount of water needed for the power plant. They would like to wait until late May 1997 to provide that amount.[1] NPC has stated that the Harry Allen Power Station will eventually consist of eight (8) combustion turbine units, in lieu of the coal fired units initially envisioned. Based on this new information, the State Engineer finds that the amount of water now required by the Harry Allen Plant is 5,000 afa. The State Engineer further finds that NPC has shown diligence towards getting the necessary easements and has modified their air quality permits to reflect the proposed addition to the Harry Allen Plant.

CONCLUSIONS

I.

The State Engineer has jurisdiction over the parties and of the subject matter of this action and determination.[26]

II.

The State Engineer is prohibited by law from granting an application to appropriate water where:[27]

1. there is no unappropriated water in the proposed source of supply;
2. the proposed use conflicts with existing rights; or
3. the proposed use threatens to prove detrimental to the public interest.

III.

The source of water for Application 46777 is the carbonate aquifer, not the alluvial system. The State Engineer concludes there is no evidence as to the exact quantity of water available for appropriation from the carbonate aquifer, but there is at least 18,000 afa available in total quantity.

IV.

As a result of the MX aquifer test and the MVWD aquifer test, the State Engineer concludes that the approval of Application 46777 would not interfere with any existing rights in the Coyote Springs Groundwater Basin or the Muddy River Springs Area Groundwater Basin.

V.

The 121 day carbonate aquifer test conducted in support of Applications 55450 and 58269 showed little or no effect on the water levels in the alluvial aquifer or the springs in the Muddy River Springs Area. A monitoring plan has been implemented in the Muddy River Springs Area and trigger levels have been established

[26] NRS Chapters 533 and 534.

[27] NRS § 533.370.

to identify possible adverse effects. The monitoring data collected from the monitoring plan are submitted to the State Engineer for review. If any signs of adverse effects are identified by the State Engineer, the State Engineer may order a reduction of pumping in the area. The point of diversion for Application 46777 is upgradient and further away from the Muddy Springs Area than the test well and is to be completed in the carbonate aquifer. The State Engineer concludes that the approval of Application 46777 for industrial use by the Harry Allen Power Plant does not threaten to prove detrimental to the public interest. The State Engineer further concludes that NPC must obtain additional water rights for the Harry Allen Power Station to meet growing demands for electricity in southern Nevada; thus, Application 46777 would not threaten to prove detrimental to public interest.

VI.

The FWS manages the Moapa Wildlife Refuge, the location of the habitat for the endangered Moapa Dace. The source of water for the springs on the refuge is the carbonate aquifer. The FWS is concerned that additional pumping of the carbonate aquifer will reduce the flow of water from the springs and damage the Dace habitat. A monitoring plan for the springs has already been put in place by Moapa Valley Water District and is an essential element in protecting the Dace habitat. The State Engineer concludes that additional monitoring by NPC will help provide an "early warning" program in order to avert any impacts to the springs in the Muddy River Springs Area.

VII.

The State Engineer concludes that the diversion rate of 55.0 cfs requested under Application 46777 is far in excess of the aquifer test diversion rate and considerably more than needed for a total diversion of 5,000 afa now required by the Harry Allen Power Plant, and it would be detrimental to the public interest to grant a permit for a quantity of water that will not be beneficially used.

VIII.

NPC's Application 46777 seeks to obtain additional water rights for the Harry Allen Power Plant to expand their electricity producing capability because of the increasing population growth in southern Nevada. The protestants fear that additional pumping from the carbonate aquifer will reduce the flow of water to the alluvial system, which is the source of water within the Muddy River Springs Area Groundwater Basin, the springs within the basin, and the Muddy River. From the MVWD hearing, and from other records of the State Engineer, the State Engineer concludes the following:

1. the hydraulic connection between the carbonate aquifer and the alluvial system is poorly defined;

2. it is unlikely that groundwater pumping under any permit granted pursuant to Application 46777 from the carbonate aquifer will reduce the quantity of water entering the alluvial system, the groundwater table of the alluvial aquifer, the flow of the springs, and the flow in the Muddy River to a point that creates a conflict with existing rights;

3. it is unknown whether the quantity of water entering the alluvial system from the carbonate aquifer is 37,000 afa, or if higher quantities in the range between 51,000 afa to 64,000 afa, are available for appropriation and use in the basin; and

4. the way to determine the impacts is to allow additional pumping of the carbonate aquifer and monitor the effects.

RULING

The protest to Application 46777 is hereby overruled and said application is hereby approved subject to the following conditions:

1. existing water rights;

2. payment of the statutory permit fees;

3. the pumping rate being reduced to 10 cubic feet per second, not to exceed 5,000 acre feet annually;

4. a comprehensive monitoring plan to be submitted by NPC to the State Engineer and the protestant within ninety (90) days of the date of this ruling. It is paramount that NPC work with MVWD and FWS to put together a monitoring plan that when reviewed along side MVWD's monitoring plan, will give an overall picture of the Coyote Springs Valley and Muddy River Springs Area. The plan shall be submitted and approved by the State Engineer prior to pumping the well;

5. NPC will be required to submit an annual report of the monitoring results. The FWS and MVWD will have the opportunity to review and comment on the annual report. The State Engineer will then retain the option of reducing the pumping rate for the next year, or any other action that may be necessary to protect the public interest or to prevent conflicts with existing rights; and,

6. NPC must obtain a right of way from Aerojet for the point of diversion and submit the agreement to the State Engineer.

Respectfully submitted,

R. Michael Turnipseed P.E.

R. MICHAEL TURNIPSEED, P.E.
State Engineer

RMT/JK/ab

Dated this 19th day of

June, 1997.

IN THE OFFICE OF THE STATE ENGINEER
OF THE STATE OF NEVADA

IN THE MATTER OF APPLICATIONS 55450)
AND 58269 FILED TO APPROPRIATE THE)
WATERS FROM AN UNDERGROUND SOURCE)
IN THE MUDDY RIVER SPRINGS AREA)
(219) CLARK COUNTY, NEVADA.)

RULING

4243

GENERAL

I.

Application 55450 was filed on November 9, 1990, by Moapa Valley Water District (MVWD) to appropriate 3.0 cfs of water from an underground source for municipal purposes. The proposed point of diversion is the existing Arrow Canyon well and is located within the SE¼ NE¼ of Section 7, T.14S., R.65E., M.D.B.&M. The proposed place of use is the Moapa Valley Water District service area.[1]

II.

Application 58269 was filed on October 27, 1992, by MVWD to appropriate 5.0 cfs of water from an underground source for municipal purposes. The proposed point of diversion is the Arrow Canyon well located as described above. The proposed place of use is the Moapa Valley Water District service area.[2]

III.

Application 55450 was timely protested by Nevada Power Company (NPC). NPC requested that the State Engineer deny the applications because "If approved, the appropriate(sic) and diversion proposed by this application will eventually reduce or eliminate the underground and surface water resources within the surrounding groundwater basin. Nevada Power Company's senior water rights would thus be impaired."[1]

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[1] File No. 55450, official records in the Office of the State Engineer.

[2] File No. 58269, official records in the Office of the State Engineer.

Application 55450 was timely protested by the United States Department of the Interior, National Park Service (NPS). NPS requested that the State Engineer deny Application 55450 because "...if granted, would divert water from the ground-water flow systems which feed the springs in Lake Mead National Recreation Area."[1]

IV.

Application 58269 was timely protested by the NPS. NPS requested that the State Engineer deny Application 58269 because "...if granted, would divert water from the ground-water flow systems which feed the springs in Lake Mead National Recreation Area."[2]

Application 58269 was timely protested by the United States Fish and Wildlife Service (FWS). FWS requested that the State Engineer deny Application 58269 because "...the proposed increased withdrawal from this well, as described in Application No. 58269, may not be in the public interest because it may adversely affect the resident and migratory fish and wildlife species and their habitats within the Moapa Valley..." and could be detrimental to "...a pending Service water right."[2]

V.

As a result of the protests to both applications, Moapa Valley Water District (MVWD) submitted a phased aquifer test plan to the State Engineer for approval. The plan was approved and a phase one 72-hour test and a phase two, 120-day aquifer test were conducted.[3]

VI.

On July 14, 1971, Muddy River Springs Area Ground Water Basin (219) was designated by the State Engineer as a basin in need of additional administration.[4]

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[3] File Nos. 55450 and 58269, official records in the Office of the State Engineer.

[4] State Engineer's Order No. 392, dated July 14, 1971, official records in the Office of the State Engineer.

The proposed point of diversion of Applications 55450 and 58269 is not located within the designated portion of Muddy Springs Area Ground Water Basin. The point of diversion is an existing well, known as the Arrow Canyon well and is located immediately up gradient from the designated area.[3,4]

VII.

A public administrative hearing was held before the State Engineer on January 24 through 26, 1995 in Las Vegas, Nevada to receive testimony and evidence pertaining to Applications 55450 and 58269. A continuation of January's hearing was held in Las Vegas on February 7 through 10, 1995.[5]

MOTIONS

I.

At the hearing, MVWD made two motions to the Hearing Officer. The decisions on the motions are entered below.

Mr. Marshall, counsel for MVWD, made a motion to strike certain portions of the protests filed by the NPS. Mr. Marshall felt that those portions referring to the Las Vegas Valley Water District filings and their alleged impacts to Death Valley National Monument and Devil's Hole are irrelevant to the matter of Applications 55450 and 58269.[6]

Mr. Palmer, counsel for NPS, agreed in part, that portions of the protests may not directly relate to this matter.[7]

Mr. Marshall's motion was resolved at the conclusion of the hearing. The NPS submitted revised versions of its protests in which irrelevant portions were removed. These revised protests

[5] Exhibit No. DWR-1, Public Administrative Hearing before the State Engineer, January, February, 1995.

[6] Transcript, pp. 6-8, Public Administrative Hearing before the State Engineer, January, February, 1995.

[7] Transcript, p. 8, Public Administrative Hearing before the State Engineer, January, February, 1995.

were admitted into the record as Exhibit Nos. 5 and 6.[8] Therefore, the motion to strike was rendered moot and no decision is necessary.

II.

Mr. Marshall's second motion was to strike that portion of the NPS protests that asserts federal reserved rights for the Lake Mead National Recreation Area (LMNRA). Mr. Marshall felt that there is no valid claim for reserved rights because LMNRA was established in 1964, long after the Muddy River system was declared fully appropriated.[9]

Mr. Palmer objected to the motion because any reserved right pertaining to LMNRA would be senior to Applications 55450 and 58269 and additional pumping of water as requested in said applications would have an impact to the springs in the LMNRA.[10]

It is unknown at this time, the location, quantity of water, and extent of any reserved right at the LMNRA. However, if reserved rights exist and are determined to be prior to Applications 55450 and 58269, then the State Engineer would consider any impacts on the reserved rights that said Applications may cause. If one or both of these applications were approved, they would be issued subject to any existing rights. It is not the purpose of this ruling to determine the existence of any federal reserve rights but the State Engineer is taking notice of the possibility of their existence. Therefore, the motion to strike the reference in the NPS protest to federal reserved rights is denied.

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[8] Transcript, pp. 1263-1264, Public Administrative Hearing before the State Engineer, January, February, 1995.

[9] Transcript, pp. 9-10, Public Administrative Hearing before the State Engineer, January, February, 1995.

[10] Transcript, pp. 10-11, Public Administrative Hearing before the State Engineer, January, February, 1995.

FINDINGS OF FACTS

I.

The area served by the MVWD is experiencing a population growth rate of about 5% per year and the water demand is increasing by 7% to 9% per year.[11] Considering this rate of increase, the base annual water demand and base peak daily demand are projected for future years and shown in Table I.[12]

Table I. Projection of Future Water Demand

Muddy Valley Water District

Year	Annual Water Demand, AF	Peak Daily Demand, CFS
1994	2,500	8.0
1996	2,800	9.2
1998	3,200	10.5
2000	3,600	12.0
2002	4,000	13.7
2004	4,500	15.8

MVWD presently holds existing water rights for underground and spring water of acceptable quality which allow the diversion of 8.0 cfs and the use of a total annual duty of 3985.33 AF.[13]

After 1994, the peak daily demand exceeded the permitted diversion rate of 8.0 cfs The total annual water demand will not exceed that allowed under existing rights until the year 2002. The State Engineer finds that MVWD has an immediate need for additional water rights, such as those requested in Applications 55450 and

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[11] Transcript, p. 798, Public Administrative Hearing before the State Engineer, January, February, 1995.

[12] Exhibit Nos. MWD-8 and MWD-9, Public Administrative Hearing before the State Engineer, January, February, 1995. The data shown in Table I were taken from these two exhibits.

[13] Exhibit No. MWD-7, Public Administrative Hearing before the State Engineer, January, February, 1995.

58269, to satisfy the peak daily demand. The State Engineer further finds that MVWD holds existing water rights in excess of the predicted total annual water demand until the year 2002. In 2004, MVWD will need an estimated 4,500 AFA or 515 AFA of additional annual duty to meet the demand.

II.

The Arrow Canyon well is completed to a depth of 565 feet and draws water from a large regional aquifer, in which ground water flows in a generally southerly direction, through fractured carbonate rocks.[14] This aquifer is known as the carbonate aquifer. The carbonate aquifer, in a complex and poorly understood manner, is hydraulically connected to a shallow, alluvial aquifer.[15] Ground water flows from the carbonate aquifer at a higher potentiometric surface to the alluvial aquifer and surfaces at the numerous springs in the Muddy River Springs Area.[16] Additionally, the carbonate aquifer is the source of water for the Muddy River.[16] The State Engineer finds that Applications 55450 and 58269 seek to appropriate additional water from the carbonate aquifer, which serves as the source of water for the underground water in the Muddy Springs Area Groundwater Basin, the springs in the basin, and the Muddy River.

III.

The United States of America, through the National Park Service (NPS) and the Fish and Wildlife Service (FWS) filed protests to Applications 55450 and 58269.[17] The NPS is concerned

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[14] Exhibit Nos. MWD-16 and NPC-1, Public Administrative hearing before the State Engineer, January, February, 1995.

[15] Transcript, p. 316, Public Administrative Hearing before the State Engineer, January, February, 1995.

[16] Transcript, pp. 94-95 and Exhibit Nos. NPC-5 and MWD-16, Public Administrative Hearing before the State Engineer, January, February, 1995.

[17] Exhibit Nos. DWR-5, DWR-6 and DWR-7, Public Administrative Hearing before the State Engineer, January, February, 1995.

about springs in the Lake Mead National Recreation Area (LMNRA) referred to the Rogers-Bluepoint Spring Complex. The source of water to the Rogers-Bluepoint Spring Complex is probably not the carbonate aquifer and the additional pumping of water at the Arrow Canyon well probably would have no effect on these springs.[18] The NPS is initiating a study to better understand the source of water of these springs. Because there was no evidence or testimony provided to show any connection between the carbonate aquifer and the springs, the State Engineer finds that the proposed additional pumping of the Arrow Canyon well will not affect the Rogers-Bluepoint Spring Complex.

The NPS is concerned that additional pumping of the Arrow Canyon well will reduce the flow of the Muddy River, to which NPS holds permitted water rights.[19] The pumping of the Arrow Canyon well during the 121 day pump test appeared to have no effect on the flow of the Muddy River, as measured at the U.S.G.S. gauge near Moapa.[20] The State Engineer finds that when upstream diversions are accounted for, the flow in the Muddy River can be monitored because of the existence of the U.S.G.S. gauge.

The FWS has the jurisdiction over the protection of the endangered Moapa Dace, a fish species whose only habitat is the spring outflow area located within the Moapa Wildlife Refuge.[21] The Moapa Dace has very specific hydraulic and temperature

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[18] Transcript, pp. 729-732, Public Administrative Hearing before the State Engineer, January, February, 1995.

[19] Transcript, pp. 726-728 and Exhibit No. NPS-12, Public Administrative Hearing before the State Engineer, January, February, 1995.

[20] Water Resources Data, Nevada, Water Year 1994, USGS Water Data Report NV-94-1, 1995. See stream flow record for gauge at the Muddy River near Moapa, No. 09416000, for December 1994 through April 1994.

[21] Exhibit Nos. FWS-8, FWS-9, and FWS-10, Public Administrative Hearing before the State Engineer, January, February, 1995.

requirements.[22] FWS is concerned that the additional pumping at the Arrow Canyon well will cause a reduction in flow of the springs at the Moapa Wildlife Refuge and cause negative impacts to the Dace habitat.[23]

No monitoring of the existing flows in the springs has occurred in the past.[24] The State Engineer finds that the flows from the springs in the Moapa Wildlife Refuge must be monitored as a first step in protecting the habitat of the Moapa Dace. The State Engineer further finds that if Applications 55450 and 58269 are approved, then the monitoring of the springs would be required to detect any impacts caused by the additional pumping of the Arrow Canyon well.

IV.

Applications 55450 and 58269 seek to appropriate water from the regional flow system referred to as the carbonate aquifer. The carbonate aquifer is the source of water for the Muddy River, the springs in the basin, and the underground water in the Muddy Springs Area Groundwater Basin, referred to as the alluvial aquifer.[25] The existing water rights from all these sources in the alluvial system total approximately 45,260 AFA.[26]

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[22] Transcript, pp. 497 and 509 and Exhibit No. FWS-10, Public Administrative Hearing before the State Engineer, January, February, 1995.

[23] Exhibit No. DWR-7, Public Administrative Hearing before the State Engineer, January, February, 1995.

[24] Transcript, pp. 493-494, Public Administrative Hearing before the State Engineer, January, February, 1995.

[25] Transcript, pp. 94-95 and Exhibit Nos. NPC-5 and MWD-16, Public Administrative Hearing before the State Engineer, January, February, 1995.

[26] Transcript, pp. 899-900, Public Administrative Hearing before the State Engineer, January, February, 1995.

The quantity of water flowing from the carbonate aquifer to the alluvial basin has historically been accepted as 51 cfs or 37,000 AFA.[27] However, experts testifying for the applicant estimate that there is probably at least 46,000 AFA and as much as 58,900 AFA flowing into the Muddy Springs Area Groundwater Basin, when the flows from California Wash, Lower Meadow Valley Wash and surface water inflows are considered.[28] It was estimated that an additional 5,000 AFA of secondary recharge from irrigation returns to the groundwater.[29] When this quantity is added to the previous estimates, the range of water available from all sources is estimated by the applicant to be between 51,000 AFA and 63,900 AFA. If the quantity of water under existing rights (45,260 AFA) is subtracted from the lower figure in the range of estimates (51,000 AFA), then 5,740 AFA of water would be available for appropriation. The State Engineer finds that while there is a degree of uncertainty inherent in the estimates, there is evidence that unappropriated water is available.

The above discussion of estimated recharge and quantity of existing water rights applies to the Muddy River Springs Area Groundwater Basin and surface water sources within the basin. Applications 55450 and 58269 seek to appropriate water from the carbonate aquifer which is the source of water for the alluvial basin. Therefore, the quantity of water available in the carbonate aquifer may be more important in deciding this matter than the availability of unappropriated water within the alluvial basin. Since the quantity of water existing in the carbonate aquifer is

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[27] Transcript, pp. 1282-1286 and Exhibit Nos. MWD-15 and NPC-20, Public Administrative Hearing before the State Engineer, January, February, 1995.

[28] Exhibit No. MWD-16, Transcript, pp. 1191-1194, Public Administrative Hearing before the State Engineer, January, February, 1995. See also the Closing Brief filed on behalf of MVWD, March 27, 1995.

[29] Transcript, pp. 925-926, Public Administrative Hearing before the State Engineer, January, February, 1995.

unknown, we must address the issue of whether additional diversions from the carbonate aquifer at the Arrow Canyon well would reduce the inflow to the alluvial aquifer to a point where the water available in the basin would not satisfy the existing rights within the basin. This question may have to be answered in the analysis of data from a monitoring plan, which could be established to determine any conflict with existing rights. If at some time in the future, it is determined that pumping the Arrow Canyon well causes a conflict with existing rights, then that conflict would be caused by the reduction in water inflow from the carbonate aquifer to the alluvial system. If on the other hand, no conflict is shown to exist, then there must be unappropriated water available. The question of conflict with existing rights is explored in the following sections.

V.

From December 1993 to April 1994, MVWD conducted a long term pump test on the Arrow Canyon well, in which 1,550 acre feet of water were pumped at a rate of 2,900 gpm (6.39 cfs) for 121 days.[30] This quantity of water is equivalent to an average annual pumping rate of 2.12 cfs. The discharge rates from certain springs located within the Muddy River Springs Area and the water levels in several carbonate and alluvial wells were monitored throughout the test. The drawdowns in the monitored wells are presented in Table II.[21] The discharge rates for the springs were unchanged.[31]

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[30] Exhibit No. NPC-1, Public Administrative Hearing before the State Engineer, January, February, 1995.

[31] Exhibit Nos. NPC-1 and MWD-23, Public Administrative Hearing before the State Engineer, January, February, 1995.

Table II. Maximum Drawdowns in Several Wells

Name	Aquifer	Distance from Arrow Canyon well, ft.	Maximum Drawdown, ft.
EH-4	Carbonate	14,000	0.50
EH-5B	Carbonate	1,800	0.50
MX-6	Carbonate	16,000	0.30
Dahlberg East	Alluvial	200	0.13
Lewis North	Alluvial	1,800	0
Lewis Farm	Alluvial	2,700	0

Several questions were raised about the pump test. First, NPC and FWS asserted that the length of time (121 days) was not adequate to stress the aquifer system to determine any negative impacts that would be observed in the carbonate and alluvial aquifers. The test should be a minimum of one year to cover all seasons, especially the summer when all the alluvial wells are pumping and the stress on the system is at its maximum.[32]

Second, the test was accomplished during the winter, coinciding with the seasonal recovery of the carbonate and alluvial systems. Normally, the water level in the wells would rise during this time and NPC stated that the hydrographs for the monitoring wells should be adjusted to account for this phenomenon. NPC concludes that the real drawdown in the monitoring wells should be two to three times what was actually observed during the pump test.[33]

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[32] Exhibit No. NPC-10 and Transcript, pp. 351-352 and pp. 592-595, Public Administrative Hearing before the State Engineer, January, February, 1995.

[33] Exhibit Nos. NPC-5 through NPC-8 and Transcript, pp. 340-347, Public Administrative Hearing before the State Engineer, January, February, 1995.

Next, NPC observed that the Arrow Canyon well was pumped at a rate of 6.39 cfs for 121 days. When the diversion rate of water requested under Application 55450 and 58269 (3 cfs and 5 cfs, respectively) is added to the quantity of water already appropriated in the Arrow Canyon well (2 cfs, Permit 52520), the result is 10 cfs. NPC feels that conclusions based on a pump test at 6.39 cfs may understate the impacts when 10 cfs is being diverted from the Arrow Canyon well. The MVWD analysis does not consider the complex boundary conditions, but instead assumes that the system has simple boundary conditions. NPC asserts that to correctly predict the drawdowns for higher pumped rates and longer times, one must consider the complex boundary conditions. NPC feels that MVWD's use of the Theis non-equilibrium method inaccurately estimates the long-term drawdowns.[34]

Finally, NPC feels that the MVWD ignored the data gathered over years of monitoring the Muddy River Springs Area Groundwater Basin.[34]

Considering the data produced from the 121 day pump test, there appears to be little or no impact to either the carbonate aquifer or the alluvial aquifer based on the observations from the monitoring wells. Even if we double or triple the observed drawdowns, they are still very small, on the order of one or two feet. The question is whether the 121 day pump test and MVWD's analysis of the data accurately predicts the long term effects on the aquifer system that will occur if Applications 55450 and 58269 are approved. Experts testified on both sides of the issue. After considering the evidence and testimony from the seven day hearing, the State Engineer makes the following findings:

1. The drawdowns observed during the 121 day pump test were reasonable;

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[34] Exhibit No. NPC-11, Public Administrative Hearing before the State Engineer, January, February, 1995.

2. The results from the 121 day pump test are not sufficient to accurately predict the long term impacts to the carbonate and alluvial aquifers when 10 cfs are pumped continuously from the Arrow Canyon well. There may be no economical way to predict the long term effects;
3. A realistic way to assess the long term impacts is to allow additional pumping of the Arrow Canyon well while implementing a comprehensive monitoring program on the wells in the carbonate and alluvial aquifers, the springs in the Muddy River Springs Area, and the Muddy River.

VI.

MVWD has a need for additional pumping rate to meet the present and future peak demand for water within the service area.[35] Applications 55450 and 58269 were filed to appropriate additional water from the carbonate aquifer at the existing Arrow Canyon well, to meet the demand through the year 2004.[36] However, additional pumping of the Arrow Canyon well, up to a rate of 10 cfs, may lower the potentiometric elevation of the ground water surface in the carbonate aquifer, which would reduce the flow of water from the carbonate aquifer to the alluvial aquifer. The result may be a lower groundwater table in the alluvial aquifer and possibly reduced flows in the springs located within the basin and a reduced flow of the Muddy River.[37] It is not possible to predict the Arrow Canyon well pumping rate that causes unacceptable conditions, with the present information on the record.

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[35] Exhibit Nos. MWD-8 and MWD-9, Public Administrative Hearing before the State Engineer, January, February, 1995.

[36] File Nos. 55450 and 58269, official records in the Office of the State Engineer.

[37] Transcript, pp. 348-349, Public Administrative Hearing before the State Engineer, January, February, 1995.

The answer can be found by instituting a comprehensive monitoring plan and allowing additional pumping of the Arrow Canyon well, above the permitted 2.0 cfs, at an increasing rate each year, as shown in Table III.[38]

Table III. Required Pumping Rate from the Arrow Canyon Well to meet the Increasing Demand.

Year	Total Pumping Rate Required, cfs	Additional Pumping Rate Required, cfs
1996	3.2	1.2
1997	3.9	1.9
1998	4.5	2.5
1999	5.2	3.2
2000	6.0	4.0
2001	7.0	5.0
2002	7.7	5.7
2003	8.9	6.9
2004	9.8	7.8

The objectives of the comprehensive monitoring program are:

1. Provide an "early warning" so that any negative impact can be mitigated or reversed by ceasing pumping;
2. Protect the groundwater table in the alluvial aquifer;
3. Protect the groundwater table in the carbonate aquifer;
4. Protect the flow from the springs in the Muddy Springs Area, and in the LMNRA;
5. Protect the flow in the springs which supply water to the Moapa Dace habitat;
6. Protect the flow in the Muddy River.

[38] The total pumping rate required from the Arrow Canyon well (second column, Table III) was calculated by subtracting 6.0 cfs, the permitted diversion rate from all other sources, from the demand curve in Exhibit No. MWD-9. The additional pumping rate required (third column, Table III) was calculated by subtracting 2.0 cfs, the permitted diversion rate from the Arrow Canyon well, from the entries in the second column, Table III.

The successful implementation of the monitoring plan requires the cooperation of at least four parties, MVWD, FWS, NPS, and NPC. Each year, MVWD will be required to submit to the State Engineer the results of their monitoring, the results of the other parties' monitoring for the previous year, and a justification for increasing the Arrow Canyon well pumping for the next year.

The State Engineer finds that the approval of Applications 55450 and 58269, conditioned on the phased-in increases in pumping of the Arrow Canyon well, and the annual evaluation of the monitoring data will allow MVWD to meet its water demand, prevent any conflict with existing rights, and protect the public interest.

CONCLUSIONS

I.

The State Engineer has jurisdiction over the subject matter.[39]

II.

The State Engineer is prohibited by law from granting an application to appropriate water where:

1. There is no unappropriated water in the proposed source of supply;
2. The proposed use conflicts with existing rights; or
3. The proposed use threatens to prove detrimental to the public interest.[40]

III.

Under its present water rights, which allow the diversion of up to 8.0 cfs of water, MVWD cannot meet the peak daily demand.[41] The State Engineer concludes that MVWD must obtain additional water rights to meet the peak daily demand. The State Engineer further

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[39] NRS Chapters 533 and 534.

[40] NRS 533.370.

[41] Exhibit Nos. MWD-7 and MWD-9, Public Administrative Hearing before the State Engineer, January, February, 1995.

concludes that the diversion rates requested under Applications 55450 and 58269, or 3.0 cfs and 5.0 cfs, respectively, will meet the projected demand through the year 2004.

Under its existing water rights, MVWD is allowed to divert 3985.33 AFA, which will meet the projected annual water demand through the year 2001.[42] After that, MVWD will require an additional 515 AFA to meet the demand through the year 2004.

IV.

NPS protested Applications 55450 and 58269 because of potential impacts to the springs within the Rogers - Bluepoint Spring Complex on the LMNRA. However, the source of water for the springs is not known to be the carbonate aquifer and therefore, the additional pumping of the Arrow Canyon well would have no effect on the springs. NPS will attempt to determine the source of water for the Roger - Bluepoint Spring Complex. The NPS should begin a formal monitoring program of the springs of concern so that changes in spring flow can be detected and related to the causes.

NPS is concerned that additional pumping of the Arrow Canyon well will cause a reduction in the flow of the Muddy River. Because the source of water for the Muddy River is the carbonate aquifer, this is a valid concern. The United States Geological Survey maintains a monitoring station on the Muddy River near Moapa. The State Engineer concludes that the approval of Applications 55450 and 58269 must be conditioned upon the review and analysis of the stream gauge records, in order to detect any reduction in flow of the Muddy River.

V.

FWS manages the Moapa Wildlife Refuge, the location of the habitat for the endangered Moapa Dace. The source of water for the springs on the refuge is the carbonate aquifer. FWS is concerned that additional pumping of the Arrow Canyon well will reduce the flow of water from the springs and damage the Dace habitat. The

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[42] Exhibit No. MWD-8, Public Administrative Hearing before the State Engineer, January, February, 1995.

State Engineer concludes that a monitoring plan for the springs is an essential element in protecting the Dace habitat. The reporting of the monitoring of the springs is essential to the success of the comprehensive monitoring plan.

VI.

There is evidence on the record that the historically accepted quantity of water flowing from the carbonate aquifer to the alluvial system (51 cfs of 37,000 AFA) may underestimate the quantity of water available in the alluvial system. The applicant estimates the range of values to be 51,000 AFA to 63,900 AFA, which is more than the quantity of existing water rights from all sources within the alluvial basin (45,260 AFA).

The source of water for Applications 55450 and 58269 is the carbonate aquifer, not the alluvial system. There was no evidence or testimony received regarding the quantity of existing water available for appropriation from the carbonate aquifer. Instead, evidence and testimony were related to the issue of whether increased pumping of the Arrow Canyon well would reduce the inflow of water from the carbonate aquifer to the alluvial system. The State Engineer concludes that this issue is properly addressed later in this ruling when the subject of potential conflicts with existing rights is considered.

VII.

The results of the 121 day pump test of the Arrow Canyon well showed a very small drawdown (0.3 to 0.5 ft.) in the carbonate aquifer, spread over a large area and a negligible drawdown in the alluvial aquifer (up to 0.13 ft.). The flow in the Muddy River and the flow from the springs did not decrease during the pump test. It must be noted that with regard to the spring flows, there may have been some diversions upstream from the measuring points that were not taken into account. The protestants pointed out other problems with the pump test and the applicant's interpretation of the results. The State Engineer concludes that the way to accurately determine the impact of additional pumping of the Arrow

Canyon well on the carbonate aquifer and the alluvial aquifer is to allow the additional pumping and require the monitoring of the entire system.

VIII.

MVWD filed Applications 55450 and 58269 to obtain additional water rights to satisfy the increasing peak daily demand and the total annual demand for water within its service area. The protestants fear that additional pumping from the Arrow Canyon well will reduce the flow of water from the carbonate aquifer to the alluvial system, which is the source of water for the underground water within the Muddy River Springs Area Groundwater Basin, the springs within the basin, and the Muddy River. After reviewing the record which includes expert testimony from both sides, the State Engineer concludes the following:

1. The hydraulic connection between the carbonate aquifer and the alluvial system is poorly understood;
2. It is unknown whether the additional pumping of the Arrow Canyon well will reduce the quantity of water entering the alluvial system and reduce the groundwater table within the alluvial aquifer, the flow in the springs, and the flow in the Muddy River to a point when a conflict with existing rights is created;
3. It is unknown whether the quantity of water entering the alluvial system is limited to 37,000 AFA or if higher quantities in the range between 51,000 AFA to 64,000 AFA, are available for use in the basin;
4. The way to determine the impacts is to allow the additional pumping of the Arrow Canyon well and measure the effects.

Therefore, as a condition of approval, a comprehensive monitoring plan must be submitted by MVWD to the State Engineer and the Protestants. The Protestants will be allowed to comment on the plan. The plan must then be approved by the State Engineer.

MVWD will be required to submit an annual report of the monitoring results, which will include the monitoring data from the FWS, NPS, and NPC. The report will also include a justification for increasing the pumping rate for the next year. The FWS, NPS, and NPC will have the opportunity to review and comment on the annual report. The State Engineer will then approve the pumping rate that will be allowed for the next year, or any other action that may be necessary to protect the public interest or to prevent any conflict with existing rights.

If any of the parties choose not to cooperate with MVWD and submit the monitoring data in a timely manner, then the State Engineer will approve the pumping rate allowed for the next year, based on the information provided.

Applications 55450 and 58269 should be approved subject to limitations on the pumping rate and total quantity of water allowed for each year. Beginning in 1996, MVWD will be allowed to pump 1.2 cfs under Applications 55450 and 58269. Considering the 2.0 cfs already permitted in the Arrow Canyon well, MVWD will be allowed to pump a total of 3.2 cfs from this well. The total annual quantity diverted from all sources will be limited to 3985.33 AFA, the quantity of water already appropriated. At the end of 1996, MVWD will submit its report. After receiving comments from the other parties, the State Engineer will approve the allowable pumping rate for 1997 and any other appropriate action that may be required to protect the public interest and to ensure no conflict with existing rights.

RULING

The protests to Applications 55450 and 58269 are hereby overruled and said Applications are hereby approved subject to:

1. Existing rights;
2. The payment of statutory fees;
3. The approval of a comprehensive monitoring plan to be submitted by Moapa Valley Water District, on or before December 29, 1995.
4. Annual review of the previous year's monitoring data and approval of the allowed pumping rate for the next year. The annual review will continue past the year 2004.
5. Applications 55450 and 58269 are approved supplemental to Permits 22739, 28791, 46932, and 52520 and the total annual quantity of water will be limited to the actual demand for any given year.

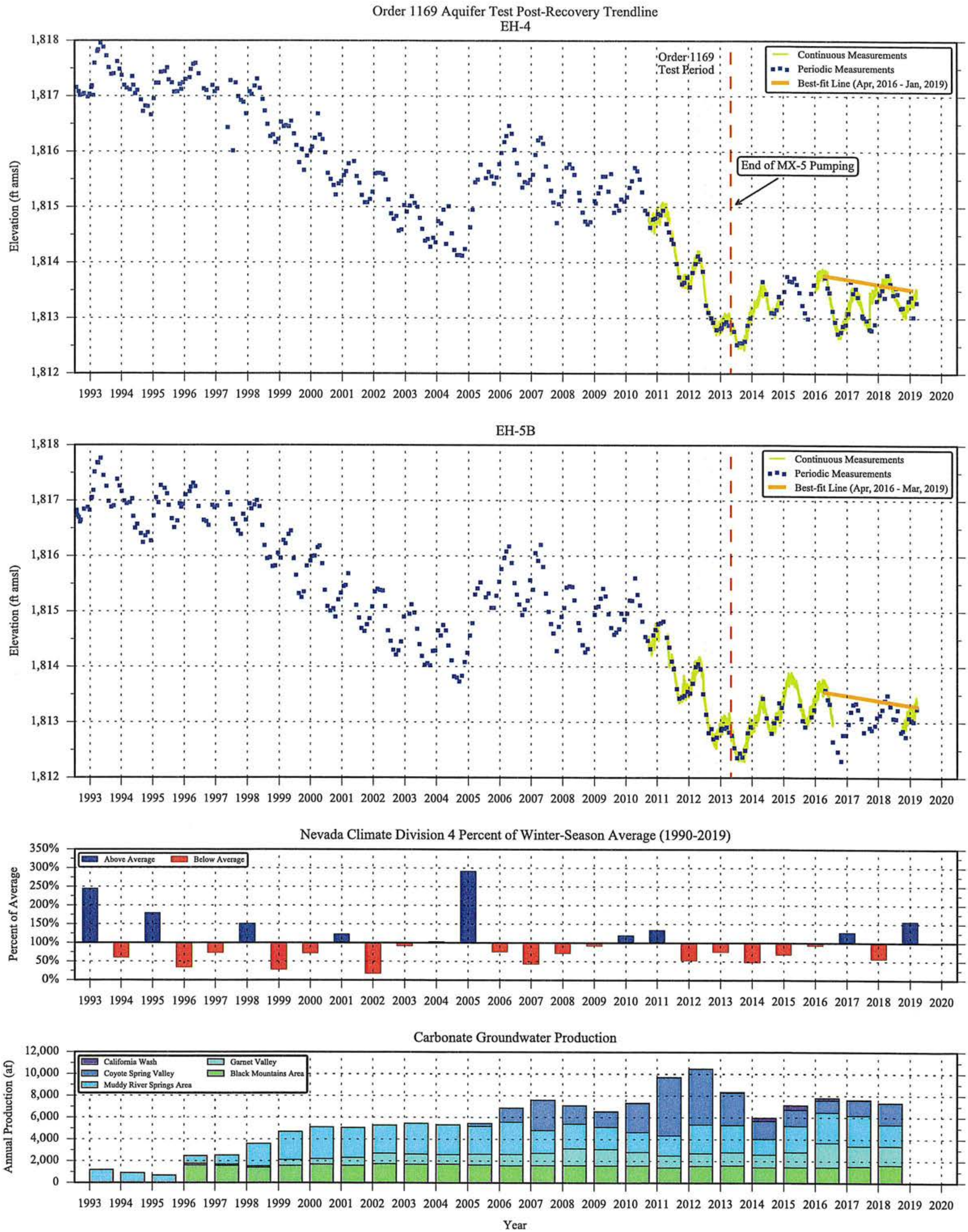
Respectfully submitted,

R. MICHAEL TURNIPSEED, P.E.
State Engineer

RMT/JCP/ab

Dated this 27th day of

October, 1995.


Order 1169 Aquifer Test Post-Recovery Trendline
EH-4
Order 1169 Test Period
End of MX-5 Pumping
Continuous Measurements
Periodic Measurements
Best-fit Line (Apr, 2016 - Jan, 2019)
Elevation (ft amsl)
EH-5B
Continuous Measurements
Periodic Measurements
Best-fit Line (Apr, 2016 - Mar, 2019)
Elevation (ft amsl)
Nevada Climate Division 4 Percent of Winter-Season Average (1990-2019)
Above Average
Below Average
Percent of Average
Carbonate Groundwater Production
California Wash
Coyote Spring Valley
Muddy River Springs Area
Garnet Valley
Black Mountains Area
Annual Production (af)
Year

IN THE OFFICE OF THE STATE ENGINEER OF THE STATE OF NEVADA

IN THE MATTER OF APPLICATION NUMBER 46777,
FILED BY Nevada Power Company,
ON March 31 19 83, TO APPROPRIATE THE
WATERS OF Underground

PROTEST

FILED
JUN 21 1983
STATE ENGINEER'S OFFICE

Comes now William A. Molini
Printed or typed name of protestant

whose post office address is P.O. Box 10678, Reno, Nevada 89520
Street No. or P.O. Box, City, State and Zip Code

whose occupation is Director, Nevada Department of Wildlife, and protests the granting of Application Number 46777, filed on March 31, 19 83

by Nevada Power Company to appropriate the
Printed or typed name of applicant

waters of Underground situated in Clark
Underground or name of stream, lake, spring or other source

County, State of Nevada, for the following reasons and on the following grounds, to wit:

The granting of this permit would have a detrimental impact on the wildlife values of the Muddy River drainage including the Moapa dace (Moapa coriacea) which is classified as an endangered species. Past studies ("A Regional Interbasin Ground-Water System in the White River Area, Southeastern Nevada, By Thomas E. Eakin 1966) have indicated that Coyote Springs Valley supplies a major portion of the groundwater recharge for the Muddy River springs. The granting of this permit would not be in the best public interest.

THEREFORE the protestant requests that the application be Denied
(Denied, issued subject to prior rights, etc., as the case may be)

and that an order be entered for such relief as the State Engineer deems just and proper.

Signed William A. Molini
Agent or protestant

William A. Molini, Director
Printed or typed name, if agent

Address P.O. Box 10678
Street No. or P.O. Box No.

Reno, NV 89520
City, State and Zip Code No.

CERTIFICATE OF SERVICE

RE: Interim Order 1303 Hearing Beginning on September 23, 2019

I, the undersigned, declare that:

I am a citizen of the United States, over the age of eighteen, and on September 5 2019, I served two hard-copies and one electronic copy of the foregoing

List of Witnesses, Summaries of Witnesses' Testimony, and List of Exhibits for The United States Department of the Interior Fish and Wildlife Service

and the exhibits identified in the list of exhibits, via Fedex to:

State Engineer
Nevada Division of Water Resources
901 South Stewart Street, Suite 2002,
Carson City, NV 89701

I also served the foregoing

List of Witnesses, Summaries of Witnesses' Testimony, and List of Exhibits for The United States Department of the Interior Fish and Wildlife Service

via e-mail to the addresses indicated below:

8milelister@gmail.com;
ablack@mcdonaldcarano.com;
admin.mbop@moapabandofpaiutes.org;
alaskajulie12@gmail.com;
andrew.burns@snwa.com;
barbnwalt325@gmail.com;
bbaldwin@ziontzchestnut.com;
bostajohn@gmail.com;
bvann@ndow.org;
chair.mbop@moapabandofpaiutes.org;
Chris.Benkman@nsgen.com;
Colby.pellegrino@snwa.com;
Coop@opd5.com;
coopergs@ldschurch.org;
counsel@water-law.com;
craig.primas@snvgrowers.com;
craig.wilkinson@pabcogypsum.com;
dan.peressini@lasvegaspaving.com;
david_stone@fws.gov;
Dbrown@ldalv.com;
dennis.barrett10@gmail.com;
derekm@westernelite.com;
devaulr@cityofnorthlasvegas.com;
dfrehner@lincolncountynv.gov;
dixonjm@gmail.com;
dorothy@vidlerwater.com;
doug@nvfb.org;
dvossmer@republicservices.com;
dwight.smith@interflowhydro.com;
edna@comcast.net;
emilia.cargill@coyotesprings.com;
fan4philly@gmail.com;
gary_karst@nps.gov;
gbushner@vidlerwater.com;
glen_knowles@fws.gov;
gmorrison@parsonsbehle.com;
golden@apexindustrialpark.com;
golds@nevcogen.com;

greatsam@usfds.com;
greg.walch@lvvwd.com;
hartthethird@gmail.com;
Howard.Forepaugh@nsgen.com;
ircady@yahoo.com;
info4gbwn@gmail.com;
JCaviglia@nvenergy.com;
jeff.phillips@lasvegaspaving.com;
jim.watrus@snwa.com;
joe@moapawater.com;
Karen.glasgow@sol.doi.gov;
kbrown@vvh2o.com;
Kevin_Desroberts@fws.gov;
kimberley.jenkins@clarkcountynv.gov;
kingmont@charter.net;
kpeterson@allisonmackenzic.com;
krobison@rssblaw.com;
kurthlawoffice@gmail.com;
lazarus@glorietageo.com;
lbelenky@biologicaldiversity.org;
lbenezet@yahoo.com;
liamleavitt@hotmail.com;
Lindseyd@mvdsl.com;
Lisa@ldalv.com;
lle@mvdsl.com;
lon@moapawater.com;
lroy@broadbentinc.com;
LuckyDirt@icloud.com;
luke.miller@sol.doi.gov;
luke.stewart@pabcogypsum.com;
martinmifflin@yahoo.com;
MBHoffice@earthlink.net;
michael_schwemm@fws.gov;
mjohns@nvenergy.com;
mmmiller@cox.net;
moapalewis@gmail.com;
moorea@cityofnorthlasvegas.com;
muddyvalley@mvdsl.com;
onesharp1@gmail.com;
paul@legaltnt.com;
pdonnelly@biologicaldiversity.org;
progress@mvdsl.com:
rafelling@charter.net:
raymond.roessel@bia.gov;
rberley@ziontzchestnut.com;
rhoerth@vidlerwater.com;
robert.dreyfus@gmail.com;
Rott@nvenergy.com;
rozaki@opd5.com:
rteague@republicservices.com;
Sarahpeterson@blm.gov;
SCarlson@kcnvlaw.com;
sc.anderson@lvvwd.com;
sc.anderson@snwa.com;
sharrison@mcdonaldcarano.com;
stever@stetsonengineers.com;
sue_braumiller@fws.gov;
technichrome@jps.net;
tim@legaltnt.com;
tommyers1872@gmail.com;
trobison@mvdsl.com;
twtemt@hotmail.com;
veronica.rowan@sol.doi.gov;
vsandu@republicservices.com;
whitfam@mvdsl.com;
william.paff@rocklandcapital.com;
wpoulsen@lincolnnv.com

I certify under penalty of perjury that the foregoing is true and correct. Executed on the 5 day of September 2019.

Janette J. Pizarro

Jeanette Pizarro
Administrative Officer
Southern Nevada Fish and Wildlife

IN THE OFFICE OF THE STATE ENGINEER
OF THE STATE OF NEVADA

IN THE MATTER OF THE ADMINISTRATION AND MANAGEMENT OF THE LOWER WHITE RIVER FLOW SYSTEM WITHIN COYOTE SPRING VALLEY HYDROGRAPHIC BASIN (210), A PORTION OF BLACK MOUNTAINS AREA HYDROGRAPHIC BASIN (215), GARNET VALLEY HYDROGRAPHIC BASIN (216), HIDDEN VALLEY HYDROGRAPHIC BASIN (217), CALIFORNIA WASH HYDROGRAPHIC BASIN (218), AND MUDDY RIVER SPRINGS AREA (AKA UPPER MOAPA VALLEY) HYDROGRAPHIC BASIN (219), LINCOLN AND CLARK COUNTIES, NEVADA	Regarding Interim Order 1303 Hearing Beginning on September 23, 2019

List of Witnesses, Summaries of Witnesses' Testimony, and List of Exhibits for The United States Department of the Interior Fish and Wildlife Service

The United States Department of the Interior, for and on behalf of the Fish and Wildlife Service ("FWS"), hereby submits the following List of Witnesses, Summaries of Witnesses' Testimony, and List of Exhibits for possible presentation at the administrative hearing scheduled for the above captioned matter.

List of Witnesses and Summary of Witness Testimony

The FWS may call the following witnesses at the administrative hearing:

1. Sue Braumiller, Hydrologist (Groundwater Hydrologist), for the FWS Nevada Field Office, Reno, Nevada. Ms. Braumiller prepared Sections 1.1 through 1.5, and 1.7, of the FWS' Report in Response to Order 1303, Exhibit 5. As such, Ms. Braumiller may testify to the contents, data, methods of analysis, and conclusions within those portions of that report, which principally addressed a joint interpretation of available geologic and hydrologic data for the vicinity of the Muddy River and basins believed to influence the availability of water in the river in response to the State Engineer's request for information regarding conjunctive management of water resources of the Lower White River Flow System, including but not limited to questions posed on pages 13 and 14 of

Order 1303. Ms. Braumiller is being presented as the author of Sections 1.1 through 1.5, and Section 1.7, of FWS's Exhibit 5 report and as a requisite expert on the matters covered within such sections. Ms. Braumiller's expert qualifications as a hydrologist are presented in her Curriculum Vitae, Exhibit 1.

2. Tim Mayer, Supervisory Hydrologist, Water Resources Branch, Division of Refuge Resources, for Regions 1 and 8, FWS, Portland, OR. Mr. Mayer prepared Section 1.6 of FWS' Report in Response to Order 1303, Exhibit 5. As such, Mr. Mayer may testify to the contents, data, methods of analysis, and conclusions within that portion of the report, which principally analyzed the spring discharge/groundwater relationships in the Muddy River Spring Area. Such testimony will include a summarization of the underlying theory of that spring discharge/groundwater relationship; review the methods and data underlying the analysis, using Pederson Springs as an example; and present the results as summarized in Table 1 in the Exhibit 5 Report.

   Mr. Mayer also authored the FWS' Rebuttal Report, Exhibit 7. As such, Mr. Mayer may testify to the contents, data, methods of analysis, and conclusions within that report, which principally examined the contention that longer-term drying or drought has affected water levels and spring discharge in the LWFRS, as alleged in the Moapa Band of Paiutes Order 1303 report. Such testimony will include a presentation of other evidence that shows a lack of drying or drought in the region; discuss the contrast in aquifer response between wet years and dry years in the LWRFS; review the interpretation of discharge data from Panaca Springs, the North Fork of the Virgin River, and Big Muddy Springs that is presented in the Moapa Band of Paiutes Order 1303 report; and will otherwise discuss errors and questionable assumptions in the statistical analysis presented in that report.

   Mr. Mayer is being presented as the author of Section 1.6 of FWS's Exhibit 5 report and the Exhibit 7 rebuttal report, and as a requisite expert on the matters covered within such Section 1.6 and rebuttal report. Mr. Mayer's expert qualifications as a hydrologist are presented in his Curriculum Vitae, Exhibit 2, which includes a list of administrative proceedings where Mr. Mayer has already been admitted and qualified as an expert in hydrology and water quality, both before the Nevada State Engineer in other water adjudication tribunals.

3. Michael Schwemm, Senior Fish Biologist, for the Southern Nevada FWS Office. Mr. Schwemm prepared the entirety of Section 2 of FWS' Report in Response to Order 1303, Exhibit 5. As such, Mr. Schwemm may testify to the contents, data, methods of analysis, and conclusions within that portion of the report, which principally addresses the biology, status, and recovery efforts associated with the Moapa dace. Such testimony will include an overview of the dace's biogeography, feeding, growth, reproduction and migration; challenges to recover the Moapa dace historically and at present; how certain habitat improvements have and can benefit the species; and will highlight one investigation of occupancy modeling that specifically showed how water depth predicts the distribution of Moapa dace, that water flow is directly related to the amount of habitat available, that any reduction in surface flow results in reduced habitat for Moapa dace.

   Mr. Schwemm is being presented as the author of Section 2 of FWS's Exhibit 5 report and as a requisite expert on the matters covered within such Section 2. Mr. Schwemm's expert qualifications as a biologist are presented in his Curriculum Vitae, Exhibit 3.

4. **List of Exhibits**

Copies of exhibits included within the following list will be served on the Nevada State Engineer as per its August 23, 2019 Notice of Hearing, for prompt publication on its associated webpage.

DOI Fish and Wildlife Service Exhibits	
Lower White River Flow System - September 23, 2019 Hearing	
Exhibit No.	**Description**
FWS Ex. No. 001	Sue Braumiller Curriculum Vitae
FWS Ex. No. 002	Tim Mayer Curriculum Vitae
FWS Ex. No. 003	Michael Schwemm Curriculum Vitae
FWS Ex. No. 004	July_3_USFWS_FINAL_NSE_ORDER 1303_LWRFS Submittal Cover Letter
FWS Ex. No. 005	Report in Response to Order 1303
FWS Ex. No. 006	USFWS_Ex_No_006_USFWS_Rebuttal_Report_on_NSE Order_1303_Cover_Letter-signed
FWS Ex. No. 007	Rebuttal to: Water-Level Decline in the LWFRS: Managing for Sustainable Groundwater Development by Cady Johnson and Martin Milfflin, Mifflin & Associates, Inc., submitted by the Moapa Band of Paiutes in accordance with Order 1303
FWS Ex. No. 008	Warm Springs West and EH4 regression output
FWS Ex. No. 009	Jones Spring and EH4 regression output
FWS Ex. No. 010	Iverson Flume and EH4 regression output
FWS Ex. No. 011	NV Climate Division 4_Pcp_PDSI_1990-2019
FWS Ex. No. 012	NV Climate Division 3_Pcp_PDSI_1990-2019
FWS Ex. No. 013	WaterLevelDataChart_181_N01 E63 36ABAA1_2008-2019
FWS Ex. No. 014	WaterLevelDataChart_181 S03 E65 07CCDA1_2008-2019
FWS Ex. No. 015	USGS MX_N_Dry_Lake_V_181_N03_E63_27CAA1_1980-2019
FWS Ex. No. 016	WaterLevelDataChart_181 N03 E64 07DC1_2009-2019
FWS Ex. No. 017	WaterLevelDataChart_182 182 S06 E63 12AD 1_2008-2019
FWS Ex. No. 018	WaterLevelDataChart_182 S07 E63 18AAAA1_2008-2019
FWS Ex. No. 019	WaterLevelDataChart_182 S07 E64 19ACDB1_2008-2019
FWS Ex. No. 020	WaterLevelDataChart_221 S08 E69 01CCCD1_2008-2019
FWS Ex. No. 021	WaterLevelDataChart_221 S09 E68 15BDBD1_2007-2019
FWS Ex. No. 022	WaterLevelDataChart_221 S09 E69 23BABC1_2007-2019
FWS Ex. No. 023	WaterLevelDataChart_221 S09 E69 23BABC2_2007-2019
FWS Ex. No. 024	WaterLevelDataChart_221 S09 E70 05ABBB1_2007-2019
FWS Ex. No. 025	WaterLevelDataChart_221 S09 E70 07DBCB1_2007-2019
FWS Ex. No. 026	WaterLevelDataChart_221 S10 E69 04BCDA1_2007-2019
FWS Ex. No. 027	WaterLevelDataChart_221 S10 E69 04BCDA2_2007-2019
FWS Ex. No. 028	WaterLevelDataChart_221 S10 E69 04BCDA3_2007-2019
FWS Ex. No. 029	WaterLevelDataChart_221 S10 E69 04BCDA4_2007-2019
FWS Ex. No. 030	WaterLevelDataChart_221 S10 E69 04BCDC1_2007-2019
FWS Ex. No. 031	WaterLevelDataChart_221 S10 E69 06CDBD1_2007-2019
FWS Ex. No. 032	WaterLevelDataChart_221 S10 E69 32BDDA1_2007-2019
FWS Ex. No. 033	North Fork Virgin River monthly baseflow_1970-2018

FWS Ex. No. 034	Panaca Springs vs CSVM-4 water levels_2005-2019
FWS Ex. No. 035	Email USGS to USFWS_RE GW development near Panaca Springs
FWS Ex. No. 036	Helsel & Hirsch_2002 Statistical Methods for Water Resources_Excerpted
FWS Ex. No. 037	Beck, D.A., and J.W. Wilson. 2006. Synoptic discharge, water-property, and pH measurements for Muddy River Springs Area and Muddy River, Nevada, February 7, 2001. U.S. Geological Survey (USGS) Scientific Investigations Report 2006-5237. 19 pp.
FWS Ex. No. 038	Crafford, A.E.J. 2007. Geologic Map of Nevada: U.S. Geological Survey Data Series 249. I CD-ROM, 46 p., I pl.
FWS Ex. No. 039	Deacon, J.E. and Bradley, W.G., 1972. Ecological distribution of fishes of Moapa (Muddy) River in Clark County, Nevada. Transactions of the American Fisheries Society, 101(3), pp.408-419.
FWS Ex. No. 040	Beck & Wilson_2006. Synoptic Discharge, Water-Property, and pH Measurements for Muddy River Springs Area and Muddy River, Nevada,
FWS Ex. No. 041	Eakin, T.E. 1964. Ground-water appraisal of Coyote Spring and Kane Spring valleys and Muddy River Springs Area, Lincoln and Clark counties, Nevada. Nevada Department of Conservation and Natural Resources, Ground-Water Resources Reconnaissance Series Report 25. 55 pp.
FWS Ex. No. 042	Heilweil, V.M. and L.E. Brooks, eds. 2011. Conceptual model of the Great Basin carbonate and alluvial aquifer system. U.S. Geological Survey Scientific Investigations Report 2010- 5193, 188 p.
FWS Ex. No. 043	Hubbs, C.L. and Miller, R.R., 1948. Two new, relict genera of cyprinid fishes from Nevada.La Rivers, I., 1942. Some new amphibian and reptile records for Nevada. Journal of Entomology and Zoology, 34(3), pp.53-68.
FWS Ex. No. 044	Kirk, S.T., and M.E. Campana. 1990. A deuterium-calibrated groundwater flow model of a regional carbonate-alluvial system. Journal of Hydrology, 119: 357-388.
FWS Ex. No. 045	La Rivers, I., 1962. Fish and fisheries of Nevada. Nevada State Fish and Game Commission. Carson City, NV.
FWS Ex. No. 046	Maxey, G.B., A.L Mindling, and P.A. Domenico. 1966. Ground water in Upper Muddy River Basin. Center for Water Resources Research, Desert Research Institute, University of Nevada, Misc. Report #3. 28 pp.
FWS Ex. No. 047	Page, W.R., D.S. Scheirer, and V.E. Langenheim. 2006. Geologic cross sections of parts of the Colorado, White River, and Death Valley regional ground-water flow systems, Nevada, Utah, and Arizona. USGS Open-File Report 2006-1040. 23 pp, 1 pl.
FWS Ex. No. 048	Page, W.R., G.L. Dixon, P.D. Rowley, and D.W. Brickey. 2005. Geologic map of parts of the Colorado, White River, and Death valley groundwater flow systems, Nevada, Utah, and Arizona. Nevada Bureau of Mines and Geology Map 150, scale 1:250,000, 21 pp, 1 pl. (part 1)

FWS Ex. No. 049	Page, W.R., G.L. Dixon, P.D. Rowley, and D.W. Brickey. 2005. Geologic map of parts of the Colorado, White River, and Death valley groundwater flow systems, Nevada, Utah, and Arizona. Nevada Bureau of Mines and Geology Map 150, scale 1:250,000, 21 pp, 1 pl. (part 2)
FWS Ex. No. 050	Perry, R.W., Jones, E.C., and Scoppettone, G.G. 2015. A stochastic population model to evaluate Moapa dace (Moapa coriacea) population growth under alternative management scenarios: U.S. Geological Survey Open-File Report 2015-1126, 46 p., http://dx.doi.org/10.3133/ofr20151126.
FWS Ex. No. 051	Scoppettone, G.G., 1993. Interactions between native and nonnative fishes of the upper Muddy River, Nevada. Transactions of the American Fisheries Society, 122(4), pp.599-608.
FWS Ex. No. 052	Scoppettone, G.G. and Burge, H.L., 1994. Growth and survivorship of Moapa dace (Osteichthyes: Cyprinidae: Moapa coriacea) in an isolated stream reach on Moapa National Wildlife Refuge. The Southwestern Naturalist, 39(2), pp.192-195.
FWS Ex. No. 053	Scoppettone, G.G., Burge, H.L., Tuttle, P.L., Parker, N.K. and Parker, N.K., 1987. Life history and status of the Moapa dace (Moapa coriacea). US Fish and Wildlife Service, National Fisheries Research Center. Seattle, Washington.
FWS Ex. No. 054	Scoppettone, G.G., Rissler, P.H., Nielsen, M.B. and Harvey, J.E., 1998. The status of Moapa coriacea and Gila seminuda and status information on other fishes of the Muddy River, Clark County, Nevada. The Southwestern Naturalist, pp.115-122.
FWS Ex. No. 055	Scoppettone, G.G., Salgado, lA. and Nielsen, M.B., 2005. Blue tilapia (Oreochromis aureus) predation on fishes in the Muddy River system, Clark County, Nevada. Western North American Naturalist, 65(3), p.13.
FWS Ex. No. 056	USFWS. 1996. Recovery plan for the rare aquatic species of the Muddy River ecosystem: U.S. Fish and Wildlife Service, Portland, Oregon, 60 p.
FWS Ex. No. 057	USFWS. 2006b. Amended stipulation between Lincoln County Water District and Vidler Water Company, Inc. and the U.S. Fish and Wildlife Service for withdrawal of protests to applications 72278, 72219, 72220, and 72221, Exhibit A, Monitoring, Management and Mitigation Plan [for] groundwater development in Kane Springs Valley. August 1, 2006. 17 pp.
FWS Ex. No. 058	Scoppettone, G.G., Burge, H.L. and Tuttle, P.L., 1992. Life history, abundance, and distribution of Moapa dace (Moapa coriacea). The Great Basin Naturalist, pp.216-225.
FWS Ex. No. 059	USFWS. 2008. Biological Opinion_84320-2008-F-0007 BLM KSV Groundwater Development Project in Lincoln County, Nevada
FWS Ex. No. 060	Southern Nevada Water Authority (SNWA). 2007. Geology of White Pine and Lincoln Counties and adjacent areas, Nevada and Utah - The geologic framework of regional groundwater flow systems. Southern Nevada Water Authority, Las Vegas, Nevada, Doc. No. HAM-ED-OOOl. 157 pp.

FWS Ex. No. 061	Stewart, J.H., and J.E. Carlson. 1978. Geologic map of Nevada: U.S. Geological Survey, scale 1:500,000. 2 sheets.
FWS Ex. No. 062	Theis, C.V. 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage. Eos, Transactions American Geophysical Union, 16(2), pp.519-524.
FWS Ex. No. 063	Tschanz, C.M., and E.H. Pampeyan. 1970. Geology and mineral deposits of Lincoln County, Nevada. Nevada Bureau of Mines and Geology. Bulletin 73. 188 p., 7 pl.
FWS Ex. No. 064	Garcia, Halford and Fenelon. 2013. Ground Water Journal 51 322-332.
FWS Ex. No. 065	Halford et al. 2012. Advanced Methods for Modeling Water-Levels and Estimating Drawdowns with SeriesSEE, an Excel Add-In (Software)
FWS Ex. No. 066	Flint, L.E. and Flint, A.L., 2007. Regional analysis of ground-water recharge. Ground-water recharge in the arid and semiarid southwestern United States, pp.29-59.
FWS Ex. No. 067	Dettinger, M.D., J.R. Harrill, and D.L. Schmidt. 1995. Distribution of carbonate-rock aquifers and the potential for their development, southern Nevada and Adjacent parts of California, Arizona, and Utah, U.S. Geological Survey Water-Resources Investigation Report 91-4146. 107pp. (Part 1 of 3)
FWS Ex. No. 068	Dettinger, M.D., J.R. Harrill, and D.L. Schmidt. 1995. Distribution of carbonate-rock aquifers and the potential for their development, southern Nevada and Adjacent parts of California, Arizona, and Utah, U.S. Geological Survey Water-Resources Investigation Report 91-4146 (Part 2 of3)
FWS Ex. No. 069	Dettinger, M.D., J.R. Harrill, and D.L. Schmidt. 1995. Distribution of carbonate-rock aquifers and the potential for their development, southern Nevada and Adjacent parts of California, Arizona, and Utah, U.S. Geological Survey Water-Resources Investigation Report 91-4146 (Part 3 of 3)
FWS Ex. No. 070	SNWA. 2009a. Conceptual model of groundwater flow for the Central Carbonate-Rock Province - Clark, Lincoln, and White Pine Counties Groundwater Development Project: Southern Nevada Water Authority, Las Vegas, Nevada. 416 pp.
FWS Ex. No. 071	SNWA. 2009b. Transient numerical model of groundwater flow for the Central CarbonateRock Province - Clark, Lincoln, and White Pine Counties Groundwater Development Project: Prepared in cooperation with the Bureau of Land Management. Southern Nevada Water Authority, Las Vegas, Nevada. 394 pp.
FWS Ex. No. 072	Pederson Spring and EH4 regression output
FWS Ex. No. 073	Pederson East Spring and EH4 regression output

FWS Ex. No. 074	Flint, Alan L., Lorraine E. Flint, Joseph A. Hevesi, and Joan B. Blainey. "Fundamental concepts of recharge in the Desert Southwest: a regional modeling perspective." Groundwater Recharge in a Desert Environment: The Southwestern United States (2004): 159-184.
FWS Ex. No. 075	National Climatic Data Center (NCDC). 2018. NCDC Divisional climatic database. Online:. Accessed most recently in Sept 2018.
FWS Ex. No. 076	NCDC 2018. NV Div 3 south-central climate data (19700101-20060101)
FWS Ex. No. 077	NCDC 2018. NV Div 3 south-central climate data (20060101-20180601)
FWS Ex. No. 078	NCDC 2018. NV Div 4 extreme-south climate data (20060101-20180601)
FWS Ex. No. 079	NCDC 2018. NV Div 4 south-central climate data (19700101-20060101)
FWS Ex. No. 080	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (Black Mtns Area well log query results)
FWS Ex. No. 081	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (California Wash well log query resultsquery results)
FWS Ex. No. 082	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (Coyote Springs Valley well log query results)
FWS Ex. No. 083	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (Garnet Valley Area well log query results)
FWS Ex. No. 084	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (Hidden Valley well log query results)
FWS Ex. No. 085	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (Kane Springs Valley well log query results)
FWS Ex. No. 086	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (Lower Meadow Valley Wash well log query results)

FWS Ex. No. 086	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. NDWR 2018b (Muddy Rover Springs Area well log query results)
FWS Ex. No. 088	NDWR. 2018b. NDWR well log database: an online source of well log information. Available on the internet at <http://water.nv.gov/datalwelllog/index.cfm>. Accessed most recently in October 2018. (NSE online Well Log Database Query - Portal)query results)
FWS Ex. No. 089	NDWR 2018c. Screen shot examples of data locations and retrieved
FWS Ex. No. 090	NDWR 2018c. Screen shot - NDWR 2018c (Portal to NSE online interactive hydro data mapping app)
FWS Ex. No. 091	NDWR 2018d - Screen shot examples of data locations and retrieved
FWS Ex. No. 092	NDWR 2018d. Screen shot - NDWR 2018d (Portal to NSE online interactive water rights mapping app)
FWS Ex. No. 093	SNWA 2007. Report and GIS files of White Pine & Lincoln Counties (used reg faults from Plate 1 in GIS)
FWS Ex. No. 094	Braumiller_PowerPt_slides_containing_info_beyond_July3_report (20190903)

Dated this 5th day of September, 2019

Respectfully submitted,

By: Luke Miller

Luke Miller
Assistant Regional Solicitor
Office of the Regional Solicitor
U.S. Department of the Interior
2800 Cottage Way, Suite E-1712
Sacramento, CA 95825
Telephone: (916) 978-6133
Telefax: (916) 978-5694
luke.miller@sol.doi.gov

United States Department of the Interior

OFFICE OF THE SOLICITOR
Pacific Southwest Region
2800 Cottage Way
Room E-1712
Sacramento, California 95825-1890

IN REPLY
REFER TO:

July 3, 2019

Tim Wilson, P.E., Acting State Engineer
Nevada Division of Water Resources
901 S. Stewart Street, Suite 2002
Carson City, Nevada 89701-5250

Subject: Report in Response to Order 1303

Dear Mr. Wilson:

In accordance with your Order 1303 and on behalf of the U. S. Fish and Wildlife Service (Service), we are submitting the Services' report in response to Order 1303 (Order) issued by the State Engineer on January 11, 2019. That order held in abeyance permanent applications to change existing groundwater rights pending the submission of the reports as requested by the Order, issued a temporary moratorium regarding any final subdivision or other submission concerning development and construction submitted to the State Engineer for review, and held such submissions in abeyance pending the conclusion of the public process to determine the total quantity of groundwater that may be developed within the Lower White River Flow System.

The attached report addresses the five topics identified by the State Engineer in Order 1303: a. The geographic boundary of the hydrologically connected groundwater and surface water systems comprising the Lower White River Flow System; b. The information obtained from the Order 1169 aquifer test and subsequent to the aquifer test and Muddy River headwater spring flow as it relates to aquifer recovery since the completion of the aquifer test; c. The long-term annual quantity of groundwater that may be pumped from the Lower White River Flow System, including the relationships between the location of pumping on discharge to the Muddy River Springs, and the capture of Muddy River flow; d. The effects of movement of water rights between alluvial wells and carbonate wells on deliveries of senior decreed rights to the Muddy River; and, e. Any other matter believed to be relevant to the State Engineer's analysis.

Based on current information, the report's findings support the conclusion that there is no water available for appropriation in the system, and that additional groundwater withdrawal from the carbonate-rock aquifer in the area will have adverse impacts on the springs in the Muddy River

Springs area, including those at the Moapa Valley National Wildlife Refuge. While the full extent of these impacts is currently unknown, due to the impacts that were evident from the current pumping levels under the Order 1169 pumping test, we continue to propose that the State Engineer adopt a careful and measured approach to additional pumping of existing water rights in the Lower White River Flow System and continue to monitor water levels and spring discharge rates.

We appreciate this opportunity to provide this information to your office and the opportunity to continue to work with you and the other interested parties to determine how best to manage these public resources. If you have any questions or need further information, please contact me at (916) 978-5675. Thank you.

Sincerely,

VERONICA ROWAN Digitally signed by VERONICA ROWAN

Veronica Rowan,
Assistant Regional Solicitor

encl.

Issues Related to Conjunctive Management of the Lower White River Flow System

Presentation to the Office of the Nevada State Engineer

in Response to Order 1303

U.S. Fish and Wildlife Service

July 3, 2019

Overview

The U.S. Fish and Wildlife Service (USFWS) respectfully submits this report in response to the State Engineer's request for information regarding conjunctive management of water resources of the Lower White River Flow System (LWRFS), including but not limited to the following questions posed in Order 1303 (NSE 2019):

a. The geographic boundary of the hydrologically connected groundwater and surface water systems comprising the LWRFS;

b. Information obtained from the Order 1169 aquifer test and subsequent to the aquifer test, including changes in Muddy River headwater spring flows, as it relates to aquifer recovery since completion of the aquifer test;

c. The long-term annual quantity of groundwater that may be pumped from the LWRFS, including relationships between the location of pumping and capture of the Muddy River Springs and Muddy River;

d. Effects of the movement of water rights between alluvial wells and carbonate wells on deliveries of senior decreed rights to the Muddy River; and,

e. Any other matter believed to be relevant to the State Engineer's analysis.

Section 1 of this report presents our current assessment of hydrologic issues and considerations related to the development of an effective conjunctive water management program for the LWRFS, including the five questions posed in Order 1303. Section 2 summarizes the current status of the Moapa dace and our understanding of habitat conditions required within the Muddy River Springs Area for its continued protection and recovery.

Summary of Conclusions

What is the geographic boundary of the hydrologically connected groundwater and surface water systems comprising the LWRFS?

Based on information developed in Sections 1.1 and 1.3.1, revisions to the areal extent of the LWRFS should be considered as shown in Figure 1 to include the following basins and parts of basins:

- the MRSA;
- most of Coyote Spring Valley;
- Hidden Valley;
- Garnet Valley;
- most of California Wash;
- northwest Black Mountains Area;
- Kane Springs Valley; and
- most of LMVW

We acknowledge the National Park Service's (NPS's) concern that there may be impacts from future pumping, particularly from wells located further south and east in the LWRFS. Based on our evaluation of the available geologic and hydrologic information, we believe that, to the extent that outflow occurs across any portion(s) of the Glendale and Muddy Mountain thrusts (or the northern strand of the Las Vegas shear zone), differences in head in carbonate and other rocks on either side of the thrusts mean that any outflow is fairly constant and unlikely to change with water management in the LWRFS. See Section 1.3.1, Lateral Outflow. However, we are open to any new evidence that would counter this view.

What information has been obtained from the Order 1169 aquifer test and subsequent to the aquifer test, including changes in Muddy River headwater spring flows, as it relates to aquifer recovery since completion of the aquifer test?

The high-elevation springs on the Moapa Valley National Wildlife Refuge continue to respond to fluctuations in carbonate water levels as expected and described in the Department of the Interior (DOI) 2013 interpretation of the Order 1169 pumping test. In contrast, the flow of the Big Muddy Spring, a major contributor to the Muddy River, appears to be unrelated to carbonate water levels in basins currently recognized as the LWRFS, including the MRSA, and may be responding primarily to a climate signal that has yet to be characterized. Moreover, a time lag was observed in the recovery of carbonate water levels and spring flows following the cessation of Order 1169 aquifer test which is consistent with basic hydrologic principles, but based on those same principles, is not a constant and depends on a great many things affecting conditions in the carbonate aquifer at the time, in addition to the location of the pumping and resource(s) in question (See Section 1.3.5).

What is the long-term annual quantity of groundwater that may be pumped from the LWRFS, including relationships between the location of pumping and capture of the Muddy River Springs and Muddy River?

An initial threshold of combined carbonate and alluvial pumping within the LWRFS of 9,318 afy appears to be the best initial estimate of the sustainable yield of the system, based on the optimum method currently available for arriving at an estimate of the maximum allowable rate of pumping in the LWRFS, i.e., the average annual rate of pumping from 2015-2017. See Section 1.4, Sustainable Levels of Pumping in the LWRFS for more discussion.

What are the effects of movement of water rights between alluvial wells and carbonate wells on deliveries of senior decreed rights to the Muddy River?

Since the Muddy River Springs (at least the refuge springs) are derived almost entirely from the carbonate aquifer, total carbonate pumping should not be increased (e.g., in exchange for reductions in alluvial pumping), even if total carbonate and alluvial pumping is maintained at a "sustainable" overall level. Additionally, existing carbonate pumping should not be moved closer to any springs (or the river), which could reduce the time lag in the development of impacts possibly before the impacts are detected based on periodic data collection and processing.

Since (in addition to the contributions of the springs) the remainder of water in the river comes from alluvium adjacent to the river in the MRSA and California Wash, alluvial pumping should not be increased (e.g., in exchange for reductions in carbonate pumping elsewhere), even if total alluvial and carbonate pumping is maintained at a "sustainable" overall level. Beyond that, existing alluvial pumping in the vicinity of the river should not be moved closer to the river, reducing the time lag in the development of impacts possibly before the impacts are detected based on periodic data collection and processing (Section 1.5).

Additional issues, considerations, and conclusions regarding the development of an effective conjunctive water management program for the LWRFS.

See Sections 1.1 through 1.6, Hydrologic Considerations Related to Conjunctive Management of the LWRFS, and Section 2, Status and Recovery of Moapa Dace. The results from our Section 1.6 on groundwater/spring relationships demonstrate that the system continues to behave as hypothesized, with the highest elevation springs being the most sensitive to changes in carbonate water levels. This implies that the triggers for flows measured at the Warm Springs West gage established in the 2006 Memorandum of Agreement between the Southern Nevada Water Authority, the USFWS, Coyote Springs Investment LLC, the Moapa Band of Paiute Indians, and the Moapa Valley Water District (2006 MOA, USFWS 2006a) are still valid and important for protecting the springs on the refuge. Protecting the most sensitive springs in the system should protect springflow, and habitat of the endangered Moapa dace as well. Recovery of Moapa dace is dependent on maintaining stream flows within the Moapa Valley National Wildlife Refuge and in the Muddy River Springs Area generally, and available information indicates that any reduction in current flow levels would result in reduced habitat for the species.

Table of Contents

Section 1 – Hydrologic Considerations Related to Conjunctive Management of the LWRFS

1.1 Groundwater-Surface Water Interactions in the LWRFS

1.1.1 *Sources of the Muddy River Springs and Muddy River*

The Muddy River Springs

It is well established that the source of the Muddy River Springs is the regional carbonate-rock aquifer (NSE 2014a-f, NSE 2002, and Eakin 1964 and 1966); specifically, that portion of the "central corridor" of the carbonate-rock province of southern and eastern Nevada identified by Dettinger et al. (1995) as effectively terminating in the area of the Muddy River Springs, including the whole of the roughly 240-mile long White River Groundwater Flow System which includes Kane Springs Valley (Eakin 1966), as well as possibly Lower Meadow Valley Wash (Page et al. 2006, NSE 2002, Dettinger et al., 1995, and Eakin 1964)[1], and additionally Hidden and Garnet valleys, California Wash, and the northwest part of the Black Mountains Area identified in the DOI (2013) analysis of the Order 1169 pumping test[2].

The Muddy River

It is also clear that the springs and intermittent runoff of local precipitation are not the only sources of water in the Muddy River (as proposed by Eakin 1964 and 1966). Synoptic discharge measurements made in February 2001 by Beck and Wilson 2006 on the Muddy River and a large number of Muddy River Spring tributaries show that the river was gaining from the confluence of its North and South Forks to below its confluence with the last spring tributary in the Muddy River Springs Area (MRSA), absent the contributions of the spring tributaries. Since the study was conducted during a period of "steady baseflow" on February 7, 2001 (presumably, no local precipitation or runoff and minimal irrigation return flows), this gain must have largely, if not entirely, occurred as natural seepage from alluvial aquifer adjacent to the river (in this case within the MRSA); which on the day of the study represented at least 17.6 cubic feet per second (cfs) or 42 percent of the 41.8 cfs measured in the river just below the last spring tributary[3]; the other roughly 24.2 cfs or 58 percent attributable to surface discharges from Muddy River Spring

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[1] Deuterium calibrated mixing-cell modeling by Thomas et al. 1996 suggests that Lower Meadow Valley Wash is a source of the Muddy River Springs (about 22 percent); although the authors were unclear regarding the extent to which their findings were influenced by deuterium samples collected in Lower Meadow Valley Wash where carbonate wells appear to be unavailable, or by samples collected from the Big Muddy Spring in the MRSA which may be uniquely influenced by Lower Meadow Valley Wash based on hydrogeologic considerations. The same can be said of the deuterium-calibrated mixing-cell modeling of Kirk and Campana 1990 which suggests broadly that Lower Meadow Valley Wash contributes underflow to the MRSA.

[2] In addition to the regional carbonate-rock aquifer, streams issuing from the Muddy River Springs are known to include at least some cold water inputs (e.g., along lower elevation portions of Pederson stream) which are attributable to gains from the local alluvial aquifer based on distributed water temperature measurements made in 2011 and 2012 for U.S. Fish and Wildlife Service (USFWS) by the University of Nevada-Reno and U.S. Geological Survey Biological Resources Division (USFWS 2012); the latter supporting an earlier observation by NSE 2002 that the alluvial aquifer may have some influence on the discharge of the Muddy River Springs.

[3] This temporary station located about one mile above the Moapa gage; the contributions of the alluvial aquifer to discharge at this location likely somewhat greater than 17.6 cfs or 42 percent given the documented occurrence of cold water seeps along low elevation portions of at least some spring tributaries in the MRSA (USFWS 2012).

tributaries.[4] The river was also gaining over about 11 of the next 15 river miles from the Moapa gage in the MRSA, through California Wash, to the vicinity of Anderson Wash above Bowman Reservoir in Lower Moapa Valley[5] through an area where a lack of permitted spring rights (NDWR 2018d) suggests no significant spring tributaries exist. The Muddy River Springs, seepage from alluvial aquifers adjacent to the river, and to a much lesser extent intermittent runoff of local precipitation, are the immediate sources of water in the Muddy River from its headwaters in the MRSA to the vicinity of Bowman Reservoir in Lower Moapa Valley. Maxey et al. 1966 proposed these same sources in the MRSA, although no supporting data were provided.

Sources of Water in Alluvial Aquifers Adjacent to the River – the MRSA

Within the MRSA, sources of water in the alluvial aquifer were originally thought to be limited to infiltration of Muddy River Spring flows, subsurface seepage from the springs, and to a lesser degree recharge of local precipitation[6] (Eakin 1964). Based on early mapping, Maxey et al. (1966) believed that Quaternary sediments in the MRSA (the alluvial aquifer) were bound from beneath and on most sides by low permeability Muddy Creek Formation, precluding significant upward movement of groundwater from the carbonate-rock aquifer into the overlying alluvium (consistent with known good water quality in the alluvial aquifer, better than in Muddy Creek Formation). Consequently, Maxey et al. (1966), in contrast to Eakin (1964), concluded that two washes in the northwest part of the basin (i.e., Arrow Canyon and a north-trending wash) were the primary sources of water in the alluvial aquifer of the MRSA, the bulk of inflows occurring during storm events. Some 30 years later (based on this limited review of the literature), Dettinger et al. (1995) was the first to acknowledge the potential for significant upward leakage from the regional carbonate-rock aquifer into local alluvial aquifers, generally. In 2014, the Nevada State Engineer (NSE 2014a-f) similarly concluded that "the alluvial aquifer surrounding the Muddy River ultimately derives virtually all of its water supply from the carbonates, either through spring discharge that infiltrates into the alluvium or through subsurface hydraulic connectivity between the carbonate rocks and the alluvium"; this presumably based on the occurrence of minimal precipitation recharge in the combined MRSA, Coyote Spring Valley, and California Wash area, any amount of which is significantly exceeded by local groundwater evapotranspiration (SNWA 2009a, Table I-7).

Since the release of the Eakin (1964) report, four (surficial) geologic maps have been constructed covering the MRSA: Longwell et al. 1965 (1:250,000), Stewart and Carlson 1978 (1:500,000), Page et al. 2005 (1:250,000), and Crafford 2007 (1:250,000). All show that alluvium is in lateral contact with outcrop of Permian to upper Mississippian Bird Spring Formation (typically

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[4] Note: The Cardy Lamb Springs were the only major spring group or spring tributary not included in Beck and Wilson's 2006 seepage study.

[5] Of the approximate 15 river miles between the Moapa gage in the MRSA and Anderson Wash in Lower Moapa Valley, the Muddy River was losing for 3 miles across the Moapa Indian Reservation and a one mile reach one to two miles below the Glendale gate during the February 2001 seepage run (Beck and Wilson 2006).

[6] Precipitation recharge in the MRSA is an estimated 41 afy (SNWA 2009a).

associated with the "upper" carbonate-rock aquifer) at the land surface about one mile west of the river[7]. However, given the depth to water in the basin's alluvial wells (10 to 25 feet minimum, NDWR 2018a), all located in "channel alluvium" near the center of the basin (Page et al. 2005) and roughly aligned with the Muddy River, the water table may be located in Muddy Creek Formation, rather than alluvium, at the contact with Bird Spring Formation carbonates[8].

What is clear is that groundwater level data collected over the last two decades (NDWR 2018a) show that water levels in alluvial and carbonate monitoring wells in the MRSA respond more or less in sync to significant increases / decreases in carbonate pumping in an area that includes, but is not limited to, the MRSA: i.e., the four-fold increase in pumping at the Arrow Canyon wells in the MRSA in May 1988; the start of pumping by Coyote Spring Investments (CSI) in Coyote Spring Valley in May 2005; and start and stop of pumping at MX-5 by the Southern Nevada Water Authority (SNWA) in southern Coyote Spring Valley for the Order 1169 pumping test in September 2010 and April 2013, respectively. Whereas groundwater level fluctuations due to local alluvial pumping dominate water levels in the alluvial wells, as expected, responses to the major changes in carbonate pumping listed above are also discernable in nearly all of the basin's alluvial wells based on simple inspection of water level hydrographs (e.g., Lewis 1 Old, Lewis 2, Lewis North, Lewis South, LDS West, Perkins Old, Behmer MW, and Abbott); although carbonate pumping signals are more clear where alluvial pumping signals are less pronounced in Lewis North, Perkins Old, Behmer Monitoring, and Abbott (Figure 2). Water levels in carbonate wells (i.e., EH-5b and EH-4[9],[10]) are also tens to more than 100 feet (ft) higher than in alluvial wells in the MRSA (NDWR 2018a). Given the existence of a clear hydraulic connection between the carbonate-rock and basin-fill aquifers in the MRSA (their roughly synchronized response to carbonate pumping), and higher hydraulic head in the underlying carbonate aquifer, leakage (whether at contacts between Bird Spring Formation carbonates and saturated alluvium, upward through the Muddy Creek Formation, or by way of fault damage zones) must occur from the carbonates into the alluvial aquifer in some volume within the basin.

Available geologic maps (Longwell et al. 1965, Tschanz and Pampeyan 1970, Stewart and Carlson 1978, Page et al. 2005, and Crafford 2007) show that in western MRSA, as well as elsewhere in the vicinity of the Order 1169 study area, Permian Bird Spring Formation carbonates are in contact with Mississippian to Cambrian carbonate rocks composing the

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[7] Page et al. 2005 depicts considerably more Muddy Creek Formation in eastern MRSA than the other three geologic maps (at the land surface), but still interprets that alluvium and Bird Spring Formation carbonates are juxtaposed from the area of Lewis South well or Cardy Lamb Springs south about 1.5 miles to Battleship Wash.

[8] The Muddy Creek Formation has been variously mapped in eastern MRSA (Longwell et al. 1965, Stewart and Carlson 1978, Page et al. 2005, and Crafford 2007). No consensus exists regarding its surficial expression, but a significant amount of Muddy Creek Formation has been mapped by all investigators in western MRSA.

[9] Both EH-5b and EH-5 appear to be completed in Bird Spring Formation carbonates based on their depths of completion (NDWR 2018a) and geologic cross-section D of Page et al. 2006.

[10] Water levels in carbonate monitoring wells EH-5b and EH-4, which vary only a fraction of a foot across the MRSA (~1,813 feet amsl), have been historically more than 10, and as much as about 110 feet higher, than water levels in alluvial monitoring wells from northwest to southeast across the basin (NDWR 2018a).

regional ("lower") carbonate-rock aquifer (cross-sections C – F, Page et al. 2006, 1:250,000). Moreover, there is limited to no evidence of confining units (common elsewhere in the carbonate-rock province of Nevada and western Utah) in the study area.

Specifically, in the study area west of the Meadow Valley Wash Fault and Muddy Mountain thrust, no outcrop of Mississippian Scotty Wash Quartzite or Cambrian Dunberberg or Pioche shale has been mapped (Page et al. 2005 and Crafford 2007). Only outcrop of strata that may contain Chainman Shale (Mississippian), Pilot Shale (Mississippian to Devonian), Eureka Quartzite (Ordovician), and undifferentiated Ely Spring Dolomite, Eureka Quartzite, and / or Pogonip Group (Ordovician) (Crafford 2007) have been identified, and then only in the Arrow Canyon Range and south part of the Meadow Valley Mountains in the area of Arrow Canyon in the MRSA. The geologic maps of Crafford (2007) and Page et al. (2005) are inconsistent with respect to mapping of Eureka Quartzite (or strata that may include it), but the presence of Eureka Quartzite, a potential confining unit, is possible in the vicinity of Arrow Canyon. Nonetheless, southeasterly groundwater flow is known to occur in the carbonates through Arrow Canyon from central Coyote Spring Valley into the MRSA based on trends in measured groundwater levels (NDWR 2018a)[11]. Given the depths of completion of the carbonate wells involved (NDWR 2018a) and information contained in geologic cross-section D of Page et al. 2006 (passing through the area of the wells), southeasterly flow appears to pass through any Eureka Quartzite that is present unimpeded[12]. Eureka Quartzite is either absent through Arrow Canyon (i.e., between the Arrow Canyon Range and Meadow Valley Mountains) or not sufficiently continuous in the regional carbonates to be an impediment to flow. If based only on geologic considerations, the lack of significant confining units in the MRSA, as well as the remainder of the Order 1169 study area, suggests that the Paleozoic carbonates, Permian through Cambrian, function as one aquifer. As such, a hydraulic connection between the alluvial aquifer of the MRSA (or other basins within the study area) and any of the Paleozoic carbonates is a hydraulic connection with the regional carbonate aquifer as a whole. In particular, the portion of the regional carbonate aquifer underlying the MRSA is in hydraulic connection with the basin's alluvial aquifer and a source of water in alluvium adjacent to the river, notwithstanding that the exact nature of the connection between the alluvial and carbonate aquifers is unknown.

Alluvial inflow from Lower Meadow Valley Wash (LMVW) also appears to be a source of water in the alluvial aquifer of the MRSA based on the continuity of alluvium between the two basins ("QTs" in Figure 3, interpreted from Crafford 2007) and trends in alluvial groundwater levels (Heilweil and Brooks 2011, SNWA 2012, and NDWR 2018a) which decrease in a southerly direction through LMVW and into the MRSA. Although limited as evidence goes, carbonate

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[11] Measured water levels decrease gradually in a southeasterly direction from carbonate monitoring wells MX-4, CVS-RW2, and CSVM-1 in southern Coyote Spring Valley, to UMVM-1, MX-6, EH-5b, and finally EH-4 in the MRSA (NDWR 2018a).

[12] Due to the truncation of south-trending folds and vertical offsets at one or more north-striking faults (seen in cross-section "D", Page et al. 2006), southeasterly flow from MX-4, CSV-RW2, and CSVM-1 in southern Coyote Spring Valley (likely completed in Devonian to Silurian carbonates) to UMVM-1 (likely completed in Cambrian carbonates), and then on to MX-6 (likely completed in Devonian to Silurian carbonates), of necessity involves flow through the Ordovician Pogonip Group mapped in outcrop (Crafford 2007, Page et al. 2005), including any Eureka Quartzite.

pumping signals, identifiable in all other alluvial wells in the MRSA, appear to be "swamped out" in LDS Central and LDS East by alluvial inflows from LMVW (based on simple inspection of the hydrographs); the two wells located immediately downgradient of the alluvial channel connecting LMVW and the MRSA, most clearly depicted in Crafford (2007) and Stewart and Carlson (1978). Less clear is the continuity of (saturated) alluvium between the MRSA and Coyote Spring Valley where shallow groundwater flow may be impeded at the mouth of Arrow Canyon by outcrop of Muddy Creek Formation (shown in all available geologic maps).

Notwithstanding the above, the extent to which groundwater in the alluvial aquifer of the MRSA is derived from the alluvial aquifers of LMVW and possibly Coyote Spring Valley versus the underlying regional carbonate-rock aquifer cannot be determined using available groundwater level data, or water budget estimates prepared at the scale of whole basins wherein no distinction is made between carbonate, alluvial, and surface flows.

Sources of Water in Alluvial Aquifers Adjacent to the River – California Wash

No or minimal precipitation recharge is believed to occur in California Wash, any amount of which is significantly exceeded by local groundwater evapotranspiration (SNWA 2009a, Table I-7). As such, the source of water in alluvium adjacent to the river in California Wash, including that documented seeping into the river during the February 2001 seepage study (a net gain of 2.0 cfs or 1,448 acre-feet per year, Beck and Wilson 2006), can only be alluvial inflows from adjacent basins, local leakage from the carbonate-rock aquifer, or both.

California Wash is bordered by four basins: Coyote Spring Valley, Garnet Valley, the MRSA, and LMVW. Alluvial inflow from Coyote Spring Valley is precluded by carbonate outcrop (Page et al. 2005 and Crafford 2007). Available water level measurements (SNWA 2012, and Heilweil and Brooks 2011) are insufficient to determine if alluvial inflow occurs from eastern Garnet Valley (the area of a dry playa) into California Wash. However, the continuity of mapped "alluvium" (Page et al. 2005 and Crafford 2007) and trends in alluvial groundwater levels (Heilweil and Brooks 2011, SNWA 2012, and NDWR 2018a) suggest that alluvial inflow does occur from both LMVW and the MRSA into California Wash, proximal to the river. In fact, two-thirds of total gains documented to the river in California Wash during the February 2001 seepage run (Beck and Wilson 2006), 3.10 of 4.70 cfs, occurred in a reach of the Muddy River intersected by the axis of LMVW.

The regional carbonate-rock aquifer is also a local source of water to the alluvial aquifer of California Wash. Indirect evidence of this leakage is available today in the form of basin-fill groundwater level measurements that decrease roughly 200 feet (ft) from south to north through the basin toward the river (SNWA 2012 and USGS 2019b), indicative of south to north groundwater flow through the fill. Since no net precipitation recharge is believed to occur in the basin (SNWA 2009a, Table I-7), including its southern part where basin fill water levels are at a maximum, the regional carbonate-rock aquifer must be the source of this south to north alluvial flow. While all available geologic maps (Longwell et al. 1965, Stewart and Carlson 1978, Page et al. 2005, and Crafford 2007) show that basin fill is in lateral contact with outcrop of Bird

Spring Formation carbonates at the land surface over most of western California Wash, the depth to water in the fill at the south end of the basin is about 800 ft (218 S18 E65 18CC 1 USBLM; SNWA 2012 and USGS 2019b); about 300 ft in the central part of the basin (218 S16 E65 31AA 1 and 218 S16 E65 32AB 1, SNWA 2012; and 218 S16 E65 33ACAA1 USBLM, USGS 2019b); and 10 ft or less in alluvium adjacent to the river in the northernmost part of the basin (218 S14 E65 36BADA1, 218 S15 E66 06 1, 218 S15 E66 09BADB1, and 218 S15 E66 04AA 1, USGS 2019b; and 218 S15 E66 02CA 1 MV-4, SNWA 2012). Any leakage that occurs from the regional carbonate-rock aquifer into basin fill, on the west side of California Wash or elsewhere in the basin, must occur at significant depths[13,14].

The regional carbonate-rock aquifer extends from south to north beneath the basin fill all the way to the Muddy River, and as far east as the Muddy Mountain thrust (cross-sections E – G, Page et al. 2006)[15]; the depth of burial of the carbonates generally increasing from south to north and at a maximum on the east side and north end of the basin, 2,000 ft or more (cross-sections E, F, G, and H, Page et al. 2006). Despite these depths of burial, this portion of the regional carbonate aquifer, like other parts of this fractured rock aquifer, is transected by a not insignificant number of normal, reverse, and strike-slip faults (Page et al. 2005, Page et al. 2006), which may provide conduit(s) for the movement of groundwater from the underlying carbonate aquifer into the alluvium and other basin fill in California Wash. Although limited, there is direct evidence of leakage from the regional carbonate-rock aquifer into overlying basin fill in the southernmost part of the basin where the depth of burial of the carbonates is at a minimum (cross-section G, Page et al. 2006). Water levels in two wells, both reportedly 860 ft deep, one completed in carbonates (218 S18 E64 25AACC1) and one in basin fill about one mile north (218 S18 E65 18CC 1 BLM), were identical at one time (i.e., 1,772 ft amsl, 1949, USGS 2019b); the two wells in apparent equilibrium, indicative of a direct hydraulic connection between the regional carbonate-rock aquifer and basin fill in southern California Wash.

Additionally, although lateral hydraulic gradients are anomalously flat in the carbonate-rock aquifer through Garnet and Hidden valleys and California Wash, and even flatter from the area of MX-5 in southern Coyote Spring Valley through the MRSA based on recent, as well as historical, groundwater level measurements[16], water levels in the regional carbonate-rock aquifer

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[13] Note: No or little outcrop of Permian redbeds, a potential confining unit between the alluvium and carbonates, has been mapped in the vicinity of the Order 1169 study area west of the Meadow Valley Wash fault and Glendale and Muddy Mountain thrusts on the east side of California Wash (Page et al. 2005).

[14] Whereas the depth to the water table is minimal in northernmost California Wash, the depth of the contact between fill and the carbonates is great in this area (Page et al. 2006, cross-section D).

[15] In California Wash, no Mississippian Chainman Shale, Scotty Wash Quartzite, or other siliciclastic rocks, which may act as a local confining unit between Permian to Mississippian carbonate rocks and Mississippian to Cambrian carbonate rocks, are present based on detailed geologic mapping by Page et al. (2005) and Crafford (2007) at locations where (less detailed) geologic cross-sections by Page et al. 2006 (D and E) indicate Mississippian siliciclastic rock outcrop should occur if present.

[16] This first observed over 20 years ago by Thomas et al. 1996 and Dettinger et al. 1995 based on groundwater level measurements collected largely in the 1960's to 1980's (as well as some older measurements). More contemporary measurements suggest a possible shift in equipotentials defining the potentiometric surface of the carbonate aquifer northward

are as much as 150 ft higher than in overlying basin fill in central California Wash and about 240 ft higher than in the alluvium close to the river (SNWA 2012, NDWR 2018a, and USGS 2019b). Given these significant differences in head, the potential exists for upward leakage from the regional carbonate-rock aquifer into overlying basin fill and / or alluvium in northern and central California Wash, if only by way of fault damage zones (in addition to direct leakage from the carbonates in the southern part of the basin).

Whereas the majority of gains documented to the Muddy River in California Wash during the February 2001 seepage study occurred in a reach intersected by the axis of LMVW (from which alluvial inflows from LMVW can safely be inferred), this same reach is also traversed by two south-southwest trending faults: a regional-scale strike-slip fault and at least one fault associated with the Glendale thrust (Page et al. 2006, cross-section D), either or both of which may provide conduit(s) for groundwater flow from the underlying carbonate-rock aquifer into the alluvium.

Notwithstanding the above, as in the MRSA, the extent to which groundwater in the alluvial aquifer of California Wash is derived from the alluvial aquifers of LMVW and the MRSA versus the underlying regional carbonate-rock aquifer cannot be determined using currently available groundwater level data, or water budget estimates prepared at the scale of whole basins wherein no distinction is made between carbonate, alluvial, and surface flows.

Summary – Sources of the Muddy River Springs and Muddy River

The source of the Muddy River Springs is the regional carbonate-rock aquifer, which in this area includes some Permian to upper Mississippian carbonate rocks of the Bird Spring Formation. Immediate sources of water in the Muddy River, from its headwaters in the MRSA through California Wash to uppermost Lower Moapa Valley, are the Muddy River Springs (surface discharges), seepage from alluvial aquifers adjacent to the river (in the MRSA, California Wash, and likely uppermost Lower Moapa Valley), and to a much lesser extent intermittent runoff of local precipitation. Sources of water in alluvium adjacent to the river, in turn, are: infiltration of surface discharges of the Muddy River Springs and subsurface seepage from the springs (within the MRSA); the regional carbonate-rock aquifer, specifically those portions underlying the MRSA and California Wash; and alluvial inflows from basins bordering the MRSA and California Wash (LMVW and perhaps Coyote Spring Valley). Recent estimates of precipitation recharge and groundwater evapotranspiration (SNWA 2009a, Table I-7) suggest that net recharge of precipitation to alluvium adjacent to the river in the MRSA, California Wash, or Lower Moapa Valley is unlikely. Consequently, the sources of water in the river, from the MRSA to uppermost Lower Moapa Valley, are the Muddy River Springs (derived nearly entirely from the regional carbonate-rock aquifer), leakage from the regional carbonate-rock aquifer into alluvium of the MRSA and California Wash, alluvial inflows from basins bordering the MRSA and California Wash (LMVW and maybe Coyote Spring Valley), and to a much lesser degree runoff of local precipitation.

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within Garnet, Hidden, and Coyote Spring valleys (based on an inspection of carbonate water levels compiled by NDWR 2018a and SNWA 2012 by this author).

1.1.2 *Basins Known to Act as One Basin as of Today*

DOI 2013 interpreted changes in groundwater levels and pumping rates documented during and prior to the two-year Order 1169 pumping test (NSE 2002 and NSE 2014a-f) using SeriesSEE (Halford et al. 2012) with the goal of characterizing the extent of drawdown created by test pumping in carbonate well MX-5 in southern Coyote Spring Valley within the regional carbonate-rock aquifer, as well as other geologic / hydrogeologic units, in the overall Order 1169 study area; a basic question that yielded surprising results.

SeriesSEE Analysis

SeriesSEE is a U.S. Geological Survey Microsoft® Excel add-in (Halford et al. 2012) curve-fitting tool that "models" changes in the level of water in a well by jointly optimizing analytical approximations of the effects of various stresses judged to be contributing to changes in water level. The authors have described the purpose of SeriesSEE curve-fitting a number of ways (Halford et al. 2012 and Garcia et al. 2013), including "analytically simulating all pumping and non-pumping water-level stresses simultaneously with the aim of differentiating pumping signals from changes in groundwater levels due to "environmental" stresses (e.g., long-term trends in area groundwater levels, barometric pressure fluctuations, tides, earth tides, groundwater recharge, or changes in the stage of connected surface-water bodies). More generally, SeriesSEE curve-fitting can be used to differentiate (isolate) the effects of individual pumping and / or non-pumping (environmental) stresses on the level of water in a well. In DOI (2013), SeriesSEE curve fitting was used to differentiate the effects of ongoing water supply pumping from that induced by the MX-5 test pumping during the Order 1169 pumping test in monitoring wells located across the study area.

Put another way, curve-fitting using SeriesSEE begins with the premise that changes in water level in a well are generally due to a combination of stresses, pumping and / or non-pumping, each of which can be approximated by an analytical expression that is a function of independent input (e.g., the rate of pumping in a nearby well or measurements of barometric pressure) and coefficients that are "fitted" to the expression during an optimization process. In the case of pumping, the analytical expression takes the form of a "Theis transform" (the Theis solution used as a transfer function), which is then used to transform recorded rates of pumping (approximated stepwise for efficiency) into "simulated" drawdown; the Theis solution (Theis 1935) serving only to approximate the nature of the relationship between pumping and the creation of drawdown during the curve fitting process. The parameters of "Theis transforms", as applied in SeriesSEE analysis, are neither intended to represent or serve as estimates of aquifer parameters, but merely as empirical fitting coefficients with the aim of isolating changes in groundwater level due to pumping. Firstly, because the underlying assumptions of the Theis solution are rarely (if ever) met (Garcia et al. 2013); but more important because the coefficients are not intended to be "predictive", but rather facilitate *a posteriori* identification of pumping effects during curve fitting.

Having assembled a collection of analytical expressions (a "water level model") judged to adequately approximate the effects of potential pumping and non-pumping (environmental) stresses on the level of water in a well, the coefficients of the analytical expressions are jointly optimized using singular value decomposition and Tikhonov regularization to minimize a sum-of-squared residuals objective function, where the residuals are calculated as the difference between observed changes in water level and those approximated (simulated) using the SeriesSEE water level model (Halford et al. 2012). Once the "water level model" as a whole has been optimized (the residuals judged to be sufficiently minimized), its component analytical expressions are likewise presumed to be reasonably optimized inasmuch as taken together they reproduce measured water levels with minimal residuals.

That SeriesSEE serves well in this capacity, despite the use of transfer functions in the form of the Theis solution, even in highly heterogeneous (and anisotropic) aquifers, is supported by examples provided by Garcia et al. (2013), as well as the results of the DOI (2013) application of SeriesSEE to the interpretation of the Order 1169 pumping test in which measured changes in water levels in a large number of monitoring wells known to be completed in the regional carbonate-rock aquifer were successfully reproduced across the study area. One of many possible examples is presented in Figure 4, which shows good agreement between measured water level changes in carbonate monitoring well EH-4 in the MRSA prior to and during the pumping test and those approximated using SeriesSEE (the latter exceeding the goodness of numerical model simulations to date).

Test Data Analyzed

Prior to and during the two-year Order 1169 test, pumping occurred in 31 major wells within the study area (a minor correction from DOI 2013): carbonate test well MX-5 in southern Coyote Spring Valley, introduced specifically for the test; and 30 additional wells (carbonate and alluvial) for ongoing water supply, primarily in Coyote Spring Valley, the MRSA, Garnet Valley, and Black Mountains Area. SeriesSEE curve-fitting was employed to differentiate (isolate) drawdown created by the 31 pumped wells aggregated into 13 "pumping centers" (based on the proximity of many of the water supply wells to each other[17]).

SeriesSEE curve-fitting was performed to water level records for 14 monitoring wells across the Order 1169 study area:

- (8) wells judged *a prori* to be completed in the regional carbonate-rock aquifer based on geologic mapping (Page et al. 2005, Page et al. 2006, and Crafford 2007) and groundwater level trends during and prior to the test (NDWR 2018a): CSVM-4, CSVM-6, and CSVM-2 in Coyote Spring Valley (as well as CE-VF-2 in Coyote Spring Valley,

[17] For the purposes of the curve-fitting analysis, the effects of pumping at 31 production wells were "simulated" at the following wells and "pumping centers": "CSI-12" (CSI-1 and CSI-2), CSI-3, CSI-4, and MX-5 in Coyote Spring Valley; MX-6, "ArrowCanyon1+2" (Arrow Canyon wells 1 and 2), "Lewis+LdsW" (the Lewis wells and LDS West), "LdsCE" (LDS Central and LDS East), and "Beh+Perk" (Behmer and Perkins Production wells) in the MRSA; and "GV_M1+PW" (GV-Migrant1 and GV-PW-WS-1), GV-RW-1, "Apex" (Republic Wells 1, 2, 5, and 6, Chem Lime Old and New, and GV_Duke-WS-1 and GV_Duke-WS-2), and "NV_Cogen" (NV Cogen EGV-3 and NV Cogen EBP-2) in Garnet Valley.

later discarded since breached in November 2011 during the test); GV-1 and M-2 in Garnet Valley; M-1 in California Wash; and EH-4 and CSV-2 in the MRSA;

- (2) wells judged *a priori* to be completed in carbonate rocks isolated from the regional carbonate-rock aquifer based on geologic mapping and groundwater level trends during and prior to the test: Byron-1 in eastern California Wash and EH-7 in Lower Moapa Valley;
- (2) wells judged *a priori* to be completed in carbonate rocks isolated from the regional carbonate-rock aquifer based only on groundwater level trends during and prior to the test (NDWR 2018a): CSVM-3 and CSVM-5 in Coyote Spring Valley;
- (1) well completed in siliciclastic rocks outside the mapped extent of the regional carbonate-rock aquifer (Page et al. 2005, and Crafford 2007): BM-ONCO-1 in the Black Mountains Area; and
- (1) well completed in basin fill: MW-1A in LMVW about 18 miles north of the Muddy River.

Because changes in groundwater levels during the test (September 2010 to December 2012, the official end of the test) were in part due to pumping that preceded the test, the curve fitting was performed from January 2008 to December 2012, beginning 21 months prior to the test.

Given that the purpose of the curve-fitting was to isolate (approximate) drawdown induced by the MX-5 test pumping apart from the effects of ongoing water supply pumping, the relatively minor effects of earth tides, changes in barometric pressure, and long-term trends in area groundwater levels were not accounted for during the analysis. Additionally, no-flow boundaries cannot be “simulated” (accounted for) during SeriesSEE curve fitting; SeriesSEE not a distributed groundwater flow model. Consequently, although a number of no-flow boundaries are known or likely to exist in the vicinity of the portion of the regional carbonate-rock aquifer stressed during the test[18], they were not accounted for during the estimation of MX-5 induced drawdowns. Despite this, or particularly because of this, MX-5 induced drawdowns were, if anything, underestimated by the 2013 analysis (due to the compounding effects of no-flow boundaries on pumping-induced drawdowns). Had it been possible to account for the effects of no-flow boundaries during the 2013 analysis, estimates of MX-5 induced drawdowns would likely have been no less (roughly) uniform than presented in DOI 2013; carbonate monitoring well EH-4 was the only location at which MX-5 induced drawdown may have been underestimated (originally an estimated 1.2 ft[19]).

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[18] No-flow boundaries identified and discussed in detail in Section 1.3.1.

[19] Carbonate monitoring well EH-4 may be located just upgradient of one or more unmapped west-dipping normal faults of the East Arrow Canyon Range fault zone (Page et al. 2006); fault gouge in the footwall of the fault(s) forcing groundwater flowing southeast through the regional carbonate-rock aquifer to the surface in the form of springs, while damaged zones (zone of enhanced fracturing) on the hanging wall sides of the faults act as conduits for spring discharge. These same gouge zones may have compounded MX-5 induced drawdown in EH-4 during the Order 1169 pumping test beyond that isolated using SeriesSEE.

Findings and Limitations

The DOI 2013 SeriesSEE estimates of MX-5 induced drawdown as of December 2012, the official end of the test, are shown in Figure 5 (as reported in 2013 with the exception of CE-VF-2).

Several of the analyzed water level records (i.e., locations) were chosen because the wells were anticipated, based on geologic considerations and trends in measured groundwater levels, to be completed in carbonates or other geologic / hydrogeologic units located outside the area in which groundwater levels are responsive to carbonate pumping in southern Coyote Spring Valley; confirmed by the results of these analyses. Specifically, no MX-5 induced drawdown could be isolated in the water level records for carbonate wells EH-7 or Byron-1, or clastic well BM-ONCO-1; suggesting that locations east of faults and offsets associated with the Glendale and Muddy Mountain thrusts in Lower Moapa Valley and California Wash, and east of the Muddy Mountain thrust and south of the northern strand of the Las Vegas Shear Zone in the Black Mountains Area, are outside the area responsive to carbonate pumping in Coyote Spring Valley[20]. Likewise, no MX-5 induced drawdown could be isolated in the water level record for carbonate well CSVM-5 in Coyote Spring Valley, located just upgradient of an overturned anticline, one of a series, on the east side of the northern part of the Las Vegas Range (Page et al. 2005), which appears to act as a local barrier to flow and the propagation of drawdown in southern Coyote Spring Valley[21]. SeriesSEE estimates of MX-5 induced drawdown in carbonate monitoring wells CSVM-3 and CSVM-4 in northern Coyote Spring Valley are discussed in Section 1.1.3.

To the west, north, and east of the above no-flow boundaries, the test pumping clearly resulted in the development of a drawdown cone in the regional carbonate-rock aquifer (as shown in distance drawdown hydrographs presented in DOI 2013, Figures 1.11 and 1.12). Nevertheless, a remarkably uniform 1.5 to 1.6 ft of drawdown was induced by the MX-5 pumping during the Order 1169 test across multiple basins in the regional carbonate aquifer, irrespective of distance from MX-5: in CSVM-6, three miles north in Coyote Spring Valley; CSVM-2, nine miles south in Coyote Spring Valley; GV-1, twenty-seven miles south in Garnet Valley; M-1, fifteen miles southeast in California Wash; and CSV-2, nine miles east in the MRSA. This can only occur if the field-scale transmissivity of the regional carbonate aquifer is exceptionally high in an area that at a minimum includes the above wells[22, 23]. Moreover, there is no evidence that wells

[20] This result also consistent with the known areal extent of the regional carbonates (Page et al. 2005, Page et al. 2006, and Crafford 2007). Note, the northern strand of the Las Vegas Shear Zone and Muddy Mountain thrust also delineate the extent of the regional carbonates in the Black Mountains Area; limited to the northwest part of the basin.

[21] CSVM-5 is also located at the mouth of a drainage that may be contributing to steadily rising water levels observed in the well since 2003.

[22] This conclusion consistent with anomalously flat hydraulic gradients long observed in this portion of the aquifer Thomas et al. (1996) and Dettinger et al. (1995) and the lack of mapped confining units noted earlier.

[23] Although exceptionally high based on the response to the MX-5 test pumping, the field-scale transmissivity of this portion of the regional carbonate-rock aquifer cannot, and consequently was not, estimated as part of this SeriesSEE analysis. To date, estimates of the transmissivity of this portion of the carbonate-rock aquifer are limited to model-calibrated values (SNWA 2009b,

CSVM-6, CSVM-2, GV-1, M-1, and / or CSV-2 are located in or connected by a few high permeability structures within the carbonates (Page et al. 2005 and Crafford 2007). This pattern of near uniform drawdown in response to the test pumping, and the high transmissivity inferred by it, must be the result of permeable secondary structures that are pervasive throughout this portion of the carbonate aquifer.

This is not to say that local low transmissivity zones and structures are not present within the regional carbonate aquifer. The estimation of relatively low transmissivities based on the interpretation of small-scale pumping tests at carbonate well CE-VF-2 in Coyote Spring Valley (3,100 ft^2/d, USGS 2019a), carbonate well CSV-2 in the MRSA (1,000 ft^2/d, USGS 2019a), and reportedly carbonate production well CSI-3 (also Coyote Spring Valley), are good examples. Lesser amounts of MX-5 induced drawdown in carbonate monitoring well M-2 (western California Wash), 1.1 ft (Figure 5), is likely another example of the effects of local low transmissivity zones within the regional carbonate aquifer, in this case at the scale of the screened or gravel-packed interval of the well. Despite the inevitable presence of localized low permeability zones and structures within this fracture-rock aquifer, the response to the MX-5 test pumping could not have occurred if not for exceptionally high field-scale transmissivity in the portion of the aquifer which includes CSVM-6, CSVM-2, GV-1, M-1, and CSV-2.

What is more, considering that the drawdown cone created by the MX-5 test pumping was as "flat" as it was, but nonetheless a drawdown "cone", drawdown created by the test pumping must have extended some distance east of M-1 and CSV-2, south of GV-1, and west of CSVM-6, CSVM-2, and GV-1 in the regional carbonate-rock aquifer; at least to nearby no-flow boundaries (given that drawdown generally decreases logarithmically with distance). Those no-flow boundaries include[24]:

- the Muddy Mountain thrust on the east side of California Wash;
- Muddy Mountain thrust on the east side of northernmost Black Mountains Area;
- northern strand of the Las Vegas Shear Zone within northeastern Las Vegas Valley and northern Black Mountains Area;
- Gass Peak thrust from the northern strand of the Las Vegas Shear Zone through northeast Las Vegas Valley, along the western boundary of Garnet and Hidden valleys, and along the southernmost portion of the western boundary of Coyote Spring Valley;
- a series of anticlines on the east side of the northern part of the Las Vegas Range in southern Coyote Spring Valley, particularly where overturned (vicinity of CSVM-5); and

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Tetra Tech 2012, and Brooks et al. 2014) which vary considerably from model to model, but are anomalously high based on the calibration of all models to present (e.g., up to 1,000,000 ft^2/day per SNWA 2009b).

[24] Known and likely no-flow boundaries identified based on geologic considerations; confirmed by differences in groundwater levels where available (see Section 1.3.1).

- Gass Peak thrust through the northern half of Coyote Spring Valley (beyond the series of anticlines in the northern part of the Las Vegas Range) to the Pahranagat Shear Zone or, if not, the groundwater divide along the crest of the Sheep Range.

Based on the 2013 interpretation of the Order 1169 pumping test, the following "five-plus" basins (or parts of basins) are known to be underlain by a portion of the regional carbonate-rock aquifer possessing exceptionally high field-scale transmissivity (DOI 2013 and NSE 2014a-f):

- the MRSA;
- most of Coyote Spring Valley;
- Hidden Valley;
- Garnet Valley;
- most of California Wash; and
- northwest Black Mountains Area.

The latter encompasses an area of about 1,050 square miles, as much as 24 miles from west to east and 60 miles from north to south; most of which is underlain by the full or nearly full sequence of Paleozoic carbonates (Page et al. 2006, cross-sections B through G).

In conclusion, inasmuch as the alluvial aquifers of the MRSA and California Wash have been demonstrated to be in hydraulic connection with this portion of the carbonate-rock aquifer (Section 1.1.1), and a similar connection likely exists in Coyote Spring Valley and possibly in Garnet Valley[25], and the basin-fill aquifers in some of the above basins are themselves connected: the alluvial aquifers of the "five-plus" basins listed above, as well as the underlying carbonate-rock aquifer, function for all practical purposes as one groundwater basin that is connected to and the source of the Muddy River Springs and Muddy River. The alluvial and carbonate aquifers of this collection of basins are currently known as the Lower White River Flow System (LWRFS).

1.1.3 *Kane Springs Valley and Lower Meadow Valley Wash as Likely Parts of the LWRFS*

Kane Springs Valley and LMVW are not currently recognized as part of the Lower White River Flow System (LWRFS) based on the results or lack thereof of the Order 1169 pumping test. Kane Springs Valley was excluded from the pumping study in 2007 (NSE 2007) prior to the 2010 to 2012 test. Groundwater level monitoring was conducted in LMVW as part of the test, but limited to basin-fill wells MW-1a, b, and c. No carbonate wells were monitored in either basin as part of the Order 1169 test.

[25] Based on the roughly synchronized response of water levels in basin-fill monitoring well CE-VF-1 and carbonate monitoring well CE-VF-2 to significant increases / decreases in carbonate pumping (prior to November 2011 when CE-VF-2 was breached, NDWR 2018a), a hydraulic connection likely exists between the alluvial aquifer of Coyote Spring Valley and the underlying carbonate aquifer. Basin-fill groundwater level data (NDWR 2018a and SNWA 2012) are insufficient to determine if a similar hydraulic connection exists in Garnet Valley.

Kane Springs Valley

Kane Springs Valley was excluded from the Order 1169 pumping test following a February 2007 finding that a low permeability structure or change in lithology likely exists between Kane Springs Valley and central Coyote Spring Valley[26] which should allow for limited pumping in Kane Springs Valley without "any measurable impact on the Muddy River Springs" (NSE 2007). The 2007 finding was based on an interpretation of groundwater levels at two generalized locations within the carbonate aquifer between which water levels drop about 50 to 75 ft. However, upon reexamination of carbonate water level measurements available as of the time of the finding (late 2006), the data suggest a different set of conclusions or at least a high degree of uncertainty.

The 2007 Finding

The 2007 finding (NSE 2007) was based on an interpretation of groundwater levels at two generalized locations within the carbonate aquifer: "near" the boundary between Kane Springs Valley and Coyote Spring Valley (water level approximately 1,875 ft in elevation) and an unspecified location (or locations) further south in Coyote Spring Valley and / or other basins of the Order 1169 study area (water levels about 1,800 to 1,825 ft in elevation).

As of late 2006, carbonate water level measurements were available in two monitoring wells "near" the boundary between Kane Springs Valley and Coyote Spring Valley: KMW-1 in southern Kane Springs Valley located about 1,000 ft from the boundary with Coyote Spring Valley, water level 1,880 to 1,881 ft above mean sea level (amsl)[27]; and CSVM-4 in northern Coyote Spring Valley, water level 1,875 ft amsl (NDWR 2018a). During this same period, carbonate water levels in the range of 1,800 to 1,825 ft amsl were first encountered in central Coyote Spring Valley (the most northerly location with carbonate water levels in this range); specifically, the area of CSVM-6 (1,819 ft amsl), MX-4 (1,821.5 ft amsl), MX-5 (1,822 ft amsl), and CSVM-1 (1,821.5 ft amsl) (NDWR 2018a).

Separated by a distance of roughly two miles, the hydraulic gradient between KMW-1 in southern Kane Springs Valley and CSVM-4 in northern Coyote Spring Valley was about 2.75 ft/mile, while the gradient between CSVM-4 and CSVM-6 in Coyote Spring Valley (distance approximately 11 miles) was about 5.1 ft/mile; both gradients considerably steeper than at more southerly locations in the Order 1169 study area where the transmissivity of the carbonate aquifer has been determined to be exceptionally high (Section 1.1.2). Steeper gradients in the area of CSVM-4 to CSVM-6, and KMW-1 to CSVM-4, could be due to significant changes in lithology within the carbonate sequence (e.g., confining units) or discrete low permeability structures (fault gouge) as suggested in 2007; or alternatively, simply a relative scarcity of the

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[26] Described in NSE 2007 as southern Coyote Spring Valley, but presumably in reference to the vicinity of CSVM-6, MX-5 and CSVM-1 in central Coyote Spring Valley where carbonate water levels drop to 1,819 to about 1,821.5 in elevation (late 2006), or more recently (2017) 1,817.4 to about 1,819.7 ft in elevation (NDWR 2018a).

[27] Estimated from monitoring data collected beginning in early 2007 (NDWR 2018c).

types and numbers of permeable secondary structures giving rise to exceptionally high transmissivity in the carbonate aquifer to the south and east.

Eureka Quartzite, Pilot Shale, strata that may contain Chainman Shale, and undifferentiated Ely Spring Dolomite, Eureka Quartzite, and / or Pogonip Group have been mapped in carbonate outcrop in the Arrow Canyon Range and Meadow Valley Mountains (Crafford 2007). Likewise, two faults are mapped between KMW-1 and central Coyote Spring Valley (the area of CSVM-6, MX-4, MX-5, and CSVM-1): the Kane Springs Wash Fault near the boundary of Kane Springs and Coyote Spring valleys, and a north-northwest striking normal fault located just east of CSVM-6, MX-4, MX-5, and CSVM-1 (Figure 6). Nonetheless, prior to the 2007 finding, water level trends in CSVM-4 mirrored those in the central Coyote Spring Valley wells, and trends in KMW-1 mirrored those in CSVM-4; the similarity of carbonate water level responses continuing post-2007 through the Order 1169 pumping test (Figures 7, 8a and 8b). Based on the continuity of water level responses across this portion of the carbonate aquifer, any changes in lithology or discrete low permeability structures present in the carbonate aquifer between KMW-1 and central Coyote Spring Valley are not sufficiently impermeable to preclude or significantly minimize the impacts of carbonate pumping in KPW-1 (or KMW-1) on carbonate water levels in Coyote Spring Valley (or the other basins currently recognized as the LWRFS), consequently the Muddy River Springs or Muddy River.

Moreover, to the extent that the completion of KMW-1 (the only carbonate well in Kane Springs Valley) relative to the Kane Spring Wash Fault is unclear, broad conclusions should not be drawn concerning the effects of pumping in Kane Springs Valley based on water level responses, or the response to pumping, in KMW-1 alone. Well KMW-1 is located about 150 to 200 ft northwest of the mapped location of the Kane Springs Wash Fault (Page et al. 2005), but is completed from 955 to 2,013 ft bgs (NDWR 2018b) in an area where the dip of the fault is unknown[28].

Beyond the 2007 Finding

What is known with certainty is that the carbonate aquifer (the full or nearly full sequence of Paleozoic carbonates) extends north to south through Coyote Spring Valley from the Pahranagat Shear Zone to Hidden Valley (and beyond), and west to east from the Gass Peak thrust (if not the crest of the Sheep Range) into LMVW, the MRSA, and California Wash (SNWA 2009b, hydrogeologic framework model; and cross-section B, C, D, and F, Page et al. 2006); and that large amounts of groundwater flow into the north end of Coyote Spring Valley through the carbonates at the Pahranagat Shear Zone (Eakin 1964, Dettinger et al. 1995, and SNWA 2009a), the majority likely between the Gass Peak thrust and a north-striking normal fault that passes through the areas of CE-VF-2 and CSVM-3[29] (Figure 6). Additionally, much of the groundwater

[28] Well KMW-1 located intermediate between cross-sections B and C, Page et al. 2006.

[29] The full sequence of Paleozoic carbonate units preserved over this section of northernmost Coyote Spring Valley, but not east of the north-striking normal fault passing near CE-VF-2 and CSVM-3 and not west of the Gass Peak thrust (cross-section B, Page et al. 2006).

flowing into northern Coyote Springs Valley at the Pahranagat Shear Zone is known to discharge at the Muddy River Springs (Eakin 1964 and Dettinger et al. 1995). Consequently, large volumes of groundwater must flow through the carbonate aquifer across the Kane Springs Wash Fault from northern into central Coyote Spring Valley (before flowing into the MRSA). The Kane Springs Wash Fault must be permeable over much of central Coyote Spring Valley.

What is also known with reasonable certainty is that the full or nearly full sequence of Paleozoic carbonates is continuous on the southeast / east side of the Kane Springs Wash Fault from south of the caldera complex in Kane Springs and northern Coyote Spring valleys (an area corresponding to about forty percent of the way up Kane Springs Valley) into central Coyote Spring Valley (SNWA 2009b, hydrogeologic framework model; and cross-sections B, C, and D, Page et al. 2006). It follows, if based only on geologic continuity, that pumping in the carbonate aquifer on the southeast side of the Kane Springs Wash Fault in Kane Springs Valley can be expected to impact water levels in the carbonate aquifer on the east side of the fault in central Coyote Spring Valley (e.g., the area of production wells CSI-3, CSI-2, CSI-1, RW-2, and MX-5), and other basins currently recognized as the LWRFS, consequently the Muddy River Springs and Muddy River. The similarity of water level trends in CSVM-6 and CSVM-4 is evidence of the hydraulic continuity of the carbonate aquifer from central to northern Coyote Spring Valley on the east side of the Kane Springs Wash Fault (Figure 7) [30]. Confirmation of the hydraulic continuity of the carbonates on the southeast side of the fault in Kane Springs Valley will depend on the installation of additional monitoring wells.

What is not known are the potential impacts of pumping within a “wedge” of the carbonate aquifer located northwest of the Kane Springs Wash Fault and east of the north-striking normal fault that passes through the areas of CE-VF-2 and CSVM-3 (and south of the caldera complex); some of which is located in Kane Springs Valley and some in northernmost Coyote Spring Valley (Figure 6). What is more, this “wedge” of carbonates may be “compartmentalized” by the Delamar thrust fault (east and west of the thrust) in view of the potential for significant gouge in the reverse fault zone, which may account for the dissimilarity of water level trends in CSVM-3 versus KMW-1 and all other carbonate monitoring wells in the area (e.g., prior to and during the Order 1169 pumping test). Given that interpreting water level responses (and responses to pumping) in KMW-1 is key to resolving this and other questions, downhole geophysical surveys should be conducted in the well and interpreted, if not already available, to determine whether the well is completed on the northwest side, southeast side, or through the Kane Springs Wash Fault zone.

Proposed KMW-1 Pumping Test

Whereas a pumping test has reportedly been performed in KMW-1, the details and results of the test are not widely known or evaluated. In view of existing, but yet undeveloped, underground

[30] Additionally, while only 0.4 to 0.5 ft of MX-5 induced drawdown was estimated in CSVM-4 in northern Coyote Spring Valley during the DOI 2013 SeriesSEE analysis (substantially less than the 1.6 to 1.5 ft estimated in CSVM-6 and other carbonate wells in Garnet Valley, the MRSA, and California Wash), the fit to measured water levels in CSVM-4 during the SeriesSEE curve fitting was poor (in retrospect); that particular estimate of MX-5 induced drawdown unreliable.

water rights in Kane Springs Valley, and the interest in additional applications of significant magnitude, a long-term pumping test should be performed in carbonate monitoring well KMW-1 after determining whether the well is completed on the northwest side, southeast side, or through the Kane Springs Wash Fault zone. If KMW-1 is completed outside the fault zone and on its northwest side, the test would allow the potential impacts of carbonate pumping on the northwest side of the fault in Kane Springs Valley to be evaluated. If KMW-1 is completed outside the fault zone and on its southeast side, the test would allow the effects of carbonate pumping on the southeast side of the fault in Kane Springs Valley to be confirmed and more fully characterized. If KMW-1 is instead completed through the Kane Springs Wash Fault zone (i.e., on both sides of the fault and within the fault), then the test would provide information about both of the above, although more difficult to interpret.

If undertaken, the test should utilize at a minimum the following observation wells: carbonate monitoring wells CSVM-4, CSVM-3, CSVM-6, and if available and un-pumped CSI-4; and basin-fill monitoring wells CSV30011, CSV3009, CSVM-7, and CE-VF-1 (Figure 9). If possible, the value of the test would be significantly enhanced by installing and utilizing two additional carbonate observation wells at locations previously specified in USFWS (2006). Pending the outcome of the pumping test, that portion of Kane Springs Valley located outside the caldera complex (the plutonic core; SNWA 2009b, hydrogeologic framework model), and northwest, southeast, and / or on both sides of the Kane Springs Wash Fault zone, as applicable, should be considered for incorporation into the LWRFS for conjunctive water management.

Proposed CSVM-3 Pumping Test

Given past interests in moving existing Coyote Spring Valley underground water rights from the central to the northern part of the basin, specifically north of the Kane Springs Wash Fault and east of the north-striking normal fault that passes through the areas of CE-VF-2 and CSVM-3 (and outside the caldera complex), as well as uncertainties regarding the impacts of pumping in this "wedge" of the carbonate aquifer, a long-term pumping test should be performed in carbonate monitoring well CSVM-3[31]. The test would allow the potential impacts of carbonate pumping in this area to be evaluated prior to the approval of change applications.

If undertaken, the test should utilize at a minimum the following observation wells: carbonate monitoring wells CSVM-4, KMW-1, CSVM-6, and if available and un-pumped CSI-4; and basin-fill monitoring wells CSV30011, CSV3009, CSVM-7, and CE-VF-1 (Figure 10). If possible, the value of the test would be significantly enhanced by installing and utilizing two additional carbonate observation wells at locations previously specified in USFWS (2006).

<u>Lower Meadow Valley Wash</u>

No wells appear to be completed in the regional carbonate aquifer in LMVW (NDWR 2018a, NDWR 2018c, SNWA 2012, and USGS 2019b), although the carbonate aquifer is present beneath the southern three-quarters of the basin as far east as the Meadow Valley Wash Fault

[31] If feasible to temporarily install a pump of sufficient capacity in this 6-inch diameter well.

(SNWA 2009b, hydrogeologic framework model), including the full sequence of Paleozoic carbonates (Page et al. 2006, cross-sections A through D); and the carbonate aquifer is within 1,000 ft or less of the land surface at any number of locations.

Moreover, carbonate units in the southern third of LMVW are continuous with those in central Coyote Spring Valley[32] and the MRSA (to the west) and California Wash (to the south), with minimal vertical offsets along mostly north-striking faults[33] (cross-sections C, D, and E, Page et al. 2006); while those in Coyote Spring Valley and California Wash are continuous with carbonates (of the same age) in Hidden and Garnet valleys and the northwest part of the Black Mountains Area (Page et al. 2006, cross-sections F, G, and H). If based only on geologic continuity, the carbonate aquifer underlying LMVW should be presumed to be in hydraulic connection with the portion of the carbonate aquifer underlying central and southern Coyote Spring Valley, the MRSA, Hidden and Garnet valleys, the northwest part of the Black Mountains Area, and California Wash; basins already recognized as part of the LWRFS[34]. Likewise, "lower valley fill" in the northern quarter of LMVW, described as consolidated fill composed of conglomerates, sandstones, siltstones, ash-flow tuffs, and air-flow tuffs (SNWA 2009b), should be presumed to be in hydraulic connection with the carbonate aquifer in the southern three-quarters of the basin[35].

Additionally, the alluvial aquifer of LMVW has been demonstrated to be a source of water in alluvium adjacent to the Muddy River in California Wash (and perhaps the MRSA), making a measurable contribution to the river in California Wash during the 2001 seepage run (Section 1.1.1). Since both the alluvial and carbonate aquifers of LMVW are geologically continuous and likely in hydraulic connection with basins already recognized as part of the LWRFS, Lower Meadow Valley Wash should be considered for incorporation into the LWRFS for conjunctive water management.

1.2 Superposition of Climate and Pumping Impacts in the LWRFS

Climate versus Pumping – Always Both

Much effort and time has been committed over the years to the question of whether changes in groundwater levels and spring flows in the LWRFS are the result of climatic forces or pumping. Rather, based on fundamental hydrologic principles, both stresses are always in play; one or the

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[32] Notwithstanding the presence of scattered outcrop of Pilot Shale, other Mississippian siliciclastic rocks, and Eureka Quartzite in the Meadow Valley Mountains (Crafford 2007).

[33] Similar faulting is common at many other locations in the portion of the carbonate aquifer that is known to be hydraulically continuous (Section 1.1.2).

[34] Although limited, the results of deuterium-calibrated mixing-cell modeling by Kirk and Campana 1990 and Thomas et al. 1996 may be partial evidence of the latter.

[35] Since all are part of the Meadow Valley Flow System, through which groundwater is known to flow over long distances from north to south based on numerous shallow groundwater level measurements (Heilweil and Brooks 2011, SNWA 2012).

other possibly predominating at any particular location and time, neither of which should be discounted.

Climate – Wet and Dry Periods

Whereas it is clear that climatic conditions influence conditions in groundwater systems (generally), parameters describing wet and dry climatic periods (e.g., drought indices and baseflow in distant rivers) are poor surrogates for net gains and losses to aquifers since the latter depend on a great many things. Exceptionally wet and dry climatic periods in Nevada Climate Division 4 (Division 4), the area of the LWRFS including Kane Springs Valley and LMVW, and Nevada Climate Division 3 (Division 3), areas immediately upgradient which are the primary source of groundwater in the LWRFS, are highlighted here for the limited purpose of identifying climate signals in hydrographs of carbonate water levels, alluvial water levels, spring flows, and flows in the Muddy River within the LWRFS; and, as a first approximation, characterizing their timing relative to changes in climatic conditions. Understanding the timing, in turn, is necessary but may not be sufficient to determine the mechanisms by which climatic conditions influence trends in groundwater levels and flows in the LWRFS and the availability of water.

Whereas data for both Divisions 4 and 3 are presented in Figure 11, basin-scale water budget analyses suggest that a net loss of water occurs from aquifers to evapotranspiration in basins composing the LWRFS (SNWA 2009a, Table I-7), with or without Kane Springs Valley and LMVW: roughly 5,000 to 8,000 acre-feet per year (afy). In comparison, total groundwater inflows to Coyote Spring Valley and LMVW from Division 3 is an estimated 58,500 afy. As such, climatic conditions in Division 3 may have an outsized influence on water resources in the LWRFS, particularly carbonate water levels and the Muddy River Springs, while conditions in Division 4 have their greatest effect on water levels in the alluvial aquifers and runoff to the river (or lack thereof).

Exceptionally wet and dry periods are highlighted in Figure 11 using Palmer Drought Severity Index (PDSI) values for Divisions 3 and 4, 1970 to present (NCDC 2018). In order of intensity, wet periods occurred in Division 3 in calendar years 2004 / 2005, 1983 - 1985, 1978 - 1980, and to a lesser extent in 1998, 1994 - 1995, 1972 – 1973, and 2010 – 2011. Periods of significant or extended drought in Division 3 (in order of intensity) occurred in calendar years 2002 – 2005, 1989 – 1991, ≤ 1970 – 1972, 2007 – 2009, 2013 – 2015, 1974, 1996 – 1997, 1981, and 1977. Unusually wet and dry periods were generally the same in Divisions 3 and 4 with the exception of a unique wet period in calendar years 1992 – 1993 and more intense dry period in 1996 – 1997 in Division 4.

Climate Signals in Carbonate and Alluvial Groundwater Levels, Spring and Stream Flows

Climate signals are identifiable in groundwater level and spring / stream flow records as periods of increasing water levels or flows at times when carbonate and / or alluvial pumping is known to have been steady or increasing; and periods of decreasing water levels and flows at times when pumping was steady or decreasing.

Wet and dry periods identified using PDSI values in Figure 11 are superimposed on hydrographs of carbonate and alluvial water levels and spring and stream flows in the LWRFS in Figures 12 – 15. Climate signals are primarily identified using trends in water levels and flows from 2000 to present because carbonate and alluvial pumping is only available from the State Engineer's office (NDWR 2018a) for that period. Trends in water levels and flows prior to 2000 are used only to confirm observations based on the more recent data. Whereas the coincidence of any single wet or dry period with a period of increasing or decreasing groundwater levels or spring / stream flows could be due to wet or dry conditions at some earlier time with a delay in the arrival of climate impacts, the coincidence of two or more such events is unlikely given the irregular timing of wet and dry periods in Divisions 3 and 4. The latter has been used to estimate, as a first approximation, the timing of the manifestation of climate impacts in water resources of the LWRFS in relation to changes in Division 3 and 4 climatic conditions.

Based on careful visual inspection of the hydrographs (Figures 12 – 15), the timing of climate impacts in the carbonate aquifer, alluvial aquifer of the MRSA, various springs in the MRSA, and the Muddy River at the Moapa gage are:

- **Carbonate Aquifer** (Figure 12): Groundwater levels in the portion of the carbonate aquifer currently recognized as part of the LWRFS responded to wet conditions in Division 3, Division 4, or possibly both, within about one year. No conclusions can be drawn concerning the response of carbonate water levels to dry periods due to the "overprint" of pumping impacts. Additionally, no distinction can be made between the effects of Division 3 and 4 climatic conditions based on inspection of the hydrographs due to the similarity of wet and dry periods in the two climate divisions from 2000 to present. Based on a broader inspection of trends in carbonate water levels in the Order 1169 study area (NDWR 2018a), wet climate signals (2000 to present) are evident in all monitored carbonate wells in the basins currently recognized as part of the LWRFS within about one year, but notably are not evident in carbonate monitoring wells located outside the area identified in Section 1.1.2 (e.g., Byron, EH-7, EH-3, CSVM-5).

- **Muddy River Springs** (Figure 13): Flow rates at Pederson Spring, Pederson East Spring, the Warm Springs West gage on Pederson stream, and likely Iverson Flume downstream of the Plummer springs, all known to discharge from the carbonate aquifer, also responded to wet conditions in Division 3, Division 4, or possibly both, within about one year. No conclusions can be drawn concerning the response of the springs to dry periods due to the "overprint" of pumping impacts. Additionally, no distinction can be made between the effects of Division 3 and 4 climatic conditions on the flow of the springs based on inspection of the hydrographs due to the similarity of wet and dry periods in the two climate divisions from 2000 to present.

  In contrast, no such climate signals are evident in the hydrographs for Jones and Baldwin springs or the Big Muddy Spring from 2000 to present which, moreover, responded very differently from the Pederson and Plummer springs. Nor is it possible to evaluate the potential for a delay in the arrival of climate impacts at Jones and Baldwin springs since no pumping data are available prior to 2000.

- **Alluvial Aquifer of the MRSA** (Figure 14): Groundwater levels in most of the alluvial monitoring wells in the MRSA[36], including LDS Central and LDS East which are influenced by alluvial inflows from LMVW (Section 1.1.1), responded to wet conditions in Division 3, Division 4, or possibly both, within about one year. No conclusions can be drawn concerning the response of alluvial water levels in the MRSA to dry periods due to the "overprint" of pumping impacts (carbonate and alluvial). No distinction can be made between the effects of Division 3 and 4 climatic conditions on alluvial water levels based on inspection of the hydrographs due to the similarity of wet and dry periods in the two climate divisions from 2000 to present.

- **Muddy River at Moapa Gage** (Figure 15): Although complicated by alluvial pumping in the MRSA of 5 to 8 cfs, upstream surface water diversions of up to 3 to 4 cfs, and runoff during storm events (NDWR 2018a), at least one wet period (2004 / 2005) coincides with a period of increased flow in the Muddy River at the Moapa gage at a time when alluvial pumping and diversions were increasing moderately; the timing of the response, like that in the alluvial aquifer of the MRSA, within about one year. Beyond that, no conclusions can be drawn due to the lack of pumping data (carbonate and alluvial) prior to 2000; but decreases and increases in flow through the Moapa gage prior to 2000 generally corresponded to dry and wet periods going back to 1970.

In conclusion, the only response to climate conditions that can be observed in all of these systems (springs, carbonate and alluvial wells, and the river) is a response to wet years. Any response to dry conditions in the record is either too incremental to observe or is obscured by the simultaneous effects of ongoing water supply pumping.

Potential Multidecadal Lag in Climate Impacts on the Big Muddy Spring – An Enigma

Notably, variations in the discharge of the Big Muddy Spring appear to be lacking obvious pumping impacts (Figure 13). Flow rates from the Big Muddy Spring gradually increased and then decreased over a period of about 12 years from roughly 1995 to 2007 (unlike other springs in the area), a pattern not seen in the PDSI trends for Division 3 since about 1977 to 1989 (Figure 11), or 18 years prior; (also clearly not replicated in PDSI trends for Division 4). This apparent 18 year lag is consistent with the results of a regression analysis prepared by Mifflin Associates on the behalf of the Moapa Band of Paiutes in their submittal to the 2016 Hydrologic Review Team (HRT) Annual Determination Report (HRT 2016, Appendix C.1); albeit the results of that regression suggest that changes in the discharge of the Big Muddy Spring are linked to climatic

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36 Based on a broader inspection of alluvial water level data (NDWR 2018a), Lewis 1 Old, Lewis 2, Lewis North, LDS Central, LDS East, Perkins Old, Behmer MW, and Abbott, from northwest to southeast across the MRSA, responded to wet conditions in 2004 / 2005, 2010 – 2011, or both; climate signals absent (or not discernable) in only Lewis South and LDS West.

conditions in the Humboldt River Basin more than 200 miles north in Nevada Climate Division 2, which is not physically tenable.

Climatic Trends – The Last 48 Years

Conditions in both Climate Division 4 (the immediate area of the LWRFS) and Climate Division 3 (areas which are the primary source of groundwater in the LWRFS) appear to have been "drying" for at least the last 48 years since 1970 (Figure 11). However, more analysis is needed to determine if this trend is real or not since neither linear trend line in Figure 11 is statistically significant. If conditions are getting warmer and drier, as expected with increasing air temperatures and decreasing precipitation, this would have significant practical ramifications for the availability of water in the LWRFS and determinations of its "sustainable yield".

1.3 Hydrogeologic Conceptual Model of the LWRFS

1.3.1 *Boundaries and Boundary Conditions*

Geologic mapping (Page et al. 2005 and SNWA 2007), geologic cross-sections (Page et al. 2006), the three-dimensional hydrogeologic framework of SNWA 2009b, and groundwater level data from readily available published sources (Heilweil and Brooks 2011, SNWA 2012, and NDWR 2018a), are used to identify the physical locations of the boundaries of the LWRFS and conditions on the boundaries.

Lateral Inflow Boundaries

Pahranagat Shear Zone

It is well established that groundwater flows across the Pahranagat shear zone into Coyote Spring Valley, supported by trends in groundwater elevations, water budget analyses, and deuterium calibrated mixing-cell modeling (e.g., Eakin 1964, 1966, SNWA 2009a Table I-7, Kirk and Campana 1990, Thomas et al. 1996). Moreover, this inflow must occur largely from Pahranagat Valley into Coyote Spring Valley west of the Delamar thrust fault due to the presence of the Kane Springs Wash caldera complex with its plutonic core to the east (SNWA 2009b, hydrogeologic framework model; Page et al. 2006, cross-section A); the latter all but precluding inflow from Delamar Valley to Coyote Spring Valley. Likewise, inflow across the shear zone from Delamar Valley into Kane Springs Valley is largely, if not entirely, precluded by the caldera complex and outcrop of basement rocks (SNWA 2009b, hydrogeologic framework model; and Crafford 2007)[37].

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[37] Although some local recharge to Kane Springs Valley may occur in the Delamar and Meadow Valley mountains (SNWA 2012).

There are no carbonate wells in southern Pahranagat Valley or northernmost Coyote Spring Valley (other than CSVM-3)[38]. Basin-fill water levels drop about 800 ft from the southern end of Pahranagat Valley (Maynard spring pool) to a location roughly 9 miles south in Coyote Spring Valley (Eakin 1964), but may not be representative of gradients in the carbonate aquifer or, in particular, across the shear zone. Rather, assuming water levels in the basin fill and underlying carbonates of southern Pahranagat Valley are in equilibrium (a location where the water table is very close to the land surface and roughly 3,150 ft amsl; SNWA 2012 and Heilweil and Brooks 2011), and projecting carbonate water levels from the area of CSVM-4 in northern Coyote Spring Valley (about 1,875 ft amsl; NDWR 2018a) to the boundary with Pahranagat Valley using a gradient of 5 ft/mile, the difference in head across the Pahranagat shear zone in the carbonate aquifer is conservatively 1,200 ft. Consequently, changes on the order of many tens of feet in carbonate water levels in Pahranagat and / or Coyote Spring valleys (i.e., on either or both sides of the shear zone) would have no significant effect on the hydraulic gradient or rates of groundwater inflow across the shear zone into Coyote Spring Valley. The Pahranagat shear zone, at the boundary between Pahranagat and Coyote Spring valleys, is a constant inflow boundary for the foreseeable future.

Meadow Valley Flow System above LMVW

Although somewhat inconsistent with surficial geologic mapping by Crafford (2007), the hydrogeologic framework model of SNWA (2009b) shows that groundwater from Lake and Patterson valleys in the northern part of the Meadow Valley Flow System flows south through Panaca Valley (between and around plutonic rocks of the Caliente caldera complex and highs in basement rocks) through “upper valley fill”, “lower valley fill”, and the underlying carbonates into LMVW. Basin-scale water budget analyses by SNWA (2009a, Table I-7) estimate that about 4,700 afy of groundwater flow from Panaca Valley into LMVW. Whereas water level hydrographs for wells in the northern two-thirds of LMVW are not readily available (NDWR 2018c), and most if not all wells in northern LMVW and southern Panaca Valley are shallow and located along the wash, records for alluvial wells in southern Panaca Valley include long-term, as well as seasonal, variations in water level (e.g., wells 203 S02 E67 35A 1 and 203 S02 E67 02CD 1; NDWR 2018c). Groundwater inflows at the boundary between Panaca Valley and LMVW, unlike those across the Pahranagat shear zone, vary from year to year.

Lateral No-Flow Boundaries

The locations of likely no-flow boundaries, which largely define the areal extent of the LWRFS, are identified using a combination of geologic mapping (Page et al. 2005, SNWA 2007), geologic cross-sections (Page et al. 2006), the three-dimensional hydrogeologic framework of SNWA (2009b), and groundwater level data readily available from published sources (Heilweil

[38] CSVM-3 likely not representative of water levels elsewhere in the carbonate aquifer in northernmost Coyote Spring Valley (see Section 1.1.3).

and Brooks 2011, SNWA 2012, NDWR 2018a). The locations of likely no-flow boundaries on the LWRFS are as follows [basis for identification provided in brackets]:

- boundary of Delamar Valley with northern Coyote Spring Valley and Kane Springs Valley [groundwater flow precluded by plutonic rocks of the Kane Springs Wash caldera complex (SNWA 2009b, hydrogeologic framework model; Page et al. 2006, and cross-section A)];
- boundary of northern LMVW with Delamar and Dry Lake valleys [coincident with the likely direction of groundwater flow];
- boundary of northern LMVW with Clover Valley and northern Tule Desert to the intersection with a west-striking strike-slip fault intersecting Meadow Valley Wash Fault [coincident with likely directions of groundwater flow, then a strike-slip fault intersecting Meadow Valley Wash Fault shown in Page et al. (2005)];
- Meadow Valley Wash Fault south to its intersection with the boundary of Lower Moapa Valley [carbonates discontinuous across this portion of the fault from west to east, cross-sections A, B, and C of Page et al. (2006)];
- boundary of LMVW with Lower Moapa Valley from the Meadow Valley Wash Fault to the Muddy River near the Glendale thrust [carbonates discontinuous across the fault and thrust from west to east, cross-section D of Page et al. (2006); water levels in Lower Moapa Valley near the Muddy River and boundary with LMVW in carbonate wells EH-7 and EH-3 about 250 ft lower than in northern California Wash at carbonate well M-1, NDWR (2018a)];
- Muddy Mountain thrust on the east side of California Wash from the Muddy River south to the northern strand of the Las Vegas shear zone in northwest Black Mountains Area [carbonates discontinuous across a series of faults associated with the thrust, cross-sections E, F, and G of Page et al. (2006); water level in carbonate well Byron on the east side of a fault associated with the thrust 150 ft lower than in carbonate well M-1 in northern California Wash, NDWR (2018a); and water level in carbonate well EBM-3 in the northwest part of the Black Mountains Area 100 feet higher than in wells BM-ONCO-1 and BM-ONCO-2 completed in clastic rocks to the southeast, (NDWR 2018a)];
- northern strand of the Las Vegas shear zone from the Muddy Mountain thrust in northwest Black Mountains Area to the Gass Peak thrust in northern Las Vegas Valley [carbonates discontinuous across the shear zone, Page et al. (2006, cross-section H)];
- Gass Peak thrust from the northern strand of the Las Vegas shear zone to a location intermediate between cross-section F of Page et al. (2006) and CSVM-5 in southern Coyote Spring Valley [carbonates discontinuous across this portion of the thrust, cross-sections G and F of Page et al. (2006)]; and

- crest of the Sheep Range from a location intermediate between cross-section F of Page et al. (2006) and CSVM-5 in southern Coyote Spring Valley to the Pahranagat shear zone [no-flow conditions coincident with the topographic divide].

Lateral Outflow

Whereas some groundwater outflow may occur from the carbonate aquifer of California Wash to Lower Moapa Valley and / or the Black Mountains Area (or as suggested across some part of the Las Vegas shear zone), available estimates of the rate of outflow are based on Darcy flux approximations[39] and basin-scale water budget analyses (SNWA 2009a, Table I-7). Hence, the rate of any such outflow is poorly known (uncertain). Notwithstanding the potential for some outflow from the area currently recognized as the LWRFS, the difference in head in carbonate rocks on the west and east sides of the Glendale and Muddy Mountain thrusts is on the order of 100 to 150 ft as described in the previous section (based on water level measurements in wells M-1 and EBM-3 versus Byron and BM-ONCO-1 and BM-ONCO-2, respectively), while water levels in the carbonate aquifer in the LWRFS[40] have declined only two to five feet over the last 16 to 20 years through several periods of significant drought (e.g., 2.5 ft in GV-1 in Garnet Valley and 4.5 ft in MX-4 in Coyote Spring Valley, NDWR 2018a). Therefore, to the extent that outflow occurs across any portion(s) of the thrusts (or the northern strand of the Las Vegas shear zone), hydraulic gradients and rates of outflow are, for all practical purposes, constant, short of a change in head on either or both sides of the thrusts (or shear zone) of at least several tens of feet; the latter highly unlikely in the LWRFS given the significant areal extent of the carbonate aquifer underlying the LWRFS basins. Any outflow that occurs to Lower Moapa Valley or the Black Mountains Area from the LWRFS is fairly constant and, in particular, unlikely to change significantly with water management in the LWRFS.

1.3.2 *Areal Extent of the LWRFS – Proposed Boundaries*

Based on information developed in Sections 1.1.1, 1.1.2, 1.1.3, and 1.3.1, revisions to the areal extent of the LWRFS should be considered as shown in Figure 1 to include the following basins and parts of basins:

- the MRSA;
- most of Coyote Spring Valley;
- Hidden Valley;
- Garnet Valley;
- most of California Wash;
- northwest Black Mountains Area;
- Kane Springs Valley; and

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[39] Testimony provided by Terry Katzer and David Donavan in a July 2001 administrative hearing on Las Vegas Valley Water District applications (NSE 2014a-f and NSE 2002).

[40] Specifically, that portion of the regional carbonate aquifer located west of the Glendale and Muddy Mountain thrusts and north of the northern strand of the Las Vegas Shear Zone.

- most of LMVW

1.3.3 *Relative Aquifer Transmissivities, Storativities, and Hydraulic Diffusivities*

Only an understanding of the relative transmissivities, storativities, and hydraulic diffusivities of the carbonate and alluvial aquifers of the LWRFS are required to address questions "b" and "d" posed in Order 1303 (NSE 2019).

<u>Regional Carbonate-Rock Aquifer</u>

Based on the DOI 2013 interpretation of the Order 1169 pumping test, the transmissivity of a large portion of the regional carbonate-rock aquifer underlying the LWRFS is exceptionally high at field-scales. The storativity of the aquifer is limited since composed of fractured consolidated rocks (elastic storage where confined and otherwise largely arising from secondary structures). As such, the hydraulic diffusivity of the carbonate aquifer is high (at least in this area), but finite; consistent with the 4 to 6 month lag observed in the initiation of measurable recovery at the Pederson springs and carbonate well EH-4 in the MRSA following the cessation of MX-5 pumping in southern Coyote Spring Valley (12 miles away) during the Order 1169 pumping test (Figures 12 and 13).

<u>Alluvial Aquifers</u>

The transmissivity of the alluvial aquifers of the LWRFS is considerably lower, storativity considerably higher, and hydraulic diffusivity considerably lower than that of the underlying regional carbonate aquifer.

1.3.4 *Groundwater Flow and General Response to Pumping and Climatic Conditions*

Pumping in the Carbonate Aquifer

A sizable portion of the carbonate-rock aquifer of the LWRFS has been demonstrated to possess exceptionally high field-scale transmissivity (Section 1.1.2); i.e., transmissivity of exceptional magnitude within the carbonate-rock province of southern and eastern Nevada. Based on the response to the Order 1169 pumping test (Section 1.1.2) and anomalously flat lateral hydraulic gradients documented in the carbonate aquifer over many years (Dettinger et al. 1995, NDWR 2018a), the high transmissivity portion of the aquifer extends from CSVM-6 in central Coyote Spring Valley to the east and south beneath the whole of MRSA and Hidden and Garnet valleys, most of California Wash, and the northwest part of the Black Mountains Area. Due to its exceptionally high transmissivity (and for no other reason), pumping in this portion of the carbonate aquifer creates nearly uniform drawdown throughout the high transmissivity part of the aquifer.

North of CSVM-6 in central Coyote Spring Valley, the carbonate aquifer has been demonstrated to be of lesser transmissivity, but nonetheless transmissive and in hydraulic connection with the exceptionally high transmissivity portion of the aquifer (Section 1.1.3). As a result, pumping in the high transmissivity portion of the carbonate aquifer creates drawdown in the carbonates of northern Coyote Spring Valley (e.g., the area of CSVM-4), but of lesser magnitude (the hydraulic gradient between central and northern Coyote Spring Valley made steeper by pumping in the central part of the basin or pumping to the south or east in the carbonate aquifer). By the same token, carbonate pumping in the area of CSVM-4 in northern Coyote Spring Valley would, in addition to creating local drawdown, create drawdown that extends into the high transmissivity portion of the aquifer to the south and east; which again would be nearly uniform and distributed throughout the highly transmissive portion of the aquifer. That is, pumping anywhere in carbonates that are hydraulically connected to the high transmissivity portion of the carbonate aquifer, including possibly large parts of Kane Springs Valley and LMVW, can be expected to create drawdown that is nearly uniform and distributed throughout the carbonates in the high transmissivity area. Which is to say, pumping in any "connected" carbonates (identified in Sections 1.3.1 and 1.3.2) will create drawdown of at least some magnitude over a large area; i.e., at least 650 square miles of southern Nevada from central Coyote Spring Valley through the MRSA, Hidden and Garnet valleys, the northwest portion of the Black Mountains Area, and most of California Wash based on the results of the Order 1169 pumping test (Section 1.1.2).

Pumping in Alluvial Aquifers

Notwithstanding the occurrence of flow from the carbonate aquifer into the alluvium in the MRSA and California Wash and possibly Garnet Valley (Section 1.1.1), and from the alluvium into the carbonate aquifer in Coyote Spring Valley (based on limited data from CE-VF-1 and CE-VF-2), the carbonate and alluvial aquifers of basins currently recognized as the LWRFS are generally in good hydraulic connection. Consequently, alluvial pumping within the LWRFS that is not captured directly from the river or evapotranspiration is captured from the underlying carbonate aquifer; with impacts to the Muddy River Springs and seepage from alluvium into the river over some period of time, although impacts to the springs should be somewhat delayed (compared to the effects of carbonate pumping) due to the relatively low hydraulic diffusivity of the basin fill.

Effects of Constant Inflow at the Pahranagat Shear Zone

No less unique and unusual than the exceptional transmissivity of the carbonate aquifer in the LWRFS is the presence of constant inflow into the LWRFS at the Pahranagat shear zone. Assuming the extent of any outflow to Lower Moapa Valley and / or the Black Mountains Area is fairly constant as hypothesized (Section 1.3.1), and for the sake of the current illustration that inflow to LMVW is also constant, any increase in pumping (carbonate or alluvial) within the LWRFS must eventually be captured from the Muddy River Springs (at least the Pederson and Plummer springs at Moapa Valley National Wildlife Refuge), the Muddy River, and / or evapotranspiration in the MRSA and California Wash on a roughly 1:1 basis:

$$Q_{inflows} - Q_{outflows} - Q_{pumping} = Q_{springs/river/ET}$$

If $Q_{inflows}$ *and* $Q_{outflows}$ are constant and pumping increases from one time to another, then:

$$\Delta\, Q_{pumping} = -Q_{springs/river/ET}$$

Effects of Variable Inflow at the North End of LMVW

Inflow to LMVW from Panaca Valley is limited compared to inflow at the Pahranagat shear zone. Based on water budgets prepared by SNWA (2009a, Table I-7), about 4,700 afy flow from Panaca Valley into LMVW; while an estimated 53,800 afy flow across the Pahranagat shear zone into Coyote Spring Valley. Nonetheless, increases in pumping in the LWRFS (carbonate and / or alluvial) could result in somewhat less than 1:1 capture of the refuge springs, river, and evapotranspiration to the extent that increased pumping induces additional inflow across the Panaca Valley / LMVW boundary (assuming inflow at the Pahranagat shear zone and outflow to other basins remains constant).

Causes of "Climate Signals" in Groundwater Levels and Flow Rates in the LWRFS

Given that inflow at the Pahranagat shear zone and outflow to other basins are roughly constant, climate signals identified in carbonate water levels, the discharge of the refuge springs, alluvial water levels in the MRSA, and flows in the Muddy River at the Moapa gage (Section 1.1.2) can only be the result of variable inflow at the boundary between Panaca Valley and LMVW and / or temporal variations in local recharge. Based on basin-scale water budgets prepared by SNWA 2009a, Table I-7), local recharge to basins of the LWRFS, including Kane Springs Valley and LMVW, is about 14,800 afy; roughly three-fold the estimated 4,700 afy flowing into LMVW from Panaca Valley. It seems likely that the bulk of climate-related variations in carbonate and alluvial water levels and spring and stream flows identified in Section 1.1.2 are due to changes in local recharge (to alluvium and carbonate outcrop); that is, in response to Climate Division 4 conditions, despite overall limited local recharge in the area. Moreover, local recharge as a prime driver of the identified "climate signals" is consistent with the one year or less lag in their manifestation in the observed wet-year responses of alluvial and carbonate water levels and spring / stream flows (Section 1.1.2). This is not to say that a longer lag in climatic impacts might also be associated with variable inflow to LMVW, only that it is difficult to detect. Assuming the latter is not insignificant, no means is currently available for distinguishing climate impacts transmitted through the carbonate aquifer versus the alluvial aquifer of LMVW, versus both.

Until such questions are resolved, the costs (both time and financial) of building or improving a numerical groundwater flow model that might be useful in conjunctively managing the water resources of the LWRFS may not be warranted. Alternatively, if an empirical or analytical "model" can be developed that would serve this same purpose, uncertainties regarding the specific mechanisms by which climatic conditions influence water resources in the LWRFS may be less consequential.

Effect of Decreased Local Recharge and / or Inflow to LMVW due to Changes in Climatic Conditions

Assuming inflows at the Pahranagat shear zone, any outflow to other basins, and pumping (carbonate and alluvial) within the LWRFS are relatively constant going forward, decreases in local recharge and /or inflow to LMVW will result in corresponding decreases in the flow of the Muddy River (inclusive of the contributions of the springs) and / or evapotranspiration in the MRSA and California Wash. Accordingly, if there are increasingly dry conditions in Climate

Division 4 (the immediate area of the LWRFS) and Climate Division 3 (areas which are the primary source of groundwater in the LWRFS) this would have significant practical ramifications for the future availability of water in the LWRFS and determinations of its sustainable yield.

Effects of Groundwater Availability Upgradient of the LWRFS Due to Groundwater Development

It follows that to the extent groundwater development upgradient of LMVW in the Meadow Valley Flow System (e.g., Lake Valley), or Dry Lake, Delamar, and Pahranagat valleys, results in reduced groundwater inflows to the LWRFS, the effects would be similar to drought, but indefinite.

1.3.5 *Time Lags in the Manifestation of Pumping Impacts and Recovery*

The hydraulic diffusivity of the carbonate aquifer is high, but finite; the hydraulic diffusivity of basin fill is even more finite. Consequently, there is a time lag between pumping in either the carbonate aquifer or alluvium and the initial manifestation of pumping impacts at distant locations, as well as the initial manifestation (first measurable signs) of recovery with the cessation of or reductions in pumping. During the Order 1169 pumping test (although complicated by changing climatic conditions), the time lag in both the initiation of impacts and recovery at EH-4 and the refuge springs following MX-5 test pumping in the carbonate aquifer was about 4 to 6 months (Figure 13). Time lags are longer in the case of alluvial pumping because, all other things being equal, the hydraulic diffusivity of basin fill is much lower than that of the carbonate aquifer.

Beyond the initiation of measurable recovery, full recovery of groundwater levels (and in this case spring flows) following the cessation of pumping (or a decrease in pumping) occurs asymptotically over a period of time that marginally exceeds the length of time a well was pumped before being shut off (or the length of time a well was pumped at a higher rate before the rate of pumping was reduced); this based on fundamental mathematics describing the recovery of pumping-induced drawdown in aquifers. This occurred during the recovery from MX-5 pumping in the Order 1169 test, where MX-5 was pumped for about 2 ¼ years (from about December 2010 to late April 2013, several months past the official end of the test in December 2012) before being shut off, and full recovery was achieved sometime in late summer of 2015 based on measured spring flows and groundwater levels in carbonate monitoring well EH-4; the exact timing of the recovery is somewhat obscured in the empirical data by the effects of ongoing water supply pumping and possibly drought.

In general, the rate of recovery from pumping, including the time for the first measurable signs of recovery at any given location, depends on all stresses acting on the affected aquifer system; e.g., local rates of evapotranspiration, any groundwater recharge, leakage from one aquifer to another, and rates of pumping, in addition to the locations of pumping and the impacted resources. As such, the time lag for the start of recovery at any particular location / resource is not a constant. Rather, it depends on the location of the pumping that is reduced or stopped and location of the resource, the rate of pumping (prior to being reduced or turned off), and many other factors affecting conditions in the aquifer in question; consequently, cannot be anticipated with certainty from one set of conditions to another (including one year to another).

1.3.6 *Source of the Big Muddy Spring – A Hypothesis*

The Big Muddy Spring may discharge from a zone of high permeability "massive limestone pebble fanglomerates" mapped by Maxey et al. 1966 in an area of otherwise low permeability Muddy Creek Formation at the general location of the spring (Maxey et al. 1966, Figure 2).[41] Moreover, if the transmissive zone allowing discharge to the surface is encased in "low permeability to impermeable" Muddy Creek Formation (Maxey et al. 1966, Figure 2), this could also account for the unique lack of pumping impacts to the Big Muddy Spring during the two-year Order 1169 pumping test (Figure 13).

Further, water discharged from the spring is warm (27 ^{o}C, Beck and Wilson 2006); consequently, likely discharges from depth. The source area in particular appears to be LMVW given the location of the spring downgradient of that basin within a north-striking channel of alluvium surrounded by Muddy Creek Formation in the MRSA (Crafford 2007). If the source area is LMVW, the source could be deep basin fill or the underlying carbonate aquifer, which over much of LMVW is located at depths of thousands of feet. If the latter, significant attenuation of what appears to be climate signals (1995 to 2007) in the hydrograph shown in Figure 13 suggests that water discharged from the spring flows through a great deal of basin fill before reaching the surface.

Water quality / chemical analyses could be helpful in determining the source of this important spring, if not already available. Since the discharge of the Big Muddy Spring is about 7 cfs, i.e., roughly 30 percent of the discharge of the Muddy River Springs and more than 15 percent of flow in the Muddy River at the Moapa gage (Beck and Wilson 2006), questions regarding the source of the spring and potential lags in climate response must be answered before conjunctive management of the LWRFS can be refined beyond some initial strategy.

1.4 Sustainable Levels of Pumping in the LWRFS

Carbonate versus Alluvial Pumping

Because the carbonate and alluvial aquifers of the LWRFS are generally in good hydraulic connection (Sections 1.1.1 and 1.1.2), total carbonate and alluvial pumping must be used to establish a sustainable level of pumping in the LWRFS.

Estimating Sustainable Levels of Pumping Based on Water Budget Estimates or Numerical Models

[41] Maxey et al. 1966 further note that "this fanglomerate when cut by faults and joints (some enlarged by solution) may be a highly permeable though areally restricted… [and] seems to be closely related to the occurrence of many of the big springs in Moapa Valley." Specifically, Maxey et al. 1966 mapped a surficial occurrence of this fanglomerate in the northeast quarter of Section 16 of T 14 S R 65 E, on the fringe of which he mapped the Big Muddy Spring.

Basin-scale water budgets cannot be used to estimate sustainable levels of pumping because their formulation involves the subtraction of large numbers (representing estimates of groundwater inflows and outflows at the scale of whole basins) which themselves are in error. Likewise, there are too many significant outstanding questions regarding the hydrology / hydrogeology of the LWRFS, including factors affecting the availability and future availability of water within the system, for a numerical groundwater flow model to be constructed at this time that will be useful in "predicting" a sustainable level of pumping.

An Initial Threshold – Total 2015 – 2017 Carbonate and Basin-Fill Pumping

In 2015, 2016, and 2017, the combined rate of carbonate and alluvial pumping in this collection of highly connected basins and aquifers was relatively constant from year to year (more than at any other time since 2000); an average of 9,318 afy. Moreover, during that period the discharge of the Muddy River Springs was also relatively constant at an average of about 20.0 cfs (14,480 afy), while flow through the Moapa gage on the Muddy River was relatively constant at an average 30,550 afy or 42.2 cfs, and flow through the Glendale gage was an average 33,100 afy or 45.7 cfs. Although flow rates at the Plummer, Pederson, Jones and Baldwin springs were generally lower than before the Order 1169 pumping test (2010 and earlier), and remain so, and may be in gradual decline (perhaps in response to ongoing pumping and possibly climatic factors), the spring flows are also reasonably stable compared to earlier periods.

Additionally, compared to the average combined level of carbonate and alluvial pumping during the Order 1169 pumping test of 13,880 afy, an initial allowable level of pumping in the LWRFS of 9,318 afy would be conservative, but not likely overly conservative. At the time the pumping test was officially terminated in December 2012, the discharge of the majority of springs in the Muddy River Springs Area were in an undiminished state of decline. A new steady state had not been established as of the end of the test; the full effects of the test pumping were never realized because the test was terminated after ~25 ½ months, while the time required to reach a new equilibrium state was seen to be significantly longer (Section 1.3.5). Based on our current understanding of this hydrologic system, if the test pumping had continued until a new equilibrium state was reached, flow in the river as measured at the Moapa gage would have been reduced by approximately 2,890 afy (or 3.99 cfs) - i.e., the amount by which pumping during the test exceeded combined carbonate and alluvial pumping in the few years before the test (10,990 afy, 2008 – 2010). Consequently, flow in the Muddy River at the Moapa gage would likely have been reduced by about 11 percent; a 3.99 cfs reduction from its 2010 average of 36.3 cfs. Because the discharge of the Muddy River Springs represented about half of flow through the Moapa gage in 2010 prior to the test, the flow of the springs would also have been reduced by roughly 11 percent, with several of the highest elevation springs going dry, if the test pumping had continued until a new steady state was reached.

Consequently, assuming a flow rate of 30,550 afy through the Moapa gage is sufficient to meet senior, decreed water rights on or along the Muddy River (the domain of the State Engineer's office), an initial threshold of combined carbonate and alluvial pumping within the LWRFS of 9,318 afy, based on actual observations / data at a time when no alternative quantitative approach yet exists, appears to be the best initial estimate of the sustainable yield of the system and the best available method currently available for arriving at an estimate of the maximum allowable rate of pumping in the LWRFS (inclusive of Kane Springs Valley and any pumping in LMVW that is already occurring). It may be possible to assess the degree to which this initial threshold of 9,318 afy is under versus overly conservative by compiling total combined rates of carbonate and alluvial pumping within the LWRFS (including LMVW and Kane Springs Valley) over the last 16 to 20 years; a period during which water levels in the carbonate aquifer of the LWRFS declined a documented two to five feet (e.g., 2.5 ft in GV-1 in Garnet Valley and 4.5 ft in MX-4 in Coyote Spring Valley, NDWR 2018a).

Projections Based on Historical Pumping and Flows in the River

Alternatively, if estimates of total pumping (carbonate and alluvial) in the LWRFS can be compiled for at least the last two decades (since 1998 or earlier), it may be possible to create a simple “empirical” model (based on empirical verifiable data) that can be used to project (estimate) the level of combined pumping in the LWRFS that will allow the required amount of water to go down the Muddy River. The model would be developed (subject to periodic updates) by plotting estimates of total annual pumping (carbonate and alluvial) in the LWRFS as a function of annual average flows recorded in the river at location(s) critical to meeting senior, decreed surface water rights (e.g., at the Moapa and Glendale gages). This simple approach would also have the advantage of including the effects of progressively drier conditions, at least to the extent experienced in past years.

Periodic Adjustment for Groundwater Availability Upgradient of the LWRFS Including Climate Impacts

Given the development of increasingly dry conditions in Climate Division 4 (the immediate area of the LWRFS) and Climate Division 3 (areas which are the primary source of groundwater in the LWRFS) since at least 1970, and additional possible groundwater developments upgradient of the LWRFS, adjustments should periodically be made to the “sustainable yield” of the system that reflect significant changes in the availability of water.

1.5 Effects of Moving Carbonate and Alluvial Pumping within the LWRFS

Carbonate Pumping

Since the Muddy River Springs (at least the refuge springs) are derived almost entirely from the carbonate aquifer, total carbonate pumping should not be increased, for example in exchange for reductions in alluvial pumping, even if total carbonate and alluvial pumping is maintained at a “sustainable” overall level. Beyond that, existing carbonate pumping should not be moved closer to any springs (or the river), which could reduce the time lag in the development of impacts possibly before the impacts are detected based on periodic data collection and processing.

Alluvial Pumping

Likewise, since (in addition to the contributions of the springs) the remainder of water in the river comes from alluvium adjacent to the river in the MRSA and California Wash, alluvial pumping should not be increased, for example in exchange for reductions in carbonate pumping elsewhere, even it total alluvial and carbonate pumping is maintained at a “sustainable” overall level. Beyond that, existing alluvial pumping in the vicinity of the river should not be moved closer to the river, reducing the time lag in the development of impacts possibly before the impacts are detected based on periodic data collection and processing.

1.6 Groundwater and Spring Discharge Relationships in Muddy River Springs Area and Their Relation to Trigger Levels in the 2006 MOA

This portion of the report updates our analysis of spring discharge and groundwater levels in the MRSA, with a special focus on the springs on the Moapa Valley National Wildlife Refuge (refuge). As presented in the 2006 MOA (USFWS 2006a), Mayer and Congdon (2008), and the DOI Order 1169 report (DOI, 2013), we hypothesize that changes in spring discharge will be proportional to the changes in the hydraulic head differential at each individual spring and that the higher elevation springs with the smallest hydraulic head differential will be the most sensitive to any increase or decrease in carbonate water levels. Here we update the relationships between spring discharge and EH4 well level data to show that this hypothesis is still valid. The conclusion to be drawn from this work is that protecting the highest elevation springs on the refuge, by way of the trigger levels established at Warm Springs West in the 2006 MOA, will protect the springs and dace habitat on the refuge and elsewhere.

1.6.1 Theoretical Groundwater Level/Spring Discharge Relationships

It is well established that spring discharge in the MRSA emanates from the regional carbonate-rock aquifer (Eakin 1966, Thomas et al. 1996). The regional carbonate-rock aquifer is confined and the potentiometric surface of the aquifer (the level to which water would rise if it was not trapped or confined by an impermeable layer) is greater than the land surface elevation of the springs. This hydraulic head differential between the potentiometric surface and the land surface causes groundwater in the carbonate rock aquifer to rise to the land surface, along fissures and fractures that occur in the area, and flow as spring discharge. We assume that the flow at any spring is governed by Darcy’s Law, which states that flow through a porous medium is proportional to the hydraulic head differential or hydraulic gradient (Fetter 1994). The greater the difference between the water surface elevation at the spring and the hydraulic head of the aquifer, the greater the spring discharge, other factors being constant.

The high transmissivity of the carbonate rock aquifer in the Coyote Spring Valley (CSV)-MSRA corridor creates a consistent and fairly uniform potentiometric surface beneath the landscape with little variation in hydraulic head in the aquifer. The difference in land surface elevations between MX-4 in CSV and the springs in the MRSA, some 15 miles to the east, is about 350-450 feet, but the difference in the potentiometric surface of the regional aquifer between carbonate monitoring wells MX-4 in CSV and EH-4 in MRSA is only about 5-6 feet. The high transmissivity and associated low hydraulic gradient results in a fairly uniform potentiometric surface elevation across the MRSA. However, the elevations of springpools in the area vary by more than 70 feet (Beck et al. 2006). This potentially leads to a large range of hydraulic head differential between the individual springs in the MRSA. Higher elevation springs have a much smaller hydraulic head differential than lower elevation springs. This concept is illustrated in Figure 16.

Groundwater pumping leads to the development of a drawdown cone around the pumping center. As the drawdown cone extends to the springs, the hydraulic head differential at the springs will be reduced. Darcy's Law states that a reduction in the hydraulic head differential will result in a proportional decrease in flow rate, all other factors being constant (Mayer and Congdon 2008). If, for example, a lowering of the potentiometric surface leads to a 25% decrease in the hydraulic head differential at a spring, one would expect a similar percentage reduction in flow at that spring. It follows that the springs in the system with the smallest hydraulic head differential, i.e., the highest elevation springs, will be relatively more sensitive to a uniform decline in the potentiometric surface of the carbonate rock aquifer resulting from groundwater pumping (Mayer and Congdon 2008). This concept is illustrated in Figure 17.

1.6.2 Data Sources and Data Quality

For this update, we focus on the springs on or just downstream of the refuge. Figure 18, from the DOI report (DOI 2013), shows the location of all the monitoring sites described here. For surface water monitoring sites, we found it convenient to distinguish between spring monitoring sites (those sites located directly at the springpool outflows) and flow monitoring sites (those sites located some distance downstream of the springpools). All data presented here, along with the graphical and statistical analyses, are available on request.

The closest carbonate monitoring well in the MRSA to the Refuge is EH-4 (Figure 18). This well is monitored by Nevada Energy and has periodic measurements since 1986, with continuous data available since 1997. The water level elevations and trends at this monitoring well are very similar to other carbonate wells in the LWRFS (see Figure 12). We assume that the water level in EH-4 is representative of the elevation of the potentiometric surface in the regional carbonate-rock aquifer in the MRSA. In the DOI report (DOI 2013), the EH-4 data were used to develop relationships between carbonate water levels and discharge at various sites in the MRSA. Here we update those relationships.

The Moapa Valley NWR consists of three units: the Pedersen[42] Unit, the Apcar Unit, and the Plummer Unit (Figure 18). The springs on the Pedersen Unit are the highest elevation springs in

[42] There are two different spellings of this name: Pedersen with an "e" at the end is the correct spelling of the landowner's last name. Pederson with an "o" at the end is the incorrect spelling, adopted by the USGS for the spring and stream names. We will use both spelling here, in context.

the MRSA. Given the expected sensitivity of the higher elevation springs and the importance of the Warm Springs West site to trigger levels in the 2006 MOA, we mainly focus our analyses on this area. There are three monitoring sites on the Pedersen Unit: Pederson Spring (USGS Site No. 09415910), Pedersen East Spring (USGS Site No. 09415908), and Warm Springs West (USGS Site No. 09415920)

Pederson Spring (USGS Site No. 9415910) has been monitored continuously by the USGS with a v-notch weir since 1986. The weir was replaced in April 2004, and for this reason, we only consider measurements since 2004. Pederson Spring is the highest elevation spring on the refuge and in the MRSA.

Pedersen East Spring (USGS Site No. 09415908) has been monitored continuously since 2002 with a v-notch weir. Pedersen East Spring is the highest elevation spring in the Pedersen East Spring group and the second highest elevation spring on the refuge. There are several other springs in the Pederson East spring group that are comparable in flow.

Warm Springs West (USGS Site No. 09415920) has been monitored continuously with a flume since 1985 but we only use the measurement record since 2000, after irrigation diversions ceased upstream. The Warm Springs West gage captures the discharge produced from a number of springs on the Pedersen Unit. The majority of flow at the gage is produced by the four major spring groups (M-11, M-12, M-13, and M-19) that are larger and downstream of the Pederson and Pederson East springs, as well as any groundwater seepage that enters the channel upstream of the gage.

Other spring and flow monitoring sites examined in this section include the Warm Springs confluence at Iverson flume (USGS Site No. 09415927) which measures the collective discharge from springs on the Plummer Unit of the refuge and Jones spring, which emanates from the Apcar Unit of the refuge and is measured by Moapa Valley Water District. For the Iverson Flume discharge, we only use the measurement record after 2010 to avoid any effects from the channel restoration work here prior to 2010. For Jones Spring discharge, we only consider data from 2004 on. Measurements at this site are much less variable following a data gap in 2004, indicating a possible change in the measurement location, equipment, or method. These measurements are reported in gallons per month rather than cfs and we retained those units here.

1.6.3 Methods

We examined the relationship between discharge and carbonate water levels by correlating monthly discharge with monthly carbonate water levels in EH-4 for the period of record (POR) at each of the sites. We calculated the slope and r^2 values for these relationships and estimate the maximum, minimum, and change in discharge observed over the POR. For each site, we also estimated the maximum, minimum, and change in the hydraulic head differential over the POR by computing the difference between the water surface elevation at the spring(s) contributing to the site and the carbonate water levels observed in EH-4. We then compared the estimates of the changes in hydraulic head differential, expressed as a percent relative to the max water level, with the observed changes in discharge at each site, expressed as a percent relative to the max discharge. Our assumption, as discussed above, is that the estimated changes in head differential should be equal to the measured changes in discharge, in relative terms.

1.6.4 Results and Discussion
Pedersen Unit

The first spring considered is the Pederson Spring, the highest elevation spring in the area (the gage datum or zero point of flow is 1810.99 ft). The correlation between spring discharge and water level in EH-4 is very high (r^2 = 0.97) (Figure 19). The slope coefficient of the discharge-water level relationship is statistically significant ($p<0.0001$) and equates to -0.058 cfs per unit foot of drawdown in the carbonate-rock aquifer. This means that for every one foot decline in the EH-4 water level, Pederson Spring loses about 0.06 cfs of discharge (about 19% relative to the maximum discharge observed). The next question we address is: "How does this compare to the estimated change in head differential for this site?"

The maximum and minimum monthly EH-4 carbonate water level elevations observed over the POR were 1816.52 ft and 1812.54 ft, respectively. Pederson Spring has a water surface elevation of 1811 ft. The estimated hydraulic head differential was 5.52 ft at the maximum groundwater level elevation of 1816.52 ft and 1.54 ft at the minimum groundwater level elevation (the "head differential" being estimated as the difference between EH-4 water level elevation and the spring water surface elevation). The difference represents a 72% reduction in head differential at the spring, relative to the maximum head differential of 5.52 ft. Under the assumption that flow is proportionate to head, we should expect a similar percentage decline in flow. As shown in Figure 19, the flow at the spring ranged from a maximum of 0.3 cfs to a minimum of 0.08 cfs. This represents a 73% change in flow, relative to the maximum flow, over the range of carbonate water levels observed during the POR. The observed decline in flows agrees almost exactly with the estimated decline in flow based on the change in head. The spring continues to respond to the decline in carbonate water levels and head differential as expected.

The x-intercept of the discharge/water level regression is 1811.2 ft, using the exact coefficients from the regression equation (Figure 19 and Table 1). This is the predicted carbonate water level elevation at which the spring discharge goes to zero (the spring dries up), based on the relationship between spring discharge and EH-4 levels. This is the most sensitive spring in the MRSA and will be the first to stop flowing with further declines in carbonate water levels.

Next, we consider Pederson East Spring, which is the second highest elevation spring in the area, with a gage datum or zero point of flow of 1807.7 ft. The correlation between spring discharge and water level in EH-4 is also quite high (r^2 = 0.85) (Figure 19). The slope coefficient of the discharge-water level relationship is statistically significant ($p<0.0001$) and equates to -0.036 cfs per unit foot of drawdown in the carbonate-rock aquifer. This means that for every one foot decline in the EH-4 water level, Pederson Spring loses about 0.036 cfs of discharge (about 14% relative to the maximum discharge observed). As above, the next question we address is: “Is this reasonable and close to what we expect for this site?”

As with Pederson Spring, the maximum and minimum monthly EH-4 carbonate water level elevations observed over the POR were 1816.52 ft and 1812.54 ft, respectively. Pederson East Spring has a water surface elevation of 1807.7 ft, lower than Pederson Spring. The hydraulic head differential is therefore greater. It is estimated to be 8.82 ft at the maximum groundwater level elevation of 1816.52 ft and 4.84 ft at the minimum groundwater level elevation. The difference represents a 45% reduction in head differential at the spring, relative to the maximum head differential. This is less than Pederson Spring, as expected, since Pederson East Spring is slightly lower in elevation and has a greater hydraulic head differential, and therefore, should be less sensitive to drawdown. The flow at Pederson East ranged from a maximum of 0.255 cfs to a minimum of 0.109 cfs. This represents a 57% change in flow, relative to the maximum flow, over the range of carbonate water levels observed during the POR. The observed decline is very close to the estimated decline in flow. The spring is also responding to the decline in carbonate water levels and head differential as expected.

The relationship of Warm Springs West flow to carbonate water levels in EH-4 is shown in Figure 19. The correlation between discharge and water level for Warm Springs West is quite high again for the entire POR ($r^2 = 0.84$). The slope coefficient of the discharge-water level relationship is statistically significant ($p<0.0001$) and equates to -0.155 cfs per unit foot of drawdown in the carbonate-rock aquifer. This means that for every one foot decline in the EH-4 water level, Warm Springs West loses about 0.155 cfs of discharge (about 4% relative to the maximum discharge observed). As above, the next question we address is: “Is this reasonable and close to what we expect for this site?”

The flows at Warm Springs West ranged from a maximum near 4 cfs to a minimum of 3.24 cfs. This represents a 19% change in flow, relative to the maximum flow, over the range of carbonate water levels observed during the period of record. The measured change in flow is lower than at Pederson and Pederson East springs. As noted above, this site measures the combined discharge from a number of individual springs. Estimating the hydraulic head differential at the site is more involved and we did not do it for this report (although we did do it in our 2013 report). Suffice it to say that most of the springs contributing to this site are lower in elevation than the Pederson Spring or Pederson East Spring and are therefore expected to be less sensitive to any decline in carbonate water levels.

Apcar Unit and Plummer Unit Sites

Next, we examine the observed and/or expected reductions in discharge at springs on the Apcar and Plummer Units, given the changes in carbonate water levels observed during the pumping test. Springs in all of these areas are lower in elevation than the springs on the Pederson Unit, so they are expected to be less sensitive to declines in carbonate water levels.

At Jones Spring, the correlation with EH-4 elevations is not as strong ($r^2 = 0.44$) but the slope coefficient of the regression is significantly different from zero ($p<0.0001$) (Figure 19). The regression slope equates to 863,955 gallons per month per unit foot of drawdown in the carbonate-rock aquifer. This means that for every one foot decline in the EH-4 water level, Jones Spring loses about 863,955 gallons per month (or about 2.5% of the discharge relative to the maximum discharge observed).

Beck et al. (2006) gives the elevation of a benchmark located 140 ft northwest of the Jones Spring pumphouse as 1775.72 ft. The actual spring elevation can't be determined, since the springhead is buried, but assuming the spring is roughly the same elevation as the benchmark, then the estimated hydraulic head differential is about 40 feet at the spring at the maximum water level elevation. The 3.98 ft drawdown in carbonate water levels observed over the POR represents an estimated 10% decrease in the total head differential at the spring. Based on this, we would expect a 10% decrease in flow. The maximum and minimum flows for the POR, as estimated from the regression line, are about 34,000,000 and 30,000,000 gallons per month. (we estimated the max and min discharge from the regression line because of the variability in the data). So the observed decline in flow, 4,000,000 gallons per month or 12% relative the maximum discharge, is very close to what is expected at this spring.

The relationship of Iverson Flume flows to carbonate water levels in EH-4 during the pumping test is shown in Figure 19. The variance captured by the relationship is not very high ($r^2=0.25$) because of the variability in flows, but the slope coefficient is significantly different from zero ($p<0.0001$). The site is located a considerable distance from the springs (about 0.25 miles downstream) and measurements may be responsive to shallow basin-fill aquifer water levels and rainfall runoff, as well as carbonate-rock aquifer water levels. The regression slope equates to 0.1 cfs per unit foot of drawdown in the carbonate-rock aquifer. This means that for every one foot decline in the EH-4 water level, Iverson flume loses about 0.1 cfs of discharge (or about 2% relative to the maximum discharge observed).

Discharge measurements at the Iverson Flume gage range from a maximum of 4.7 cfs to a minimum of 4.4 cfs (again, we estimated the max and min discharge from the regression line because of the variability in the data). This represents a decline of 0.3 cfs or 6% over the range of carbonate water levels, relative to the maximum discharge. The springs contributing to the Iverson Flume are much lower in elevation than those on the Pederson Unit. Based on measurements in Beck et al. (2006), the head differential at the springs is estimated to range from 58 to 66 ft. As with Warm Springs West, it is more involved to estimate the head differential for the numerous springs contributing to this site, so we did not do that here. Nevertheless, this site is expected to be much less sensitive to carbonate water level declines, as the data suggest.

1.6.5 Conclusions for Impacts to Springs

Table 1 summarizes the results from the analyses. The springs and flow monitoring sites are ordered in terms of high to low elevation in the table, corresponding to their expected sensitivity to changes in groundwater levels. The results demonstrate that sites are behaving as expected, with the highest elevation springs on the refuge showing the greatest relative decreases in response to declines in groundwater elevations at EH-4. This implies that the triggers for Warm Springs West flows that were established in the 2006 MOA are still valid and important for protecting these springs on the Pedersen Unit of the refuge, the most sensitive springs in the MRSA. Protecting these springs protects the other springs on the refuge as well as much of the dace habitat in the MRSA.

Three other monitoring sites, Baldwin Spring, the Muddy Springs at LDS Farm, and the Muddy River near Moapa, did not show a relationship to EH-4 elevations. Baldwin Spring has an anomalous increase in flows in 2014 (Figure 13), which may indicate a change in site or measurement conditions. The Muddy Springs is the lowest elevation spring in the MRSA and therefore may be expected to be the least sensitive to changes in carbonate groundwater levels. Moreover, as discussed above, the unique geologic conditions at the spring may be related to the lack of any relationship with groundwater levels. In addition, the spring may be affected by recent land use changes upstream and in the area. The Muddy River gage shows an increase in flow since the early 2000s, in contrast to carbonate groundwater levels and most of the springs in the MRSA.

1.7 Unresolved Technical Questions – LWRFS Hydrogeology

- Hydraulic Character of the Kane Springs Wash Fault – specifically, within Kane Springs Valley and northern Coyote Spring Valley.
- Kane Springs Valley as Part of the LWRFS (a proposed pumping test) – hydraulic continuity of the carbonate aquifer in Kane Springs Valley with that underlying Coyote Spring Valley.
- Effects of Pumping in Northern Coyote Spring Valley (a proposed pumping test) – effects of moving carbonate pumping from central to northern Coyote Spring Valley.
- Influence of the Meadow Valley Flow System on Groundwater Levels, Springs and the River – characterize the effects of variable groundwater inflow from Panaca Valley into LMVW on groundwater levels (alluvial and carbonate) in the remainder of the LWRFS.
- Source of and Factors Influencing the Discharge of the Big Muddy Spring – After utilizing water quality characteristics or more specific chemical signatures in an attempt to identify or confirm the source of discharge from the Big Muddy Spring, characterize the timing of climate impacts on the discharge of the spring.
- Develop Early-Warning Triggers for Effective Conjunctive Water Management of the LWRFS – a major undertaking, other fundamental questions to be resolved first.

- Frequency of Pumping Inventory Updates Needed to Implement Conjunctive Management in the LWRFS – TBD; likely minimum biannual since the effects of over-pumping on the Muddy River Springs can take up to 6 months to manifest, and up to 6 months to begin recovering (approximated from the response to the cessation of MX-5 pumping following the Order 1169 pumping test).

- Outstanding Hydrologic Data Needs within and Upgradient of the LWRFS – Additional carbonate monitoring wells in Kane Springs Valley and LMVW.

- Role of "Models" in Effective Conjunctive Management of the LWRFS – Consider at a later date following the resolution of fundamental questions regarding how the system works and responds, for example, to changes in climatic conditions and more generally the availability of groundwater upgradient of the LWRFS.

Section 2 – Description, Status and Recovery of the Moapa dace

2.1 Biology and Management of Moapa Dace

2.1.1 *Brief Background on the Biology of the Moapa Dace*

The Moapa dace (*Moapa coriacea*) is a thermophilic minnow that exists as a relict species of the Colorado River fauna that historically inhabited the pluvial White River system in southeastern Nevada, running approximately 200 miles from the present-day White River to the Colorado River near Lake Mead. Today, few sections of this historic channel exhibit surface flow, and among the largest of these now isolated spring systems are those supporting the Muddy River. The Muddy River springs that form the headwaters (referred herein as the Muddy River Springs Area), now support eight endemic aquatic taxa, and among them the endangered Moapa dace (Figure 20). This species is taxonomically unique, and the sole extant member of the genus *Moapa*. Threats to Moapa dace and other native fish of this system are typical of the desert Southwest, including the introduction of nonnative fishes, and the modification of stream habitat for human development (e.g., agricultural, municipal, and recreational). In the 1960s, significant concerns in declining population size, unique biodiversity, and heavily human-impacted spring habitats resulted in the listing of Moapa dace under the Endangered Species Preservation Act of 1966, and later the ESA of 1973 (USFWS 1996).

The Moapa dace is unusual among minnows (family: Cyprinidae) given its unique biological requirements for both thermal and flowing spring water. The Muddy River Springs collectively discharge approximately 50 cfs from approximately 20 spring outflows at 31.0 to 32.0 ℃ degrees (88-90 °F). Waters cool with distance from the source, and Moapa dace occupy the upper two kilometers between 26.0 and 32.0 ℃ (Scoppetone 1993). Their habitat include spring pools, tributaries and the main stem Muddy River. Spring pools are characterized by pebble and organic substrate, with tributaries exhibiting areas of clay, sand, pebble and cobble substrates. Habitat use varies by life-stage, with larval fish found only near the spring sources with low velocity. Juvenile fish occur in tributaries and faster moving water as they grow larger. Adult dace historically occurred throughout the system, and frequently in the cooler and larger mainstream habitats, but also traverse upstream to spawn (Scoppetone et al. 1992). Moapa dace spawn year-around, but predominantly in the spring, and to a lesser extent in the fall (Scoppetone et al. 1992). The largest adults historically occurred in the mainstream river (Scoppetone 1987) where more abundant food items drift downstream. Stomach contents reveal that their diet is omnivorous and diverse, and variously include beetles, moths and butterflies, true flies, true bugs, caddisflies, mayflies, damselflies and worms, as well as algae, vascular plants, and detritus (Scoppetone 1987). The maximum size and age of Moapa dace is believed to be about 120mm fork length (~4.7 in.) and approximately four years (Scoppetone et al. 1992).

2.1.2 *Anthropogenic Impacts and Conservation at the Moapa Valley National Wildlife Refuge*

Negative impacts to aquatic species have occurred through two parallel processes: the modification of natural habitat by water development for irrigation, recreational and domestic uses, and the introduction of exotic and invasive plants and animals. These factors have variously affected most areas of the Muddy River Springs Area, both independently and synergistically, and resulted in harm to Moapa dace (USFWS 1996).

Although some modifications to the MRSA occurred prior to the discovery of Moapa dace in 1938, such as the introduction of western mosquitofish (*Gambusia affinis*), Moapa dace was relatively common, and remained so until approximately 1950 (Hubbs and Miller 1948, La Rivers 1962). Notable species-level declines in the abundance of Moapa dace occurred primarily after the introduction of non-native shortfin mollies around 1963 (Deacon and Bradley 1972). The need to understand the interaction between shortfin mollies and Moapa dace led to several investigations, showing that mollies overlap in occupied habitat with Moapa dace (Deacon and Bradley 1972, Scoppetone 1993), and that laboratory experiments reported that shortfin mollies predate on fish larvae (Scoppetone 1993).

Concurrent with the introduction of short-fin mollies, increases in water development combined to threaten the persistence of the species, and resulted in the establishment of the Moapa Valley National Wildlife Refuge (MVNWR) in 1979. This refuge was unique for its time, as few refuges were established expressly for endangered fishes. Presently, the Refuge is comprised of three spring systems (Plummer, Pedersen, and Apcar, Figure 20) and represents approximately 10% of the species' historic range. When acquired, no Moapa dace remained in the spring systems protected as Refuge, as the Plummer and Pedersen streams were previously converted to chlorinated swimming pools for recreational use, and Apcar was modified from its natural course for municipal water supply. Many of the historic channels were modified to earthen and concrete ditches (USFWS 1996). Since these areas were now part of the Refuge, habitat restoration efforts have returned much of the wetted habitat back to flowing streams and Moapa dace repatriated to most spring systems. Restoration efforts up through the early 1990s were extremely successful and estimates for population size of Moapa dace ranged from 1565 - 3841 fish as estimated by snorkel surveys (Scoppetone et al. 2005). However, the invasive blue tilapia (*Oreochromis aureous*) invaded the Muddy River Springs Area in 1995 (Scoppetone et al. 2005) and dramatically reduced the entire population. Current knowledge of this system suggests that the negative interaction between tilapia and Moapa dace was so severe that recovery of this species depended on the removal of tilapia from the system, a major recovery action only recently completed in full (Muddy River Biological Action Committee, *pers. comm.*).

Major events in the conservation history of Moapa began again in 2005, with the Southern Nevada Water Authority acquiring the Warm Springs Natural Area, which provided access and direct management of nearly all of the historic range of Moapa dace outside the MVNWR. At this time, more habitat became available for future restoration efforts. Concomitantly, the establishment of the Memorandum of Agreement between the USFWS and area stakeholders

(USFWS 2006a) was drafted due to increasing concerns for adequate water to support Moapa dace in the future. The MOA was especially significant for protection of the Moapa dace for two reasons. The first was that this document outlined specific water-level triggers (discussed below, Section 2.1.4) to protect in-stream flow, but also provided explicit financial commitments from most parties. Most important was the acknowledgement that all parties work cooperatively to improve the status of the endangered Moapa dace. The resources afforded by the MOA provided the necessary impetus to fund a mix of on-the-ground restoration projects, increased awareness of imperiled aquatic species, and provided funds for research necessary to guide effective management. This period of collaboration and funding was significant, as it occurred during a period of historically low population estimates of less than 500 total individuals of Moapa dace (Figure 21). Major accomplishments at the MVNWR included major stream reconstruction, public education for native fishes of the Muddy River, and the stream-side viewing window on the Plummer Stream.

The most recent phase of recovery actions began in the early 2010s, and include the costly installation of removable and permanent fish barriers to exclude invasive tilapia, along with the stepwise piscicide treatments to remove non-native fishes throughout the system. Working from upstream to downstream, the entire Muddy River system from the headwaters springs to the Wells Siding diversion had been treated to remove non-native fishes at least once by spring of 2019. Beginning in the early 2010s with coordinated restoration activities with partner agencies, the population of Moapa dace has rebounded in some streams, but still remains low in others.

2.1.3 *Connectivity and Fish Passage*

The complex life-history of Moapa dace requires stream habitats from the low-velocity headwaters to the mainstream Muddy River, and presents challenges for both habitat restoration and the management of invasive species. Logistical concerns for both piscicide treatments and restoration activities necessitate that stream segments are restored in manageable sections. Therefore, site restorations often require the temporary installation of fish barriers to prevent non-native fishes from entering stream segments. However, Moapa dace are particularly ill-suited to habitat fragmentation given their short lifespan and habitat needs. Specifically, headwater reaches are required for spawning and the inability for fish to gain access for as few as three or four consecutive years (i.e., the life-span of Moapa dace) could potentially drive a stream reach toward extirpation. However, the significant time and resources required to install or remove non-native fish barriers represent a considerable and complex decision.

A recent study to investigate habitat fragmentation and fish abundance employed a stochastic individual-based modeling approach to understand the relationship of how changes in carrying capacity of specific stream segments influence the potential for extirpation, and the overall population size of the species (Perry et al. 2015). In this study, empirical data (Scoppetonne and Burge 1994) and basic theoretical information on fishes were used simulate individual survival and estimate carrying capacity. Carrying capacity of stream segments is variously affected by many factors such as physical habitat characteristics, barriers to migration, and invasive species interactions, among others. Perry et al. (2013) simulated migration barriers to upstream and downstream travel on carrying capacity, and how carrying capacity is related to overall population size. Of particular importance in this study was the finding that barriers to migration resulted in extirpation of populations upstream of barriers when populations were very small, and that migration buffered these effects. The second finding was that when population sizes were calibrated to current estimates of abundance, the carrying capacity of the mainstream Muddy River was twice that of the smaller tributaries. This is significant at present as almost no Moapa dace occur in the mainstream habitat in recent years (Table 2). These results highlight the importance of fish passage and connectivity for the recovery goals of Moapa dace.

As numerous restoration actions have targeted individual reaches, the lack of connectivity has become an increasingly important next-step in the recovery of the species. Prominent examples for increasing fish passage in the Muddy River Springs Area include the road crossing and stream gauge for the upper and lower Pedersen stream (reaches 5 and 5.5, respectively; Figure 22). At present, this example highlights a situation where the largest population (reach 5.5) exists immediately adjacent to a very small population (reach 5). The relatively high quality of habitat both above and below the road crossing likely suggests that the near-absolute lack of fish passage may be responsible for the low population size in the upper Pedersen Stream (reach 5).

2.1.4 *Protection of Spring Flow and Habitat Needs of the Moapa Dace*

As restoration efforts continue to improve the quality of stream habitats with respect to introduced fishes and the biological interactions harmful to Moapa dace, biologists have increasingly considered the role of water diversions and groundwater pumping on the recovery of Moapa dace. At present and within the last decade (see Section 2.2, *below*), Moapa dace occur almost entirely within the tributary springs and streams emanating from the MVNWR (Table 2). Given that the carbonate rock aquifer extends with relatively homogeneity under the MRSA (Dettinger et al. 1995), and that spring discharge in this area reflects head pressure in the aquifer (Section 1.6, *herein*), flows in the MRSA provide an indication of available surface water required to support aquatic species (USFWS 2006a, Mayer and Congdon 2008). In particular, the springs on the Refuge are among the highest elevation in the MRSA (Section 1.6, *herein*; DOI 2013), and provide the basis for several agreements between the United States Fish and Wildlife Service and nearby water users (USFWS 2006a, USFWS 2006b). The USGS water gauging station *Warms Spring West near Moapa* (gage # 09415920), collectively measures the two highest elevation springs (Pedersen and Pedersen East springs) and were therefore used to define protective water flow triggers and their associated curtailment of water resources.

The first agreement, the 2006 Memorandum of Agreement (USFWS 2006a) pertains to groundwater pumping and diversions between the USFWS and four water users (Southern Nevada Water Authority, Moapa Valley Water District, Coyote Springs Investment, and Moapa Band of Paiutes) in the immediate MRSA and adjacent Coyote Springs Valley. Here, protective triggers aim to ensure springflows remain at approximately current discharge levels; presumptively, levels where Moapa dace have been maintained or increased in the past. As defined in this MOA, specific triggers begin when spring flow at the gauge *Warms Spring West near Moapa* drops below 3.2 cfs, at which point signatories initiate formal discussions to reduce water usage. Flows below 3.0 cfs subsequently trigger a series of thresholds that result in the curtailment of pumping for the four stakeholders. The second agreement, a Stipulated Agreement with Lincoln County Water District and Vidler Water Company, arose from concerns of USFWS and the potential protest of future groundwater withdrawal in the upstream Kane Springs Valley, a nearby upgradient basin with potential effects on the MRSA (USFWS 2006b; Section 1.13, *herein*). This Agreement was drafted at the same time and similarly initiates discussion of water conservation at triggers below 3.2 cfs, reduced groundwater pumping below 3.1 cfs, and total cessation of pumping below 3.0 cfs. The USFWS considers these agreements as central to the maintenance and recovery of the Moapa dace due to its complex habitat requirements.

The biology of Moapa dace simultaneously requires both a diversity of habitats (high temperature springheads, small tributaries, and high velocity reaches), and the need for ongoing migration between them. This complex life-history highlights the need to understand the interaction of hydrologic parameters and species needs. To date, one published study investigated the interaction of spring discharge and habitat availability for Moapa dace. The approach used in this study employed stream modeling to predict habitat use and the change in habitat availability with change in springflow. The study was conducted by Hatten et al. (2013), *An Ecohydraulic Model to Identify and Monitor Moapa Dace Habitat*, and was explicitly designed to investigate the potential of groundwater pumping and the associated reduction in springflows. This study evaluated the uppermost reaches of Moapa dace habitat on the Moapa Valley National Wildlife Refuge, and the springflows associated with the Plummer, Pedersen and Apcar springs (Figure 22). The habitat modelling used traditional stream metrics to explain fish presence, and the change in spring flow simulated using River2D, a extensively verified modeling package developed for streams and rivers. The first part of this study involved the fine-scale determination of habitat used by Moapa dace, and determined what features of the habitat most explained where fish occur. Results of habitat modeling by univariate logistic regression identified that water depth was the most important stream parameter explaining where dace occurred, followed (in decreasing order) by substrate (sand, gravel, etc.), and Froude number (stream type such as pool, riffle, glide, etc.). Similar results using a multivariate model selection approach (AIC) showed that the top performing model included depth, substrate and stream velocity.

Most interesting, Hatten et al. used River2D to estimate amount of habitat available for Moapa dace and how the amount of habitat would change with increasing or decreasing stream flow. Simulations included an increase or decrease in flow by 10, 20 and 30 percent relative to base flow. Results varied among the three streams, but habitat simulations in all three streams for reduced flows (-10%, -20%, -30%) produced less habitat for Moapa dace. Increasing flow produced increasing habitat proportionally for Plummer and Apcar streams, while habitat for fish in Pedersen increased and plateaued at the 10% water increase. Thus, this study suggests that any reduction in flow will negatively affect the amount of habitat at all three springs on the refuge for Moapa dace.

2.2 Current Status of the Moapa Dace

2.2.1 *Historical and Current Population Estimates of Moapa Dace*

The population size of Moapa dace is estimated bi-annually in the spring and fall seasons. Early surveys for this species (Scoppetone et al. 1998) found that snorkeling was an effective method to estimate population size without handling stresses associated with other methods. Surveys are conducted from downstream to upstream in 16 stream segments (Figure 22) to eliminate turbid conditions caused by upstream counters. In recent years snorkel surveys have been conducted using trained representatives from USFWS, Nevada Department of Wildlife, and the Southern Nevada Water Authority. Surveys of Moapa dace have indicated fluctuations in population size. Figure 21 shows the biannual estimates for Moapa dace from 2005 to spring 2019. Abundance appears to be strongly influenced by both habitat restoration, restored or lack of connectivity, and the biological interactions of predatory non-native fishes, the impacts of which depend on site-specific habitat characteristics and species-specific interactions. Although the Muddy River Springs Area is now free of blue tilapia, western mosquitofish and short-fin mollies remain in the system.

The gradual increase in population size after 2012 (Figure 21) is suspected to correspond to the period following population expansion after blue tilapia was eradicated from the system. Concurrently, significant habitat improvements were completed between 2013 and 2016 on the Warms Springs Natural Area in reach 5.5 (Figure 22). Also noteworthy is that the mainstream Muddy River and upper areas of the North and South Fork (reaches 15 and 16, respectively), at present, do not support significant numbers of Moapa dace. The upper reaches have not been recolonized since the piscicide treatments to remove blue tilapia. The larger habitat of the mainstream Muddy River (reaches 11, 12 and 13) likewise do not support dace. Given the historical importance of the mainstream channel to support large numbers of large dace (and associated higher fecundity typical of larger fishes), understanding the causes for the current low numbers of fish in these reaches remain a research priority.

2.3 Summary

The Muddy River Springs Area support several rare and endemic aquatic species that occur nowhere else. The relative scarcity of water in the Mohave Desert and the long-term isolation of these springs has resulted in the evolution of unique species, among them the endangered Moapa dace. This species became endangered due to the combined threats of habitat modification and the introductions of invasive species in the Muddy River Springs Area.

This stream minnow is characterized by an unusual life-history, where its existence depends on the high temperature springs and their outflow streams. Even more specialized for the Moapa dace is its complex habitat requirements, whereby this species uses the spring headwaters to reproduce, the larger downstream habitats to effectively grow, and unobstructed fish passage to continually move between these habitat types during the lifespan of individual fish.

The USFWS established the Moapa Valley National Wildlife Refuge to protect water resources and improve habitat for this species. Over the course of 40 years (1979-2019) the Refuge and adjacent Warms Springs Natural Area have significantly improved the habitat for Moapa dace. Among the major recovery actions include the removal of non-native fishes by piscicide treatment, and the repair of barriers that prohibit fish passage between upper and lower sections of the streams. Estimates of population size for Moapa dace have fluctuated in different stream segments over time as recovery efforts have restored habitat and removed the invasive and predatory fishes from the system. Recovery success over the most recent decade as indicated by surveys, shows the population size of Moapa dace has increased from its lowest point of 500 fish in 2008 to approximately 1500 fish in 2019.

Integral to the recovery and future management of the Moapa dace beyond restoring streams to natural conditions and removing non-native fishes is the maintenance of adequate flow in the Muddy River. Several water-use agreements among water users and the United States Fish and Wildlife Service have afforded protection to aquatic species of the Muddy River Springs Area, based on evidence discussed above in this report (Section 1.1.3). The first agreement, the 2006 MOA, ensures that flows in the system are maintained at approximately the current rate that has maintained Moapa dace as measured at the Warms Springs West near Moapa gauge. The 2006 MOA provides for formal discussion among stakeholders to reduce groundwater pumping in the Muddy River Springs Area and Coyote Springs Valley when the flow drops below 3.2 cfs, and a curtailment at 3.0 cfs or below. The second agreement, an Amended Stipulation for Withdrawal of Protests between the Lincoln County Water District, Vidler Water Company, and USFWS pertains to groundwater pumping in the upstream Kane Springs Valley, and similarly initiates discussion of reduced groundwater pumping and total cessation of pumping at 3.2 cfs and 3.0 cfs, respectively. These agreements are important protective measures to ensure the maintenance of the endangered Moapa dace for several reasons. The first is that restoring streams via habitat improvement, although necessary, is not sufficient to recover the species. Water level is also important. Recent published studies (Hatten et al. 2013) show that water depth predicts the distribution of Moapa dace, and most importantly, water flow is directly related to the amount of habitat available. This study shows via simulations that any reduction in flow results in reduced habitat for Moapa dace. At present, most stream habitat has been significantly improved by ongoing restoration efforts by the USFWS and partners agencies over the last 40 years, and thus the most important factor likely to influence the successful recovery of this species moving forward is the maintenance of surface flows in the system.

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Section 4 - Figures and Tables

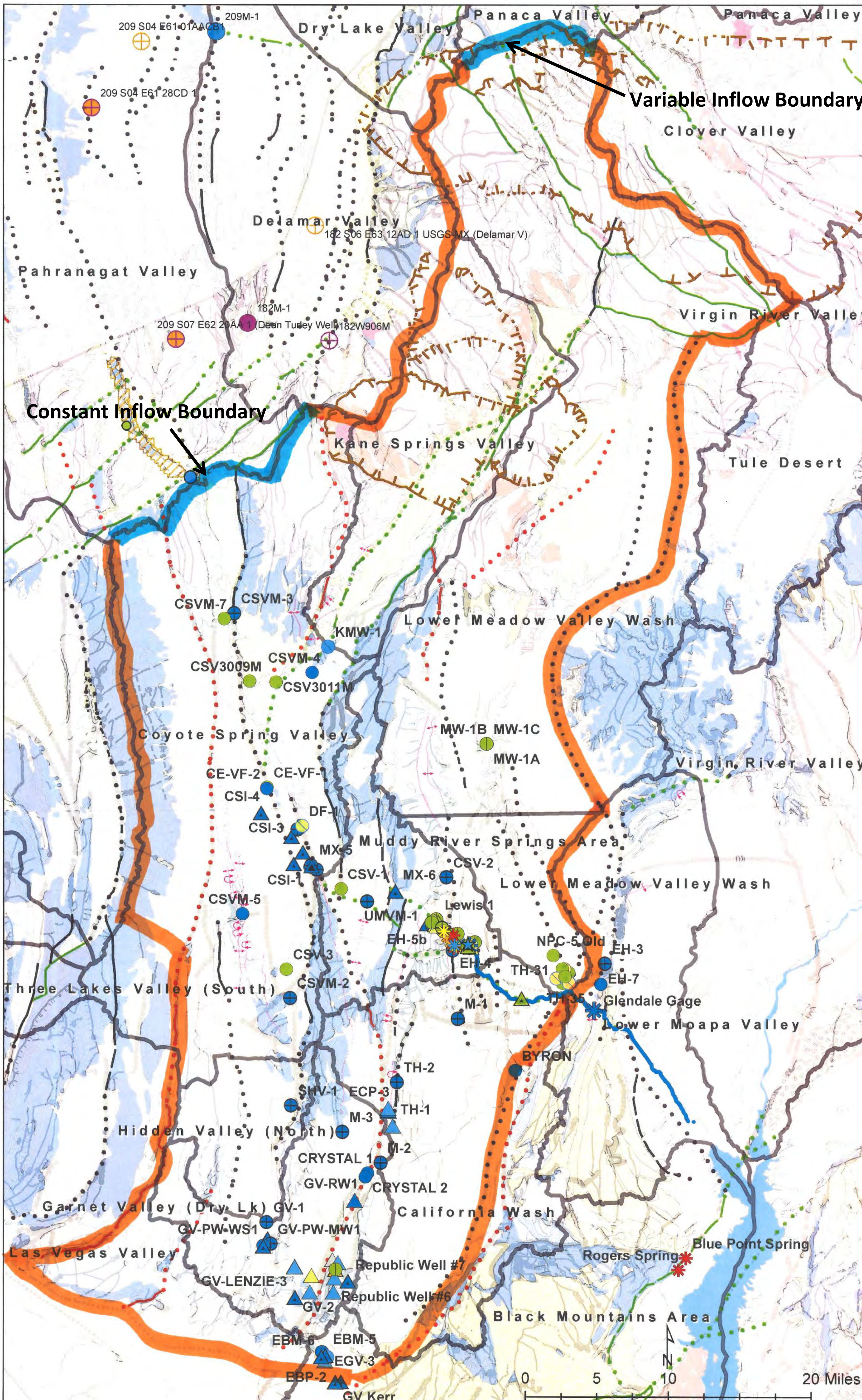

Figure 1. Lower White River Flow System; no-flow boundaries (with possible minor leakage across the Muddy Mountain thrust and northern strand of the Las Vegas shear zone) – orange, constant and variable inflow boundaries – blue.

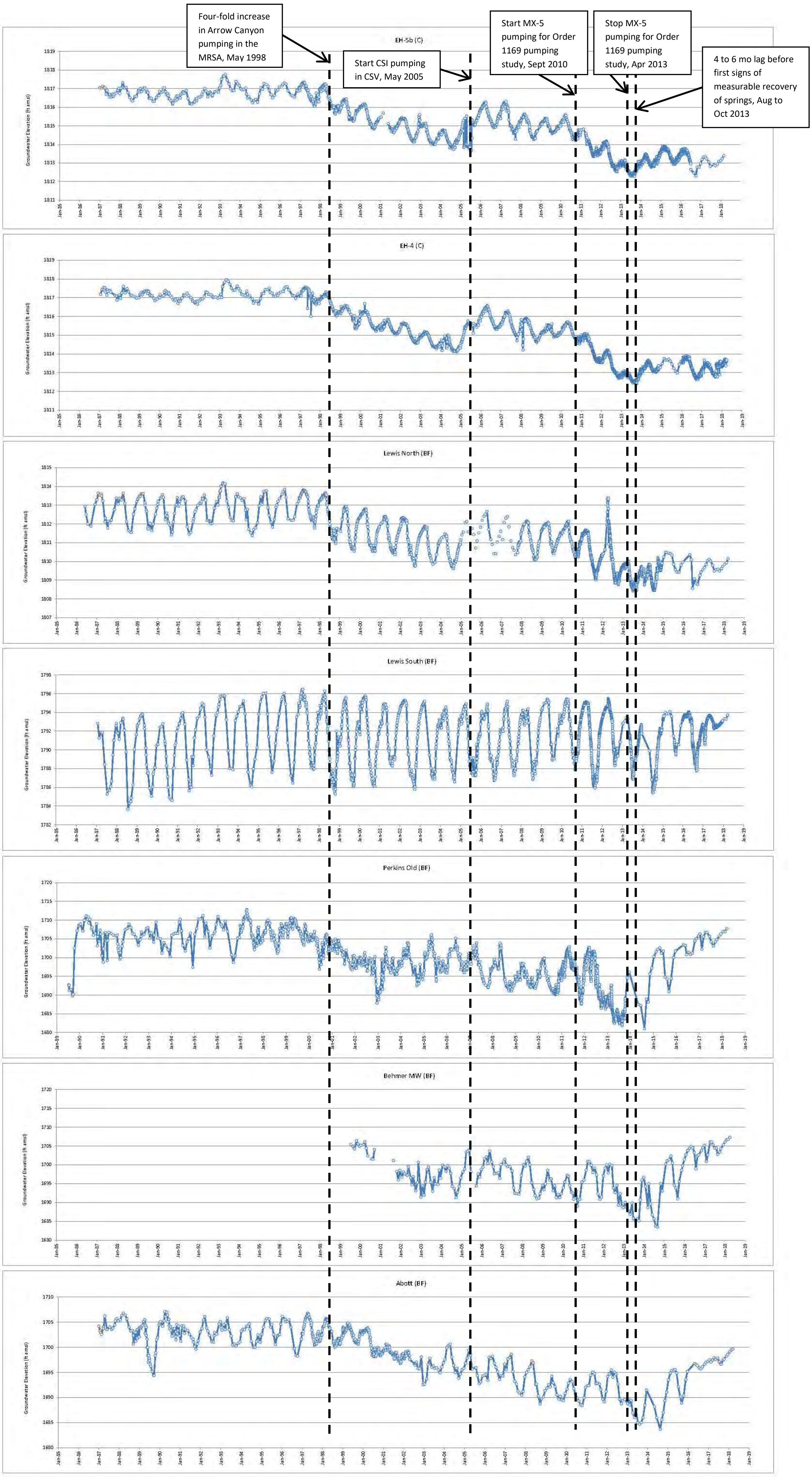

Figure 2. Water levels in alluvial and carbonate monitoring wells (NDWR 2018a) respond more or less in sync to significant increases / decreases in carbonate pumping in the MRSA and Coyote Spring Valley (annotation).

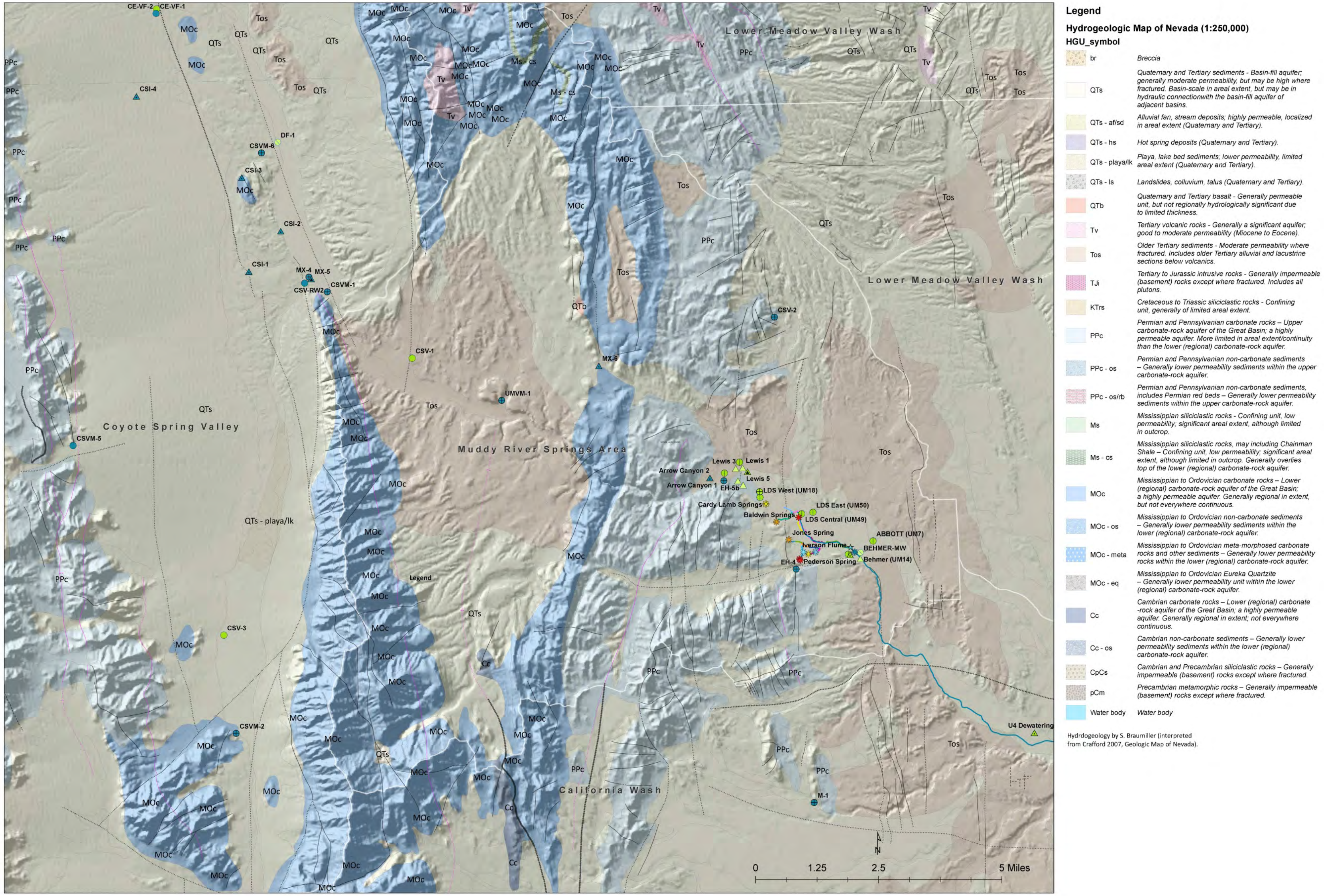

Figure 3. Hydrogeologic map showing the distribution of alluvium (QTs), Muddy Creek Formation (Tos), Permian to Pennsylvanian carbonate rocks typically associated with the "upper" carbonate-rock aquifer (PPc), and Mississippian to Cambrian carbonate rocks composing the regional ("lower") carbonate-rock aquifer within the MRSA (MOc and Cc). Hydrogeologic units interpreted by the author from the geologic map of Crafford 2007 (unpublished to date).

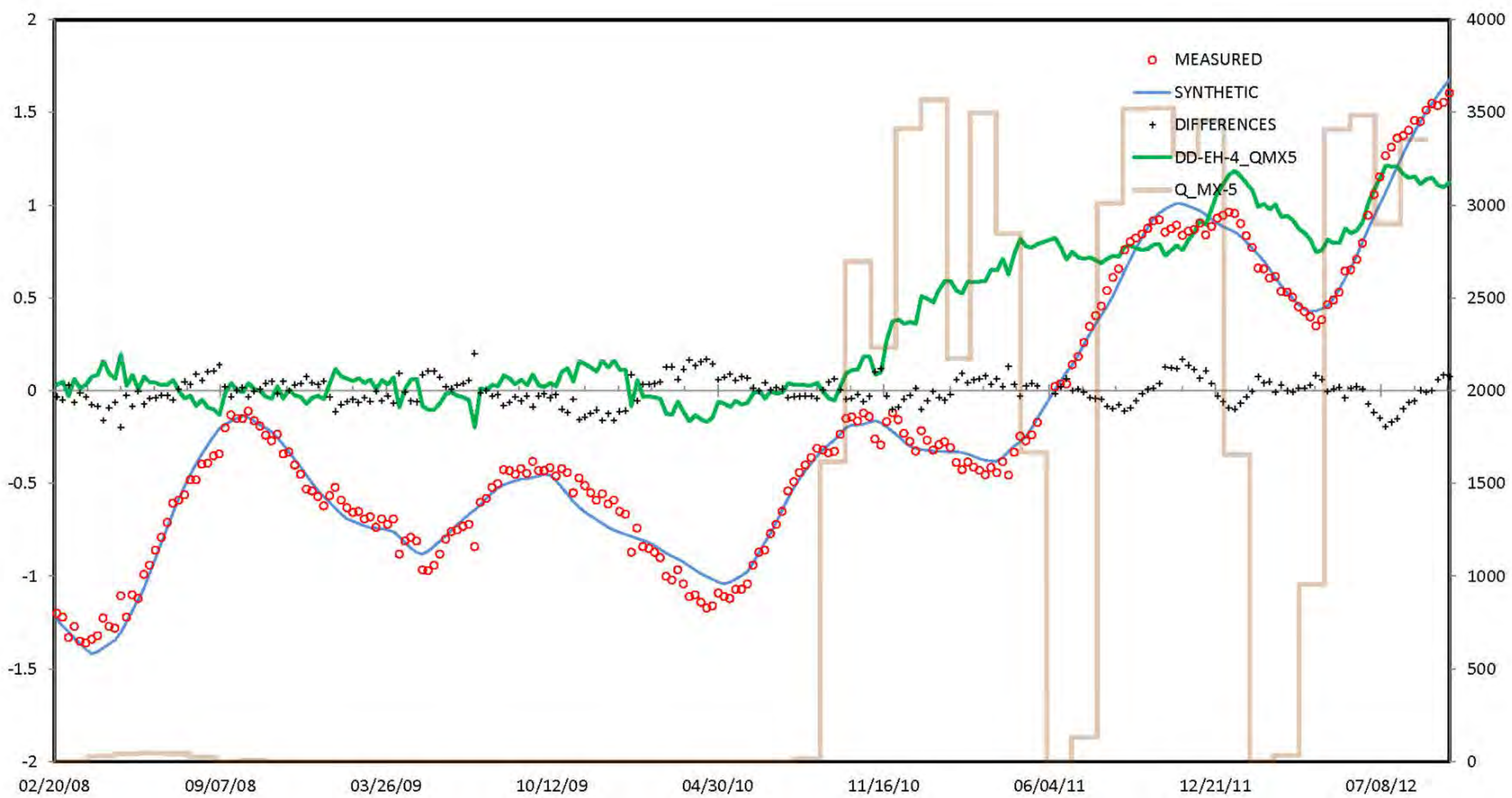

Figure 4. One of many possible examples from the Department of the Interior (2013) analysis of the Order 1169 pumping test, showing that the SeriesSEE approximation / simulation of (total) drawdown at carbonate well EH-4 during the test compares well, or even exceeds, that simulated by numerical models (SNWA 2009b and Tetra Tech 2012), providing a reasonable degree of confidence in our isolation (estimate) of drawdown induced by MX-5 pumping as of the official end of the test in December 2012 (also shown).

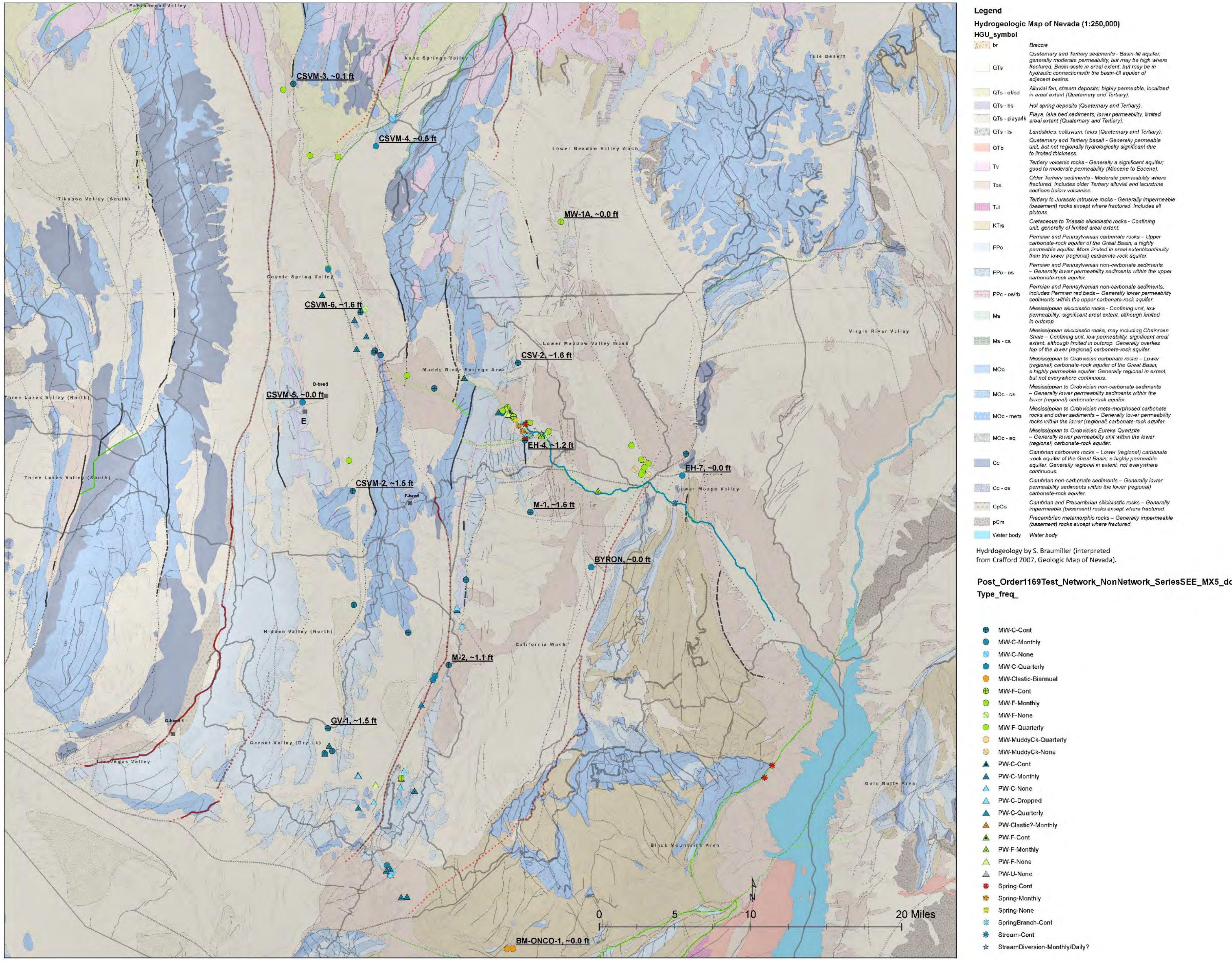

Figure 5. SeriesSEE estimates of drawdown induced by MX-5 test pumping during the Order 1169 pumping test, 9/15/2010 to 12/13/2012. Base hydrogeologic map interpreted by the author from the geologic map of Crafford 2007 (unpublished to date).

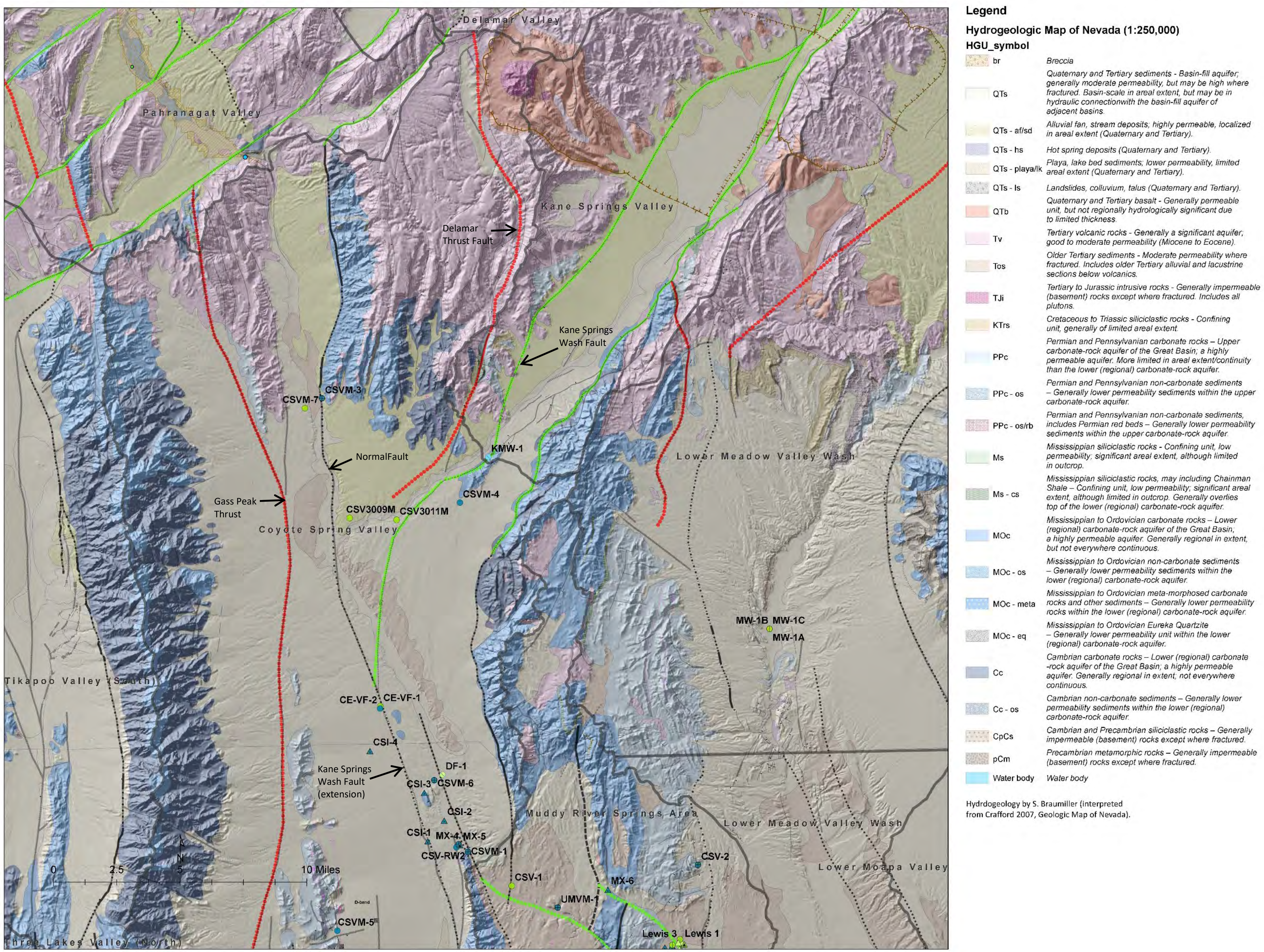

Figure 6. Hydrogeologic map showing Kane Springs and Coyote Spring valleys, carbonate monitoring wells, the Kane Springs Wash Fault (and extension), Delamar thrust fault, normal fault passing through the areas of CE-VF-2 and CSVM-3, Gass Peak thrust, and normal fault east of CSVM-6, MX-4, MX-5 and CSVM-1. Hydrogeologic units interpreted by the author from the geologic map of Crafford 2007 (unpublished to date).

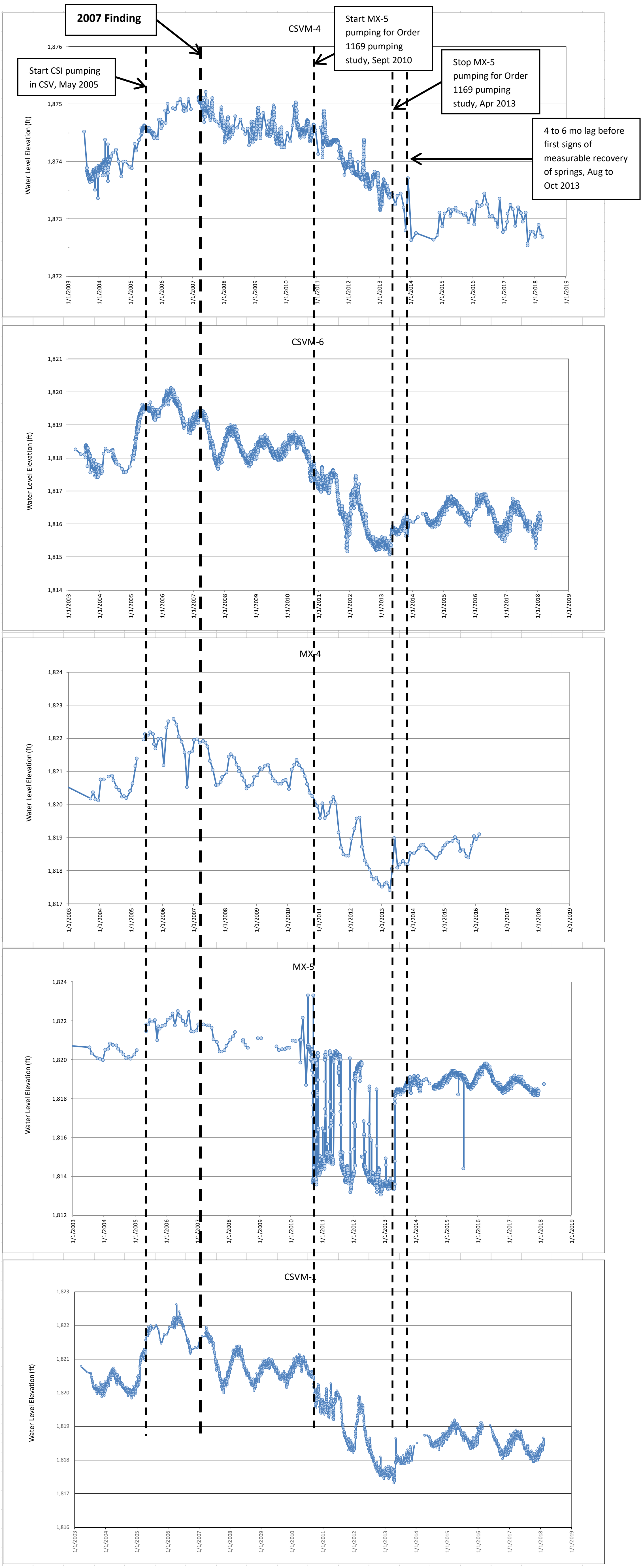

Figure 7. Change in water levels in carbonate well CSVM-4, northern Coyote Spring Valley, versus CSVM-6, MX-4, MX-5, and CSVM-1 in the central part of the basin prior to the 2007 finding (NSE 2007) and during the Order 1169 pumping test (NDWR 2018a); significant increases / decreases in carbonate pumping in the MRSA and Coyote Spring Valley (annotation).

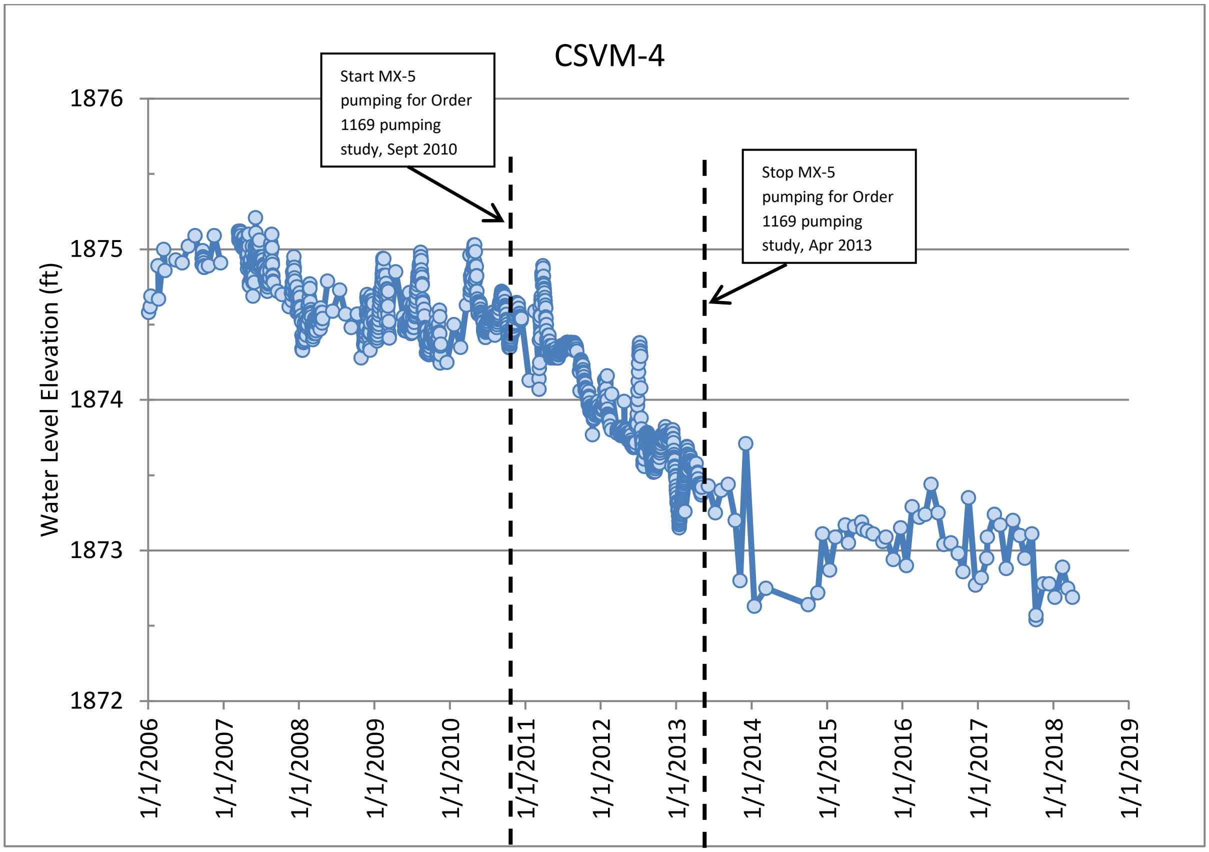

Figure 8a. Change in water level in carbonate monitoring well CSVM-4, northern Coyote Spring Valley, during the Order 1169 pumping test (~1.2 ft), September 2010 to December 2012 (NDWR 2018a).

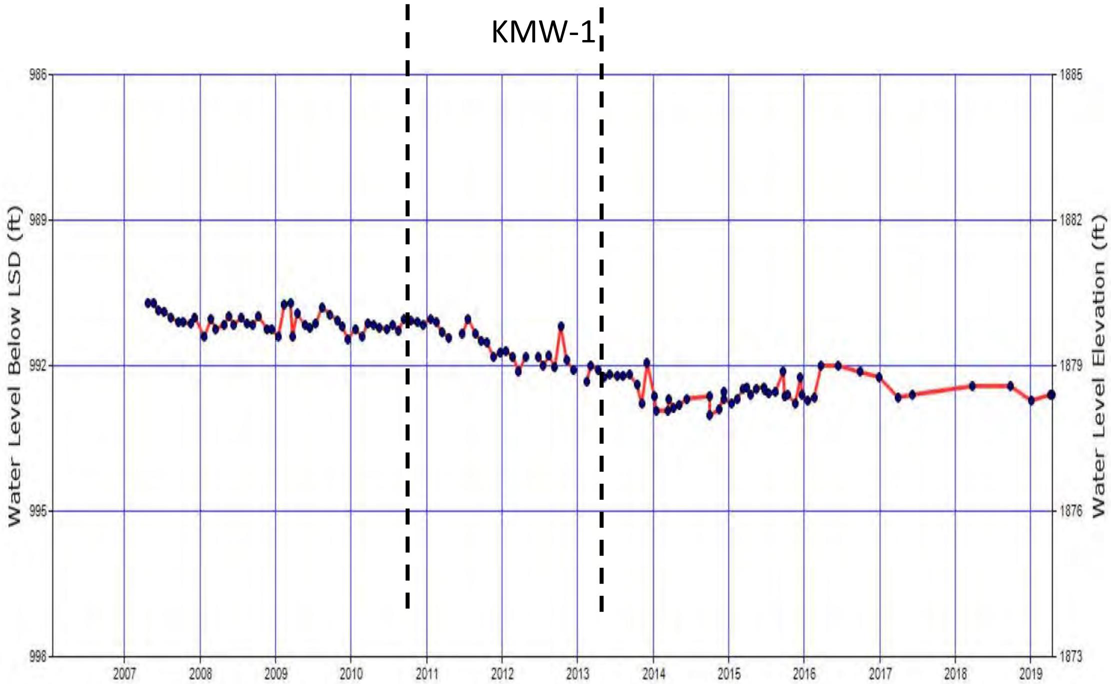

Figure 8b. Change in water level in carbonate monitoring well KMW-1, southern Kane Springs Valley, during the Order 1169 pumping test (~1.1 ft), September 2010 to December 2012 (hydrograph after NDWR 2019c).

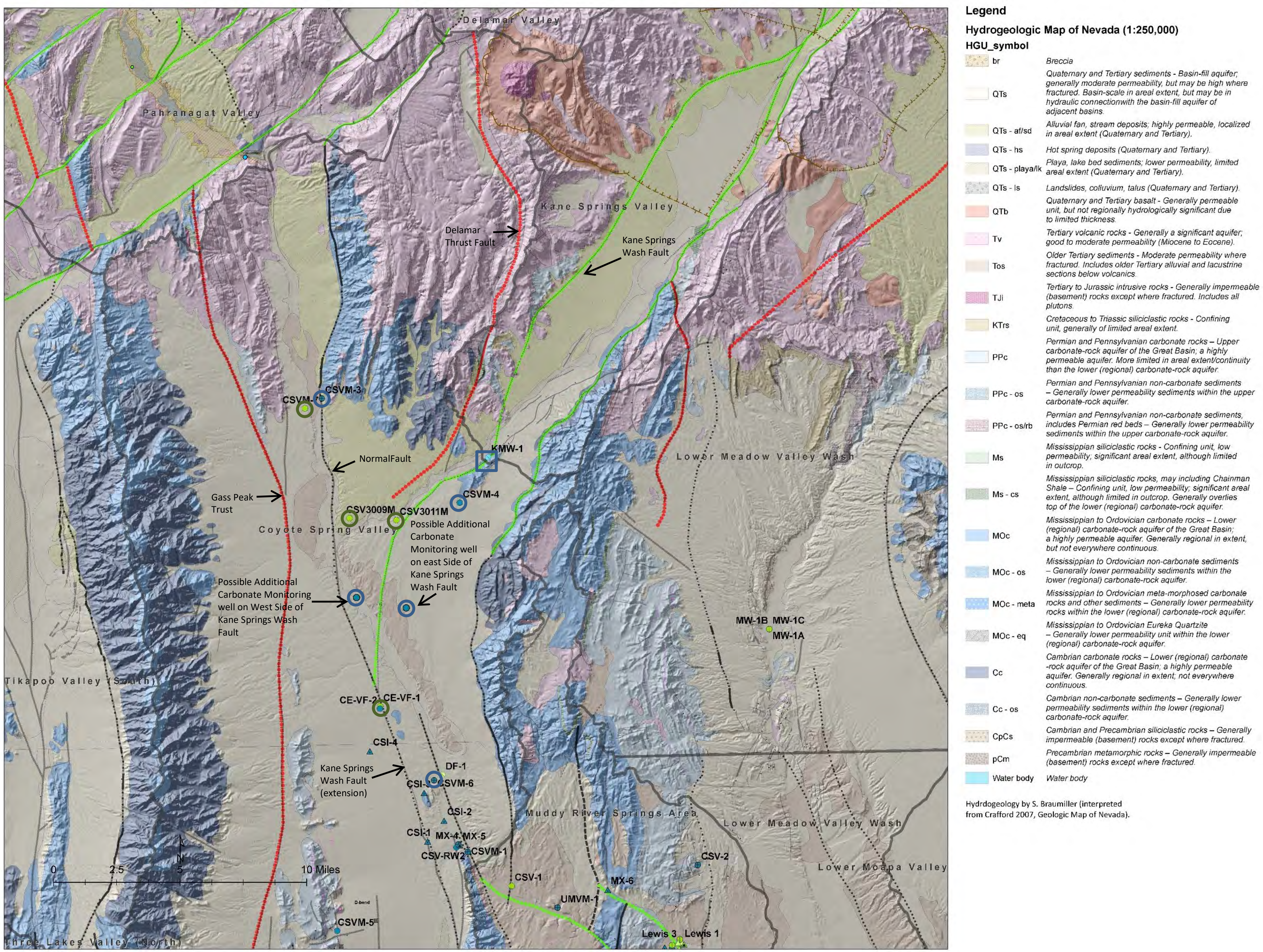

Figure 9. Hydrogeologic base map with locations of proposed observation wells (circles) for a long-term pumping test in carbonate well KMW-1 (square) in Kane Springs Valley. Hydrogeologic units interpreted by the author from the geologic map of Crafford 2007 (unpublished to date).

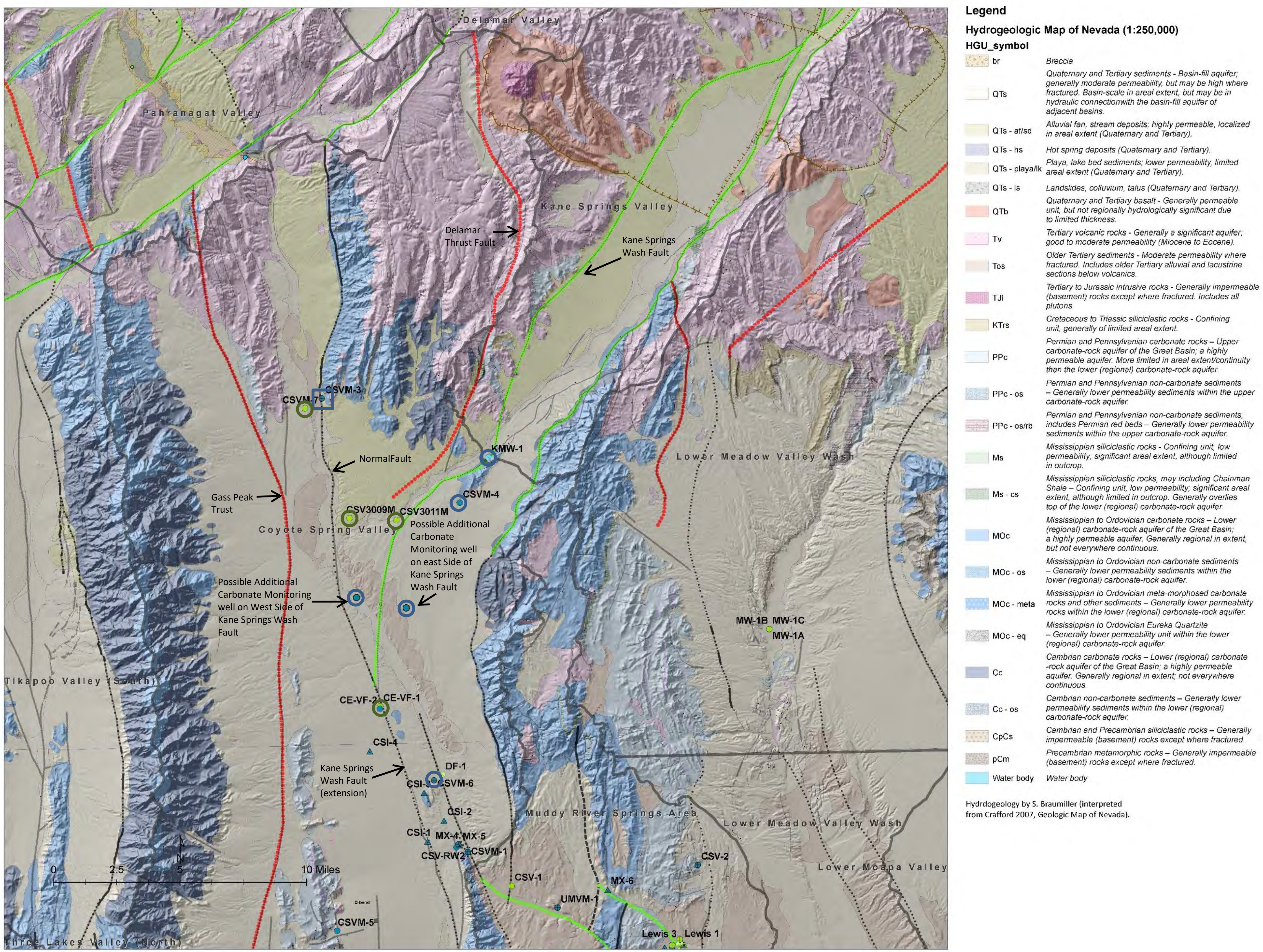

Figure 10. Hydrogeologic base map with locations of proposed observation wells (circles) for a long-term pumping test in carbonate well CSVM-3 (square) in northern Coyote Spring Valley. Hydrogeologic units interpreted by the author from the geologic map of Crafford 2007 (unpublished to date).

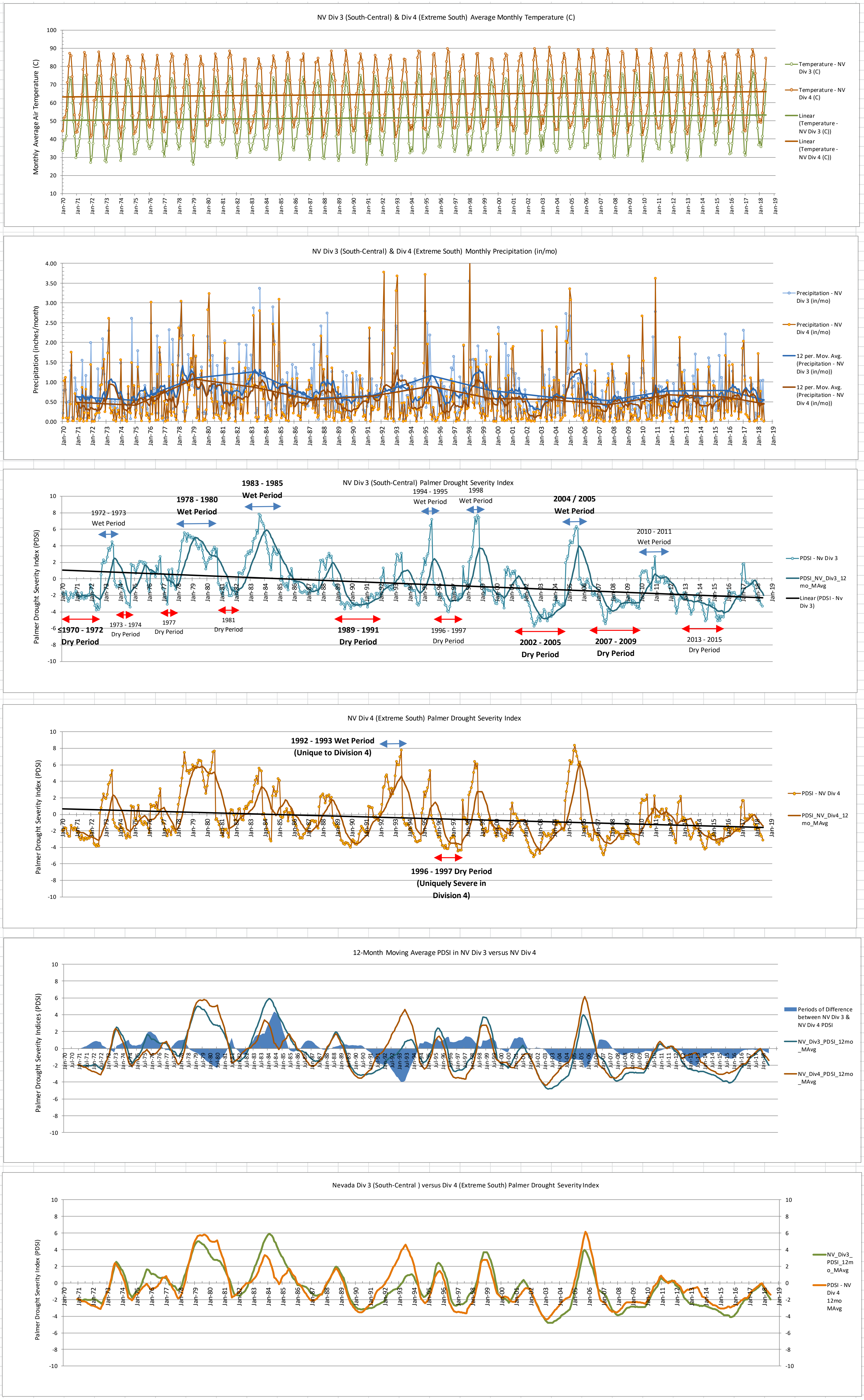

Figure 11. Climate data for Nevada Division 4 (Extreme South), the immediate area of the LWRFS, and Nevada Division 3 (South Central), areas immediately upgradient that are the primary source of groundwater in the LWRFS; January 1970 to May 2018 (NCDC 2018). Notable wet and dry periods based on Palmer Drought Severity Index (PDSI) values annotated.

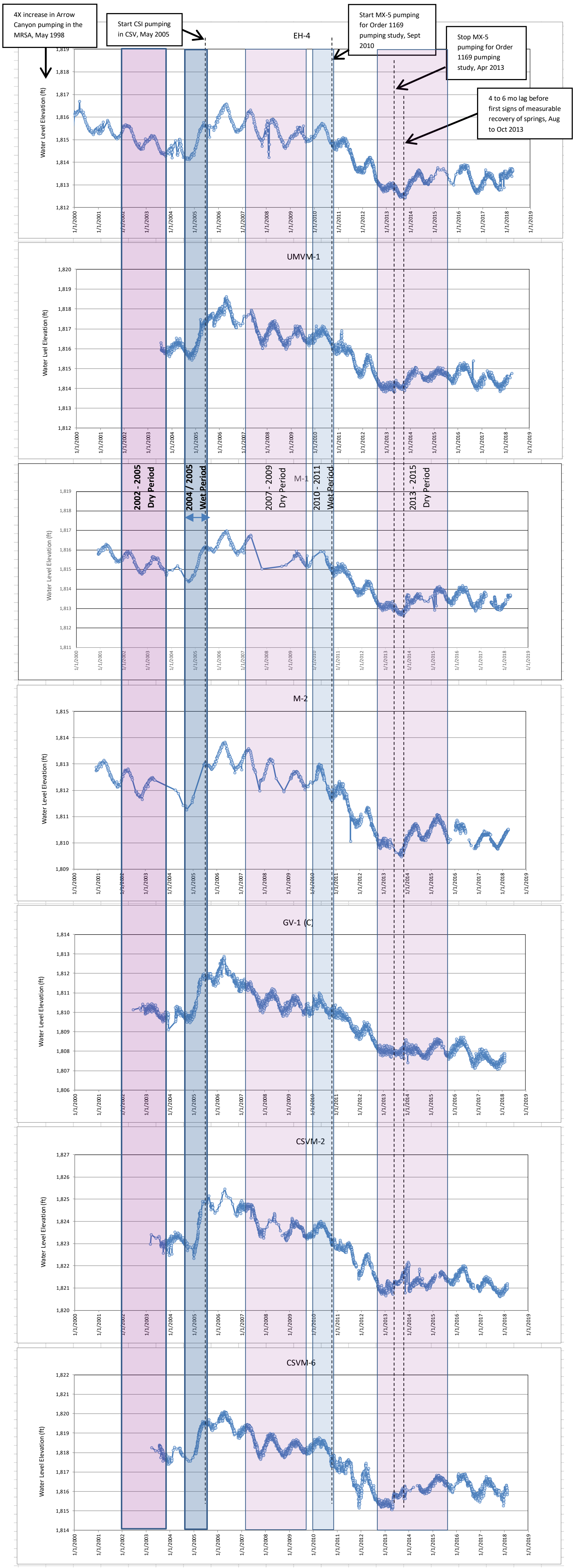

Figure 12. Wet climate signals (Nevada Divisions 3 and 4) in selected carbonate monitoring wells in the LWRFS. Notable wet and dry periods annotated relative to trends in groundwater level data, January 2000 to March 2018 (NDWR 2018a).

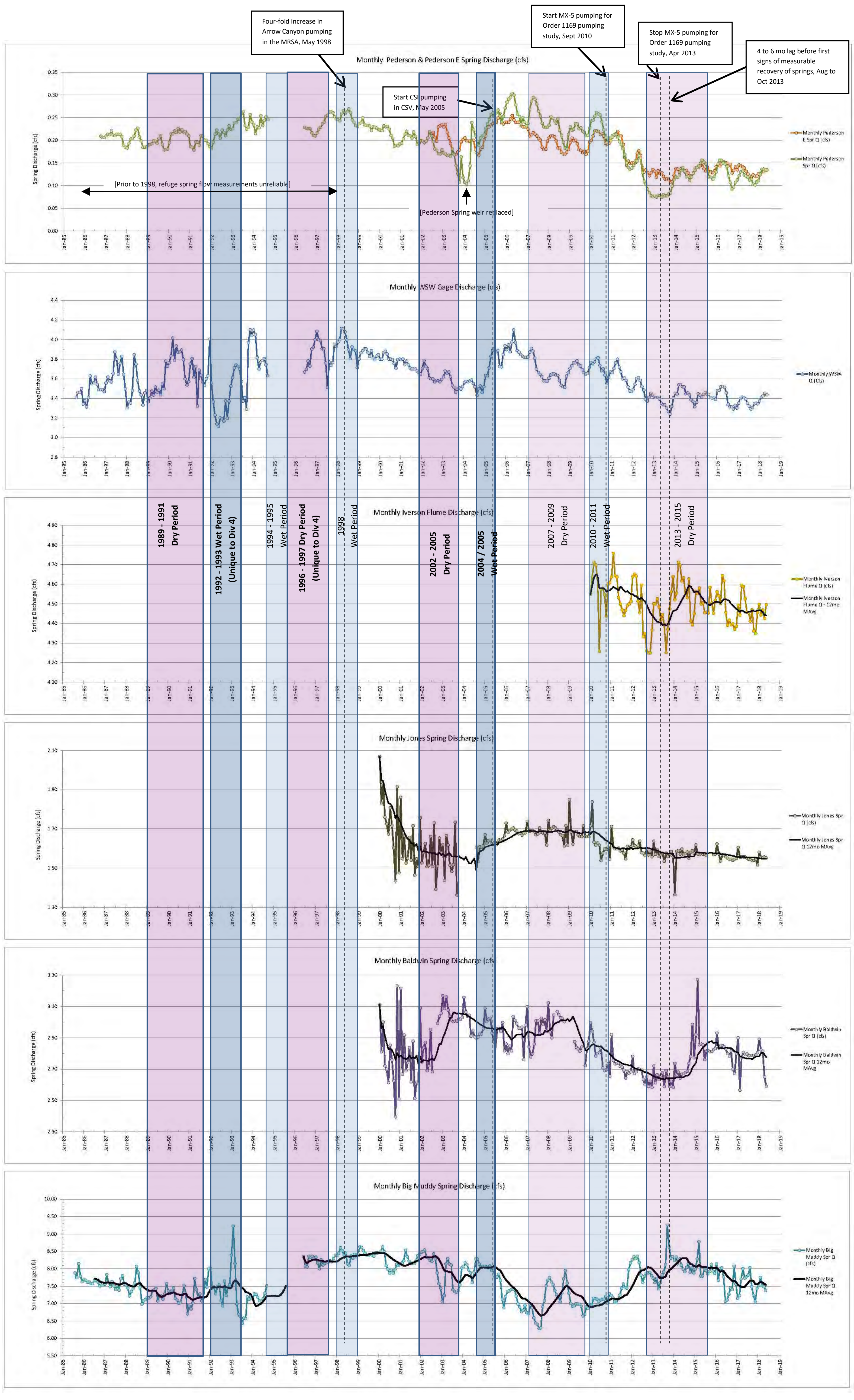

Figure 13. Wet climate signals (Nevada Climate Divisions 3 and 4) evident in the discharge records of most of the refuge springs, August 1985 to May 2018; less clear, absent, or anomalous in Baldwin and the Big Muddy springs (NDWR 2018a, USGS 2019). Notable wet and dry periods annotated relative to trends in groundwater level data, January 2000 to March 2018 (NDWR 2018a).

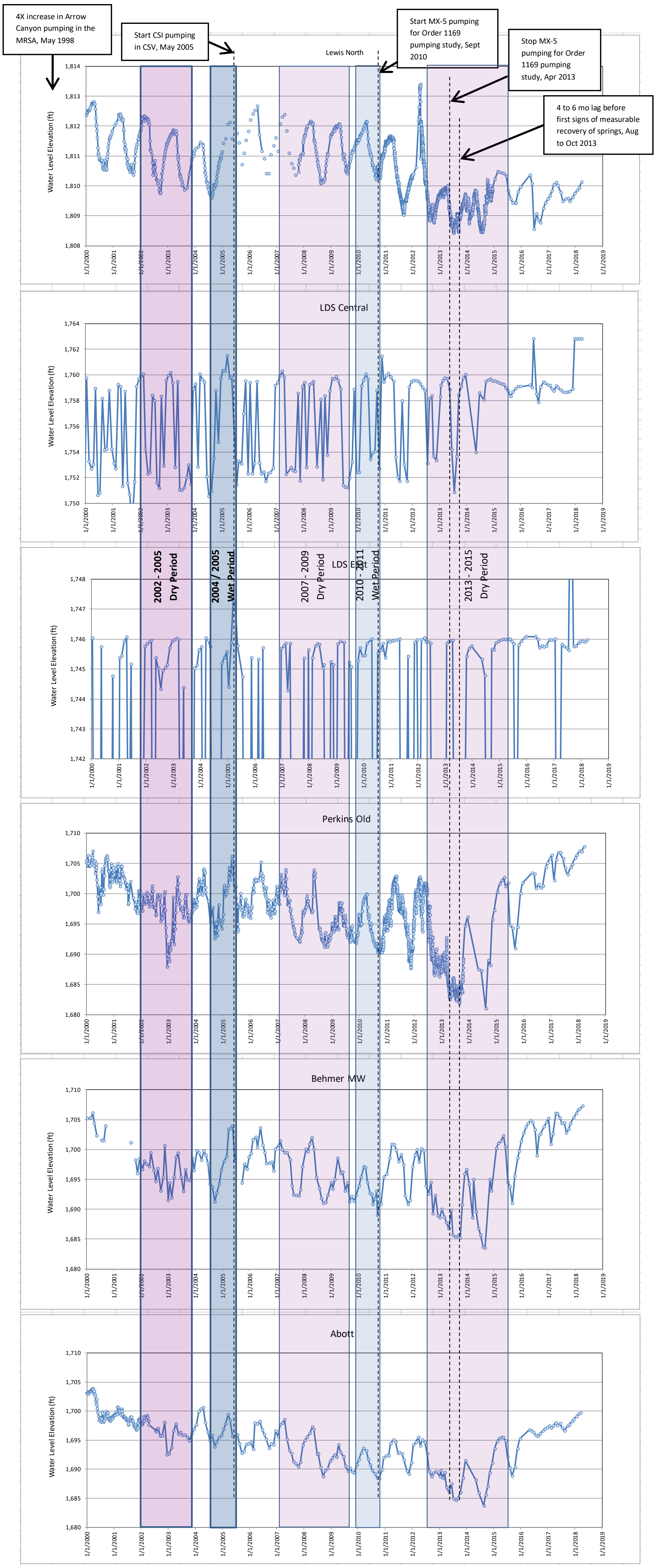

Figure 14. Wet climate signals (Nevada Climate Divisions 3 and 4) in selected alluvial monitoring wells in the LWRFS. Notable wet and dry periods annotated relative to trends in groundwater level data, January 2000 to May 2018 (NDWR 2018a).

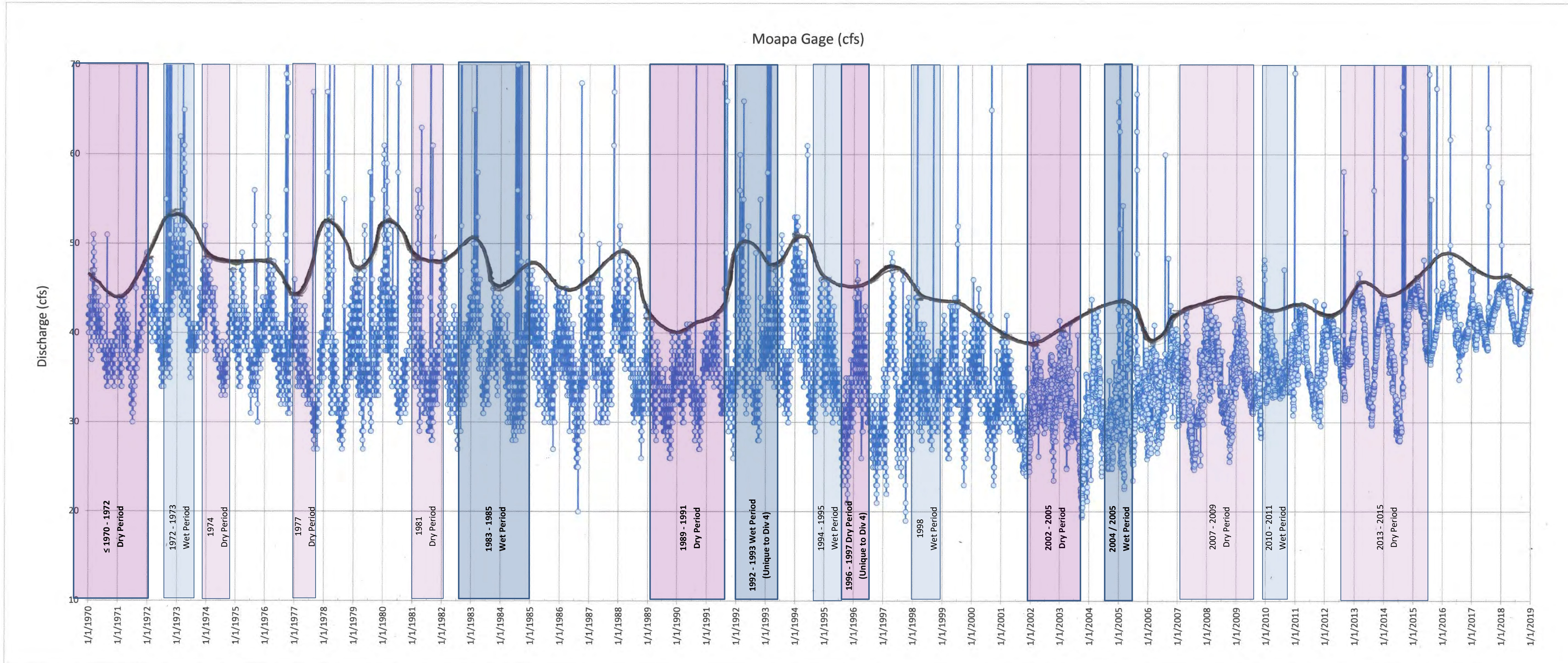

Figure 15. Wet and dry climate signals (Nevada Climate Divisions 3 and 4) evident in Moapa gage discharge record, January 1979 to January 2019 (USGS 2019). Notable wet and dry periods annotated relative to trends in discharge.

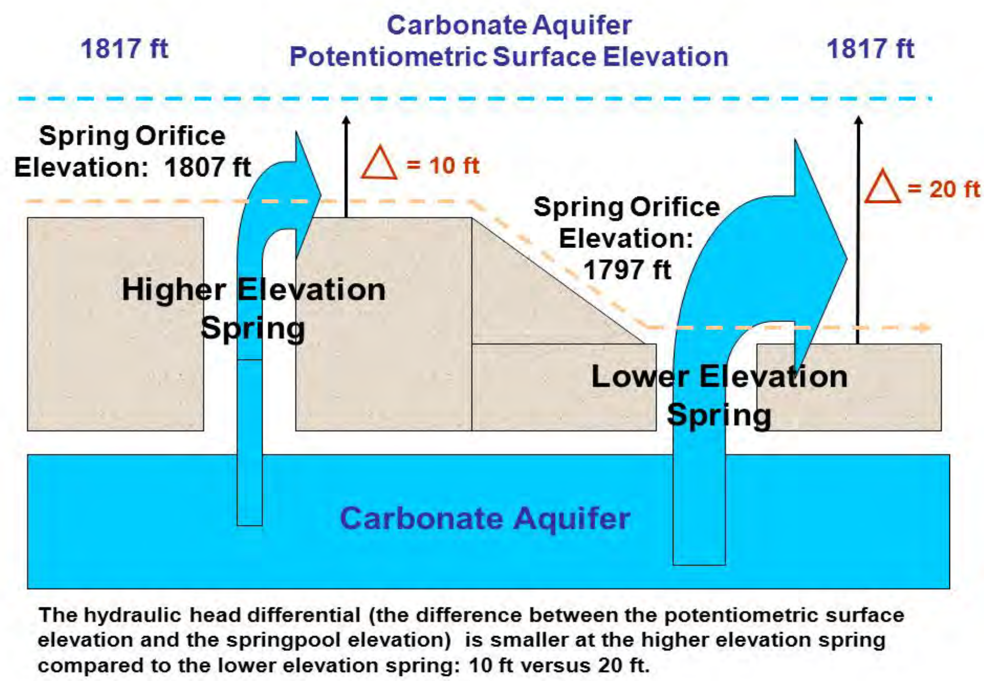

Figure 16. Theoretical head differential at springs of *different* elevation, assuming a uniform potentiometric surface in the regional carbonate-rock aquifer.

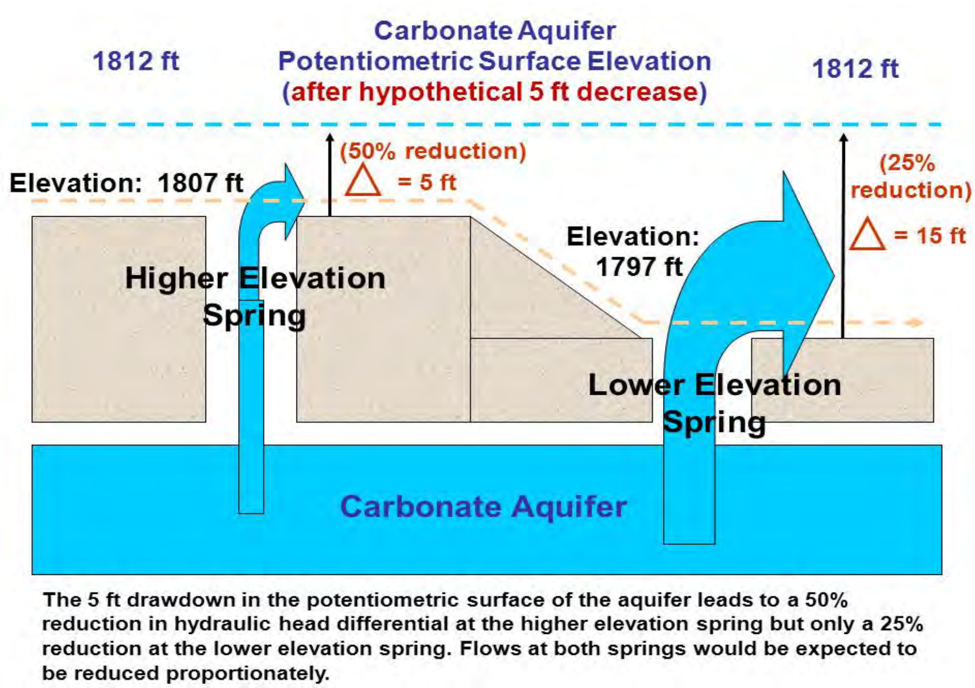

Figure 17. Theoretical effects of a uniform drawdown on head differential and spring discharge at higher and lower elevation springs.

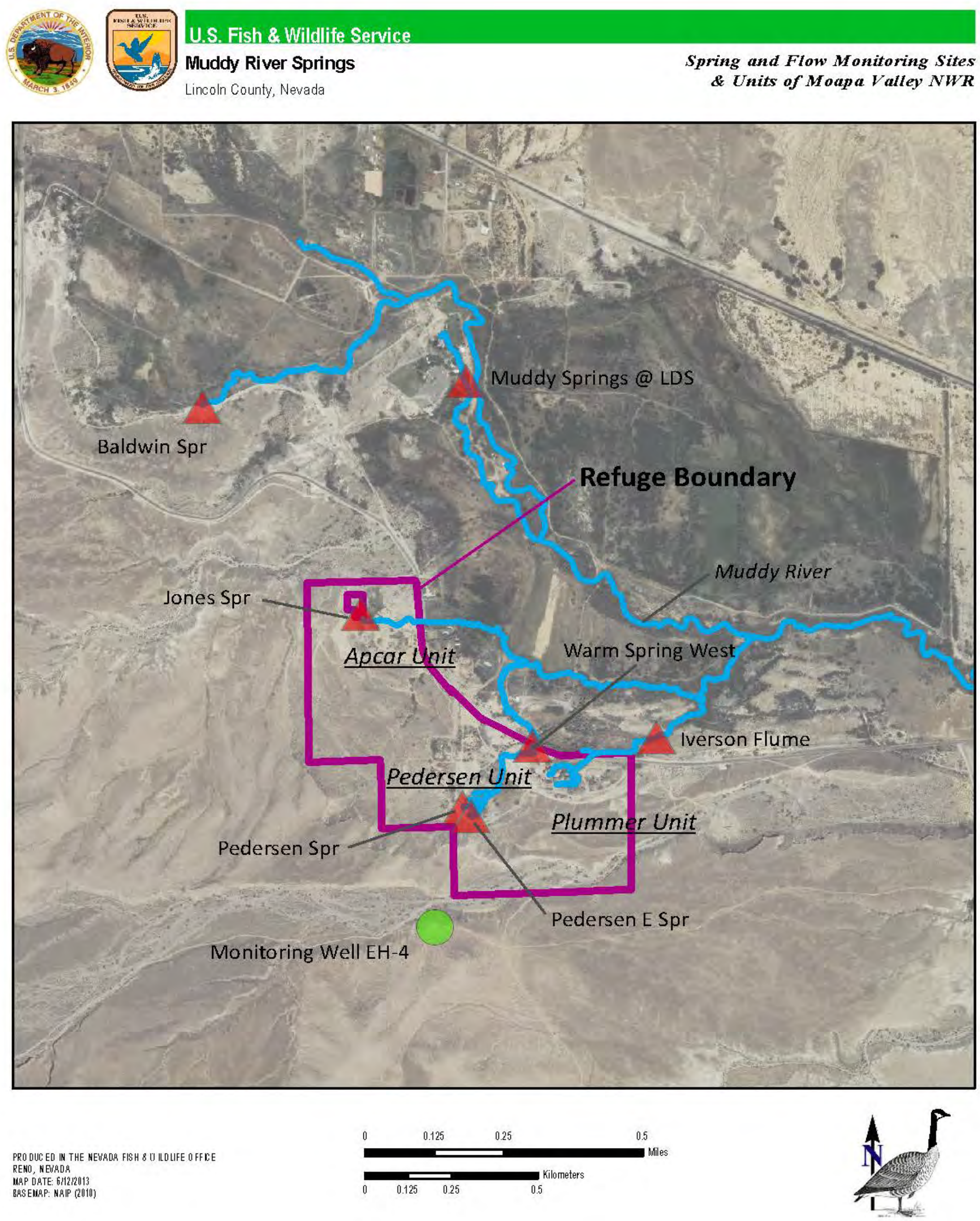

Figure 18. Map showing the locations of spring and flow monitoring sites; the boundary and three units of the Moapa Valley NWR; as well as the EH-4 carbonate monitoring well, all discussed in this section of the report.

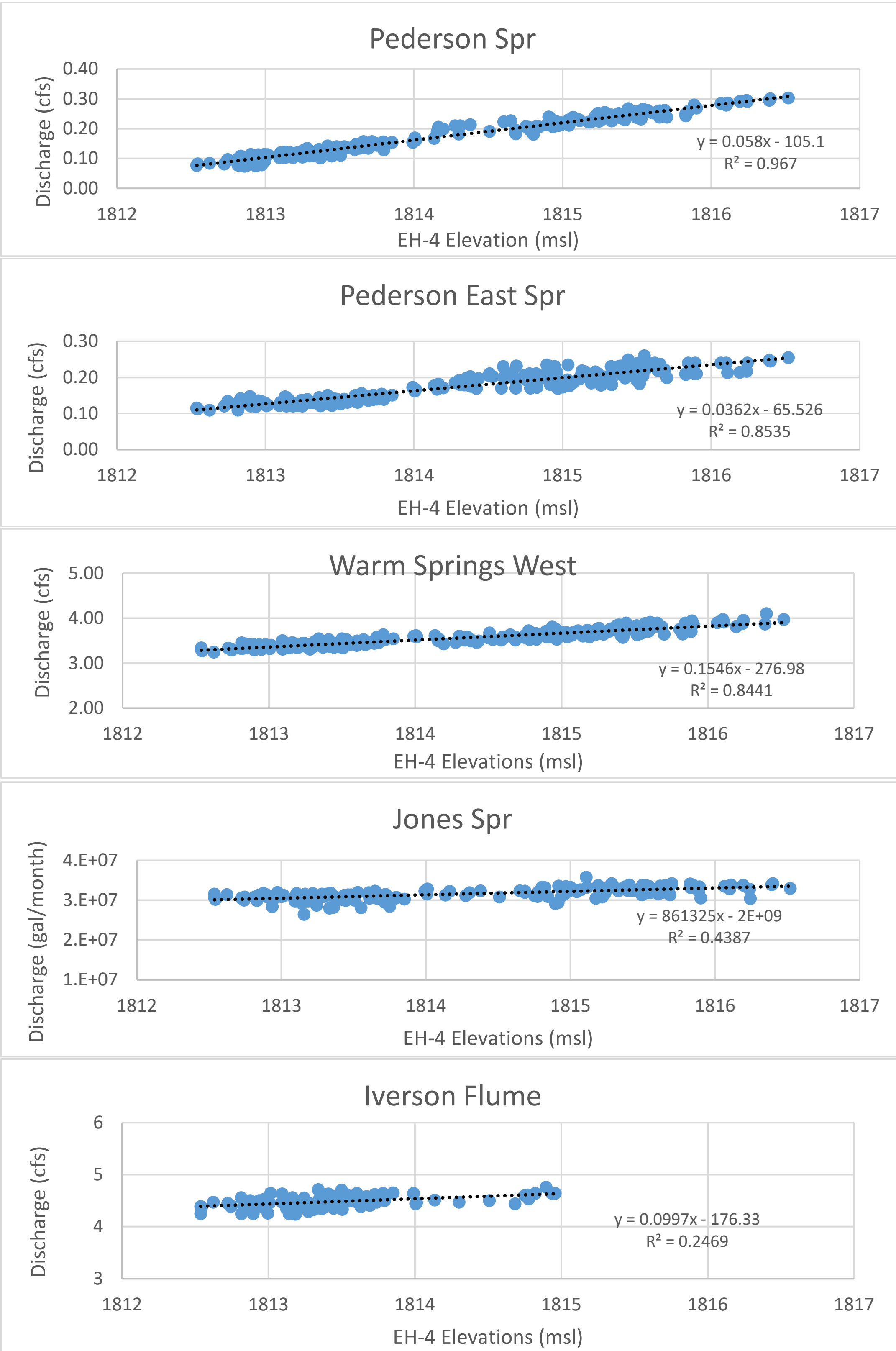

Figure 19. Discharge versus EH-4 elevations for five sites on or near the Moapa Valley NWR.

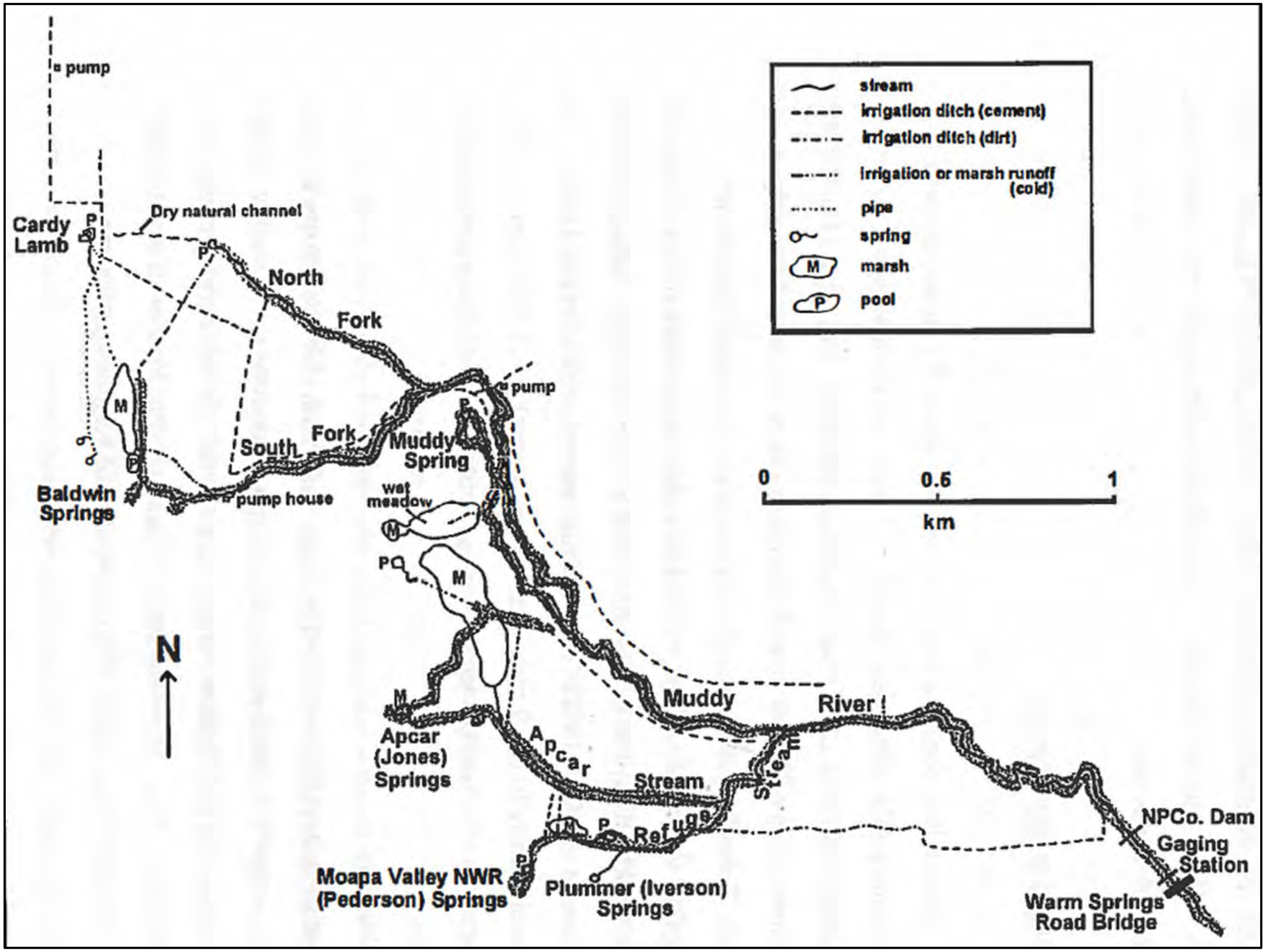

Figure 20. Map of the Muddy River Springs Area, showing the historical distribution of Moapa dace (shaded stream segments). Figure reproduced from USFWS Recovery Plan for the Rare Aquatic Species of the Muddy River System, revised 1996.

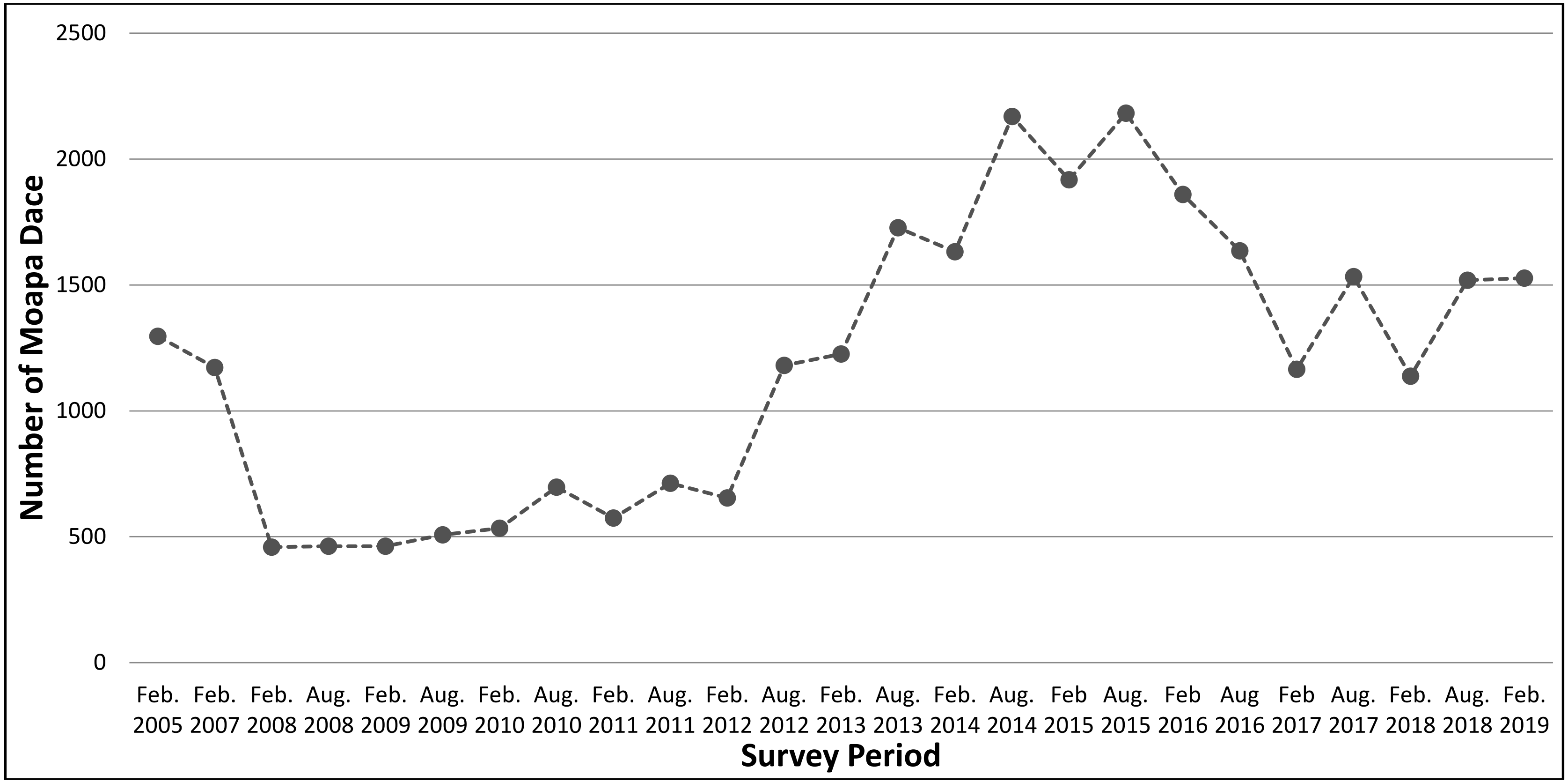

Figure 21. Population Abundance of Moapa dace for 2005 to 2019.

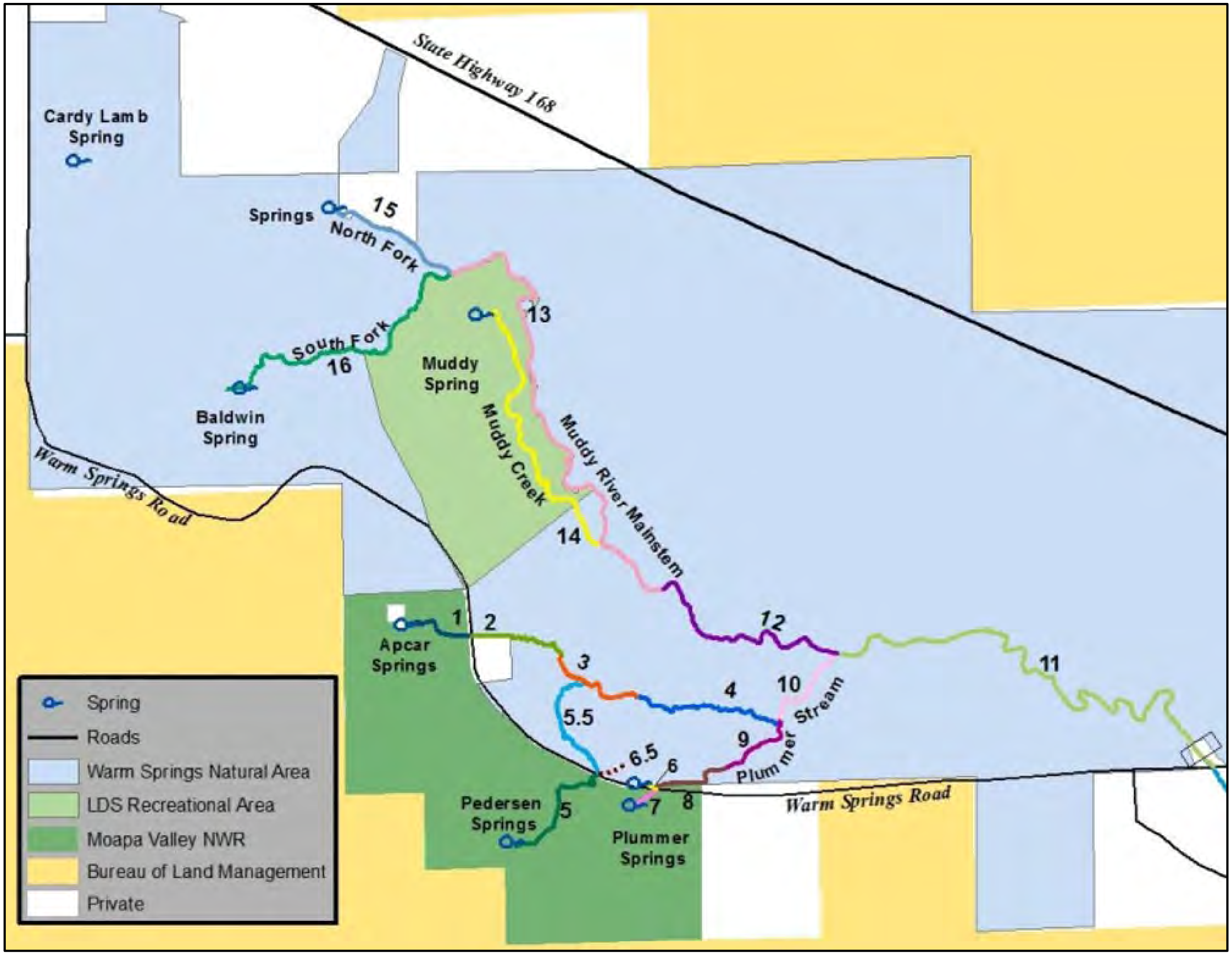

Figure 22. Stream Reach Map. Numerals (and corresponding colored segments) indicate stream reaches designated for the bi-annual spring and fall population surveys of Moapa dace.

Table 1. Summary of Results for Relationship of Discharge and Carbonate Water Level Elevations

Monitoring Site Name*	Type of Monitoring Site	Elevation of Springs Measured at Site (msl)	Correlation (r^2) with EH-4 Carbonate Water Levels over the POR	Slope Coefficient (and p-value) from Linear Regression	Relative Changes in Observed Discharge for the Range of EH4 Carbonate Water Levels in the POR	Estimated Change in Head Differential for the Range of EH4 Carbonate Water Levels in the POR
Pederson Spr	Spring Monitoring	1811	0.97	0.05803 (p=1.14E-129)	-73%	-72%
Pederson East Spr	Spring Monitoring	1807.7	0.85	0.03621 (p=1.59E-84)	-45%	-57%
Warm Springs West	Flow Monitoring	1792 to 1811	0.84	0.15463 (p=4.29E-87)	-19%	NA
Jones Spr**	Spring Monitoring	1776	0.42	861325 (p=5.29E-23)	-10%	-12%
Iverson Flume	Flow Monitoring	1749 to 1757	0.24	0.09971 (p=1.68E-7)	-6%	NA

* Spring and flow monitoring sites are ordered from high to low elevation, corresponding to their expected sensitivity to changes in groundwater levels.

** Units of flow for Jones Springs are gallons per month, all others are cfs. The values of the slope coefficients are dependent on the units.

Reach	Feb. 2005	Feb. 2007	Feb. 2008	Aug. 2008	Feb. 2009	Aug. 2009	Feb. 2010	Aug. 2010	Feb. 2011	Aug. 2011	Feb. 2012	Aug. 2012	Feb. 2013	Aug. 2013	Feb. 2014	Aug. 2014	Feb 2015	Aug. 2015	Feb 2016	Aug 2016	Feb 2017	Aug. 2017	Feb. 2018	Aug. 2018	Feb. 2019
1	6	0	0	N/A	N/A	1	7	20	28	67	74	84	69	72	66	66	119	158	106	135	105	129	64	87	53
2	87	42	50	22	29	34	13	35	20	54	78	79	139	310	271	335	429	227	349	208	169	296	230	256	382
3	52	14	0	4	2	4	3	0	1	8	10	31	127	248	229	309	244	299	218	182	170	236	300	377	371
4	18	0	0	3	0	10	7	0	2	1	0	13	62	156	133	198	187	190	93	66	44	56	10	100	125
5	174	395	50	82	80	84	82	90	99	108	66	94	128	85	70	206	118	90	105	46	29	32	49	51	88
5.5*	N/A	N/A	N/A	N/A	29	51	71	84	96	88	99	376	244	318	573	471	329	415	445	369	243	489	284	383	282
6*	80	128	56	67	9	5	8	5	22	27	10	59	36	48	20	49	31	36	17	84	15	24	6	12	25
6.5*	--	--	19	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	177	170	148	208	187	218	166	393	188	206	109	159	113	144	49	121	91	148	106	134	90	52	40	60	46
8	406	282	59	28	61	42	118	40	78	55	107	112	141	161	113	240	186	270	242	209	133	105	68	57	55
9	166	47	40	24	23	39	43	29	40	85	100	157	153	185	103	122	152	220	105	150	77	42	42	60	47
10	62	54	14	1	32	15	11	1	0	13	0	17	14	0	5	52	30	123	68	41	69	55	2	44	11
11	--	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
12	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	3	0
13	45	16	5	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	0	1	0
14	0	0	0	0	N/A	0	0	0	0	1	1	0	0	0	0	0	1	6	2	11	12	14	42	28	22
15	9	15	17	0	7	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
16	10	9	1	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	20
Total	1296	1172	459	462	462	508	534	697	574	713	654	1181	1226	1727	1632	2169	1918	2182	1859	1635	1165	1533	1138	1519	1527

Table 2. Bi-annual population estimates of Moapa dace from 2005 to 2019. Specific stream reaches are identified numerically 1 to 16, and correspond to the Stream Reach Map (Figure 3).

United States Department of the Interior

OFFICE OF THE SOLICITOR
Pacific Southwest Region
2800 Cottage Way
Room E-1712
Sacramento, California 95825-1890

IN REPLY
REFER TO:

August 16, 2019

Tim Wilson, P.E., Acting State Engineer
Nevada Division of Water Resources
901 S. Stewart Street, Suite 2002
Carson City, Nevada 89701-5250

Subject: Rebuttal to Report: Water-Level Decline in the Lower White River Flow System (LWRFS): Managing for Sustainable Groundwater Development by Cady Johnson and Martin Mifflin, Mifflin & Associates, Inc., submitted by the Moapa Band of Paiutes in accordance with Order 1303

Dear Mr. Wilson:

In accordance with your January 11, 2019, Order 1303 and May 15, 2019, Addendum to Order 1303, and on behalf of the U. S. Fish and Wildlife Service (Service), we are submitting the Services' Rebuttal to Report: Water-Level Decline in the Lower White River Flow System (LWRFS): Managing for Sustainable Groundwater Development by Cady Johnson and Martin Mifflin, Mifflin & Associates, Inc., submitted by the Moapa Band of Paiutes. We believe the information in our rebuttal is important for you to consider in your evaluation of information received in response to Order 1303 and in future management of the LWRFS.

We appreciate this opportunity to provide additional information to your office in response to Order 1303 and the opportunity to continue to work with you and the other interested parties to determine how best to manage these public resources. If you have any questions or need further information, please contact me at (916) 978-5675. Thank you.

Sincerely,
VERONICA ROWAN
Digitally signed by VERONICA ROWAN
Veronica Rowan,
Assistant Regional Solicitor

encl.

Rebuttal to:

Water-Level Decline in the LWRFS:
Managing for Sustainable Groundwater Development

Cady Johnson and Martin Mifflin
Mifflin & Associates, Inc. (MAI)

Submitted by the Moapa Band of Paiutes in Response to Order 1303

Presented to the Office of the Nevada State Engineer
in accordance with Order 1303

Tim Mayer, Supervisory Hydrologist

Water Resources Branch

U.S. Fish and Wildlife Service

August 16, 2019

Major Conclusions of the Rebuttal

1) This is a rebuttal to report: Water-Level Decline in the LWRFS: Managing for Sustainable Groundwater Development by Cady Johnson and Martin Mifflin, Mifflin & Associates, Inc. (Johnson and Mifflin, (2019)), submitted by the Moapa Band of Paiutes in accordance with Order 1303. The authors of the report contend that long-term drought is at least partially responsible for the multi-decadal declines in water levels observed in the Lower White River Flow System (LWRFS). Specifically, they state (on pg 2 of the report) that "if the long-term drought evident in the climate records persists…mitigation measures, including curtailment (of pumping) will not prove effective in protecting senior-right holders in the Muddy River and Moapa dace habitat from continued drought impacts." However, we contend that the report fails to demonstrate or provide any evidence for the existence of a long-term, regional drought.

2) The information presented in this rebuttal is a simple analysis of precipitation and drought index data for Nevada Climate Divisions 3 and 4; monitoring well data from several undeveloped basins (181, 182, 221) located immediately to the north of the LWFRS; and monthly baseflow from the North Fork of the Virgin River (USGS Site No. 9405500). The baseflow at the North Fork Virgin River is purported by Johnson and Mifflin (2019) to represent climate in the LWRFS. As demonstrated here, all of these data examined in this rebuttal lack any kind of consistent signal or decline that would be indicative of a long-term, regional drought.

3) The multi-decadal declines in water levels that have been observed in the LFWRS cannot be attributed to long-term, regional drought because there is no evidence that such a drought exists in the region.

4) The statistical analysis presented by Johnson and Mifflin (2019) shows erroneous or questionable results in the limited output that is available in the report. The inadequacy of the results and information presented in the report prevents a more in-depth review. The absence of any discussion of variable/model selection, statistical significance, residual analysis, heteroscedasticity, multicollinearity, or autocorrelation in the report is of major concern. It indicates a lack of awareness of the assumptions and potential pitfalls with multiple linear regression analysis.

Introduction

The main contention in the Johnson and Mifflin (2019) report is that there is long-term drought in the region and this has affected well levels and spring flows in the LWRFS and the Muddy River Spring Area (MRSA) and will continue to do so in the future. They conclude that mitigation measures to limit or curtail pumping in the LWRFS, including those in the 2006 Memorandum of Agreement between the Southern Nevada Water Authority, the USFWS, Coyote Springs Investment LLC, the Moapa Band of Paiute Indians, and the Moapa Valley Water District (U.S. Fish and Wildlife Service 2006), are entirely unnecessary and will be ineffective in the future. The report focuses on EH-4 water levels, which is a carbonate monitoring well located close to the Moapa Valley National Wildlife Refuge. This well is of particular interest to the U.S. Fish and Wildlife Service because of its proximity to the refuge and because water levels in the well are strongly correlated with springflows that support Moapa dace habitat on the refuge. Monthly water levels in EH-4 are shown in Figure 1 for the period of record (POR) for illustrative purposes.

As shown in this rebuttal, the evidence of a long-term drought in the region is weak or ambiguous. This conclusion is based on an analysis of divisional precipitation data, divisional drought indices, water level data from monitoring wells in the region not affected by pumping, and the North Fork Virgin River baseflow data. There are also errors that were made in the statistical analysis in Johnson and Mifflin (2019), errors that affect the conclusions from their analysis. However, the authors were unwilling to share results or any of the output files that they cited in their report at the time of this rebuttal. The lack of the results or information presented in the statistical analysis, as well as access to the output files from the analysis, prevents a more in-depth review.

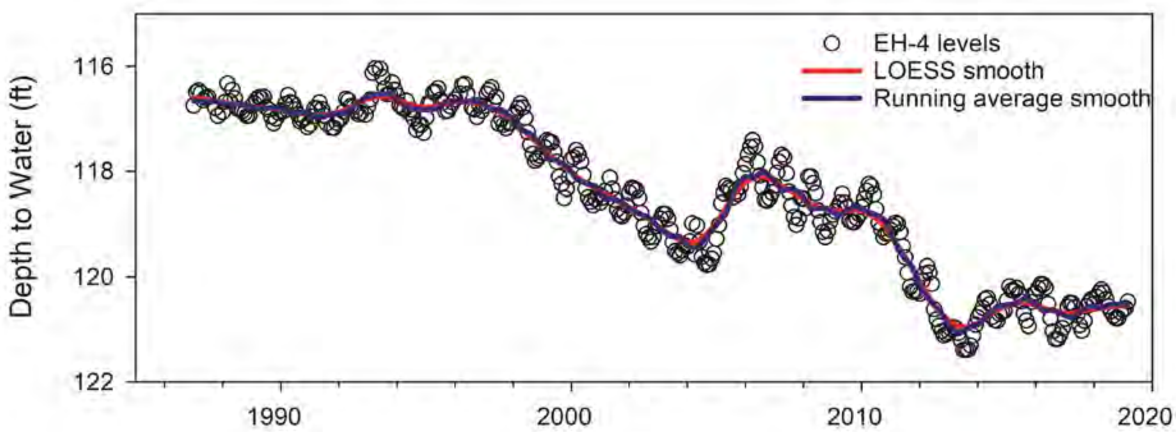

Figure 1. Monthly depth to water in carbonate monitoring well EH-4 for the period 1987-2019, along with a LOESS smooth and a 3-year running average.

Climate Division Data

There are two climate divisions that overlay the LWRFS and its contributing recharge area to the north: Nevada Climate Division 4 (Extreme South) and Division 3 (South Central). Climate division data for both divisions were downloaded from the NOAA website at https://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php including monthly precipitation, monthly Palmer Drought Severity Index (PDSI), and monthly Palmer Hydrologic Drought Index (PDHI). Only the PHDI for Division 4 was included here, since there was very little difference between the PSDI and PHDI. Graphs of these data for the past 30 years, from 1990-2019, are shown in Figures 2-5. The PDSI and PHDI are standardized indices so for both indices, the values represent standard deviations from the mean. A value of zero indicates average conditions and departures above (or below) zero indicate progressively wetter (or drier) conditions. For example, a value of 1 (or -1) indicates a value one standard deviation above (or below) the mean. By definition, severe drought conditions are indicated by values between -3 and -4 and extreme drought conditions are indicated by values <-4. Similar adjectives are attached to positive values of wet periods. These thresholds are depicted on Figures 3 and 5.

In Division 4 (Extreme South NV), which overlies most of the LWRFS, there were several periods of wet conditions interspersed with dry periods during the first half of the 1990-2019 POR (Figure 2). There appears to have been a lack of severe and extreme years, both wet and dry, in the second half of the POR. This is confirmed in Figure 3, which plots two drought indices for Division 4 and shows fewer cycles of wet and dry periods in the last half of the record as well. There is a brief period of severe drought in 2014-15 but the division recovers from this and becomes extremely wet by 2019.

The big difference between Division 4 and Division 3 (South Central, to the north of the LWRFS), is that the years from 2012-2015 show extreme drought for a more prolonged period in Division 3 compared to Division 4 (Figures 4 and 5). However, as in Division 4, the system gets wet again in 2017, briefly dips into extreme drought again in 2018, and then becomes severely wet by 2019. There does not seem to be a consistent pattern of long-term drought in either division. While a dry period existed in the 2012-2015 period, and it was worse in Division 3 than Division 4, similar dry conditions occurred in 1996-97, 2002-03, and 2007-08 (Figures 3 and 5) in both divisions without any notable change in water level trends in EH-4 (Figure 1). And these dry conditions definitely disappeared by 2019 when both divisions show extremely wet conditions.[1]

[1] In the USFWS Order 1303 report (USFWS, 2019), we noted that there appeared to be a drying trend in the PDSI for both divisions over the 1970-2018 period, and that climate, in addition to pumping, can affect water levels in wells and spring and stream flows in the LWRFS. However, we noted in the report that the linear trend was not statistically significant (statistical significance is explained in the Review of Statistical Analysis section of this rebuttal) and that more analysis is needed. Based on the more thorough examination of the data and available information provided in this rebuttal, there does not appear to be a long-term drying trend in the LWRFS over the past 30 years.

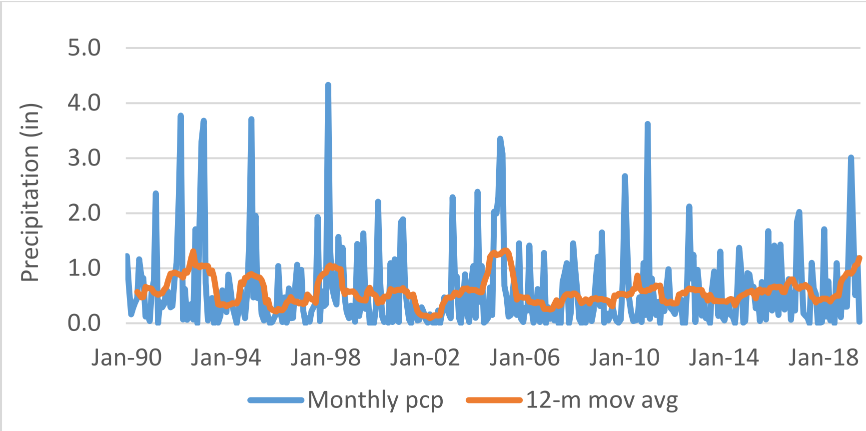

Figure 2. NV Climate Division 4 Monthly Precipitation 1990-2019

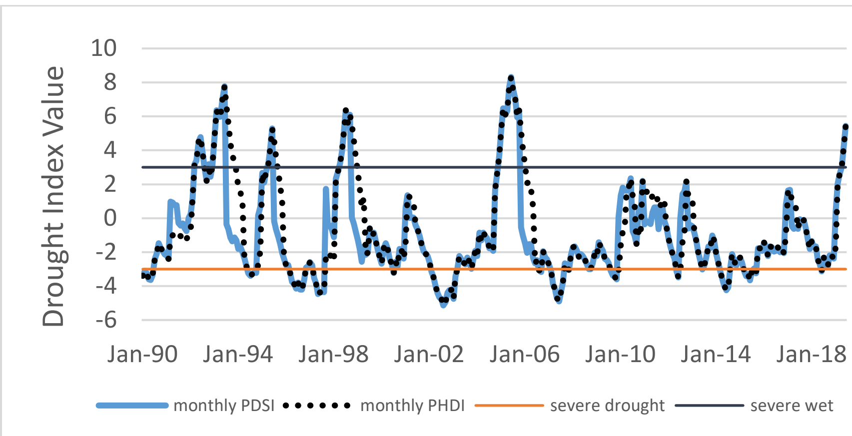

Figure 3. NV Climate Division 4 monthly PDSI and PHDI 1990-2019

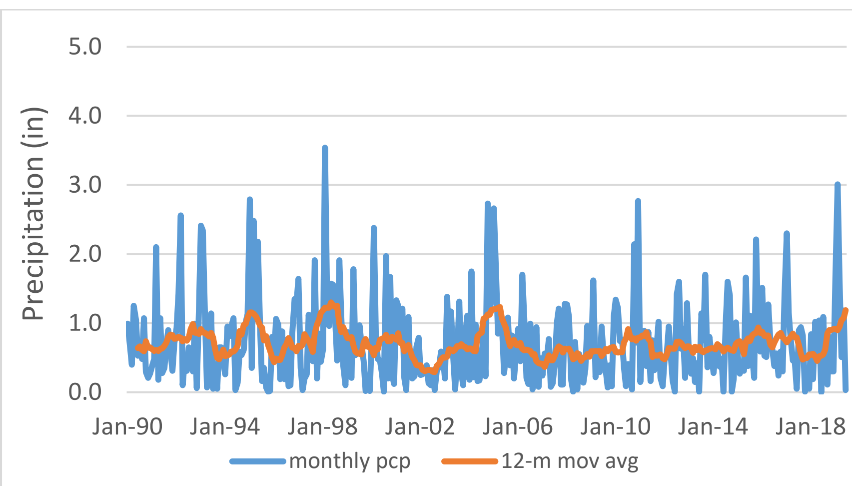

Figure 4. NV Climate Division 3 Monthly Precipitation 1990-2019

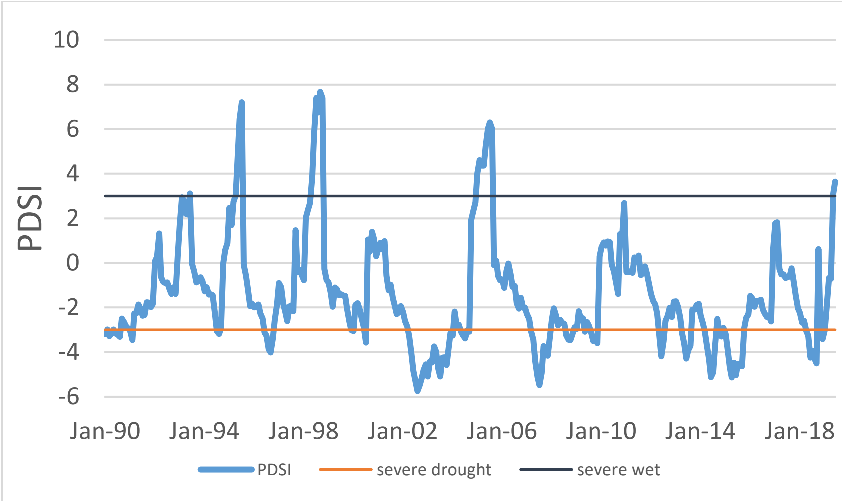

Figure 5. NV Climate Division 3 monthly PDSI 1990-2019

Monitoring Well Data

The next step in this analysis was to examine water level data from a number of monitoring wells in locations or hydrographic basins that are not affected by pumping and are presumably responding to the impacts of climate only. Data from the NDWR website were downloaded for three basins north of, but nearly adjacent to, the LWRFS. The data were from 3 DDC Stipulation monitoring wells in Delamar Valley (Basin 182), 3 DDC Stipulation monitoring wells and 1 USGS monitoring well in Dry Lake Valley (Basin 181), and 13 of the 14 monitoring wells installed by Vidler Water Co. in Tule Desert (Basin 221). (One monitoring well in Tule Desert, MW-7, was excluded because of irregularities in the hydrograph). All three basins are located in the general area of recharge for the LWRFS. All three basins have little or no pumping and the wells are assumed to be responding to the same regional climate signal as the wells in the LWRFS. In addition, data was downloaded for the CSVM-5 monitoring well in Coyote Spring Valley, a higher-elevation well located on the east slopes of the Sheep Mountains in the LWRFS that is presumed to be unaffected by pumping and responding to local recharge only.

In Delamar Valley for the period 2008-2019 (Figure 6), one well shows a slight decline in water levels, but only since 2016, while the other two wells are stable for the period. In Dry Lake Valley for the same years (Figure 7), one well shows a long-term decline, two wells show long-term increases, and one is stable for the period. In Tule Desert for the same years (Figure 8), three of the wells show long-term increases in water levels and the other well was stable over the period. For the sake of brevity, only four of the 13 wells in Tule Desert are shown here but almost all of the remaining wells show long-term increases through the period and none showed a decline. In Coyote Spring Valley for the period 2003-2019 (Figure 9), CSVM-5 shows a long-term increase in water levels for the POR. Note that there is a small increase (relative to the total increase observed over the entire POR) in response to the extremely wet conditions of 2005. A similar response was observed in EH-4 and most of the other wells in the LWRFS, as discussed below. None of the other monitoring wells discussed in this section have records extending back to 2005 so it is not known if they responded similarly.

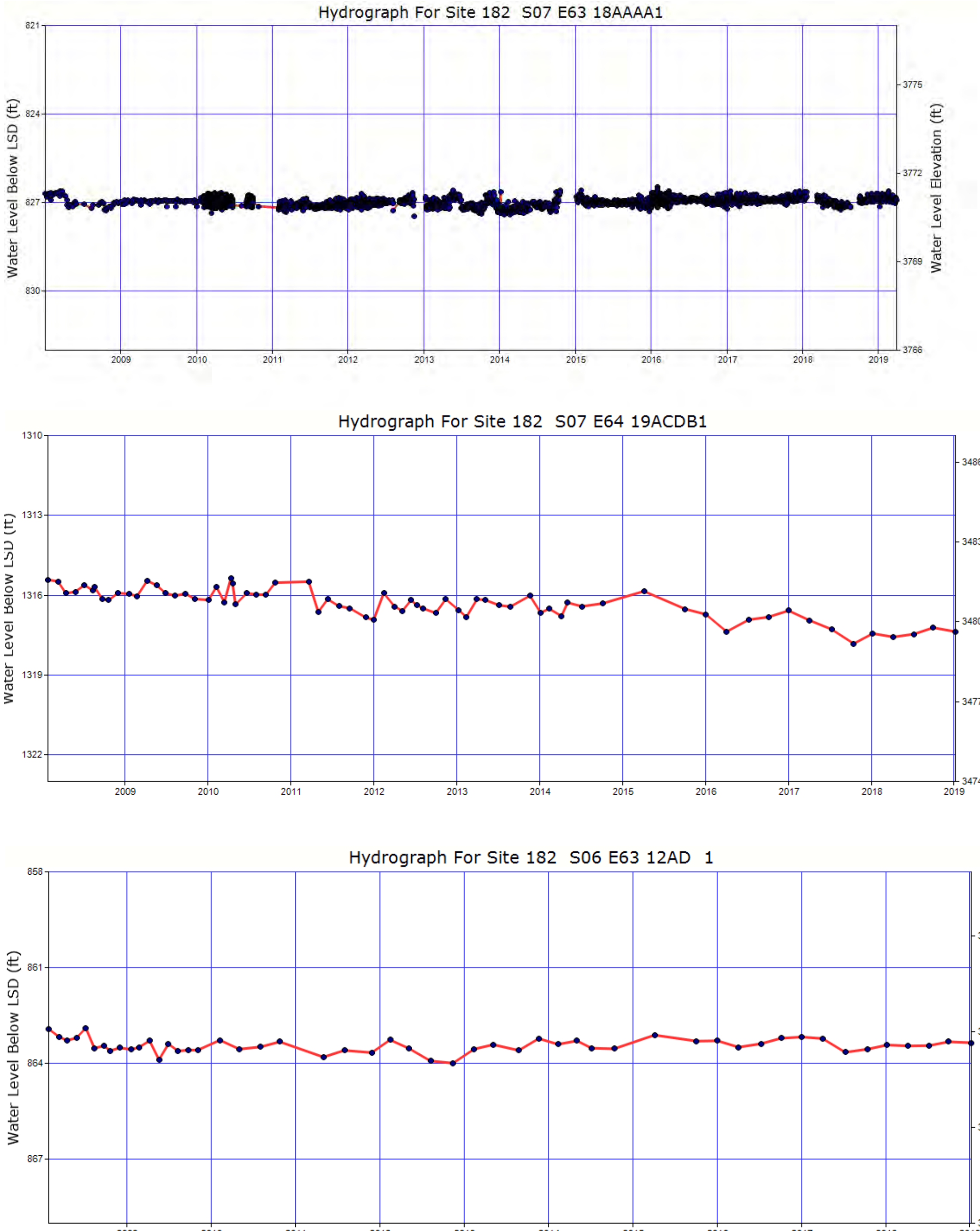

Figure 6. Water levels in three monitoring wells in Delamar Valley (Basin 182) for the period 2008-2019.

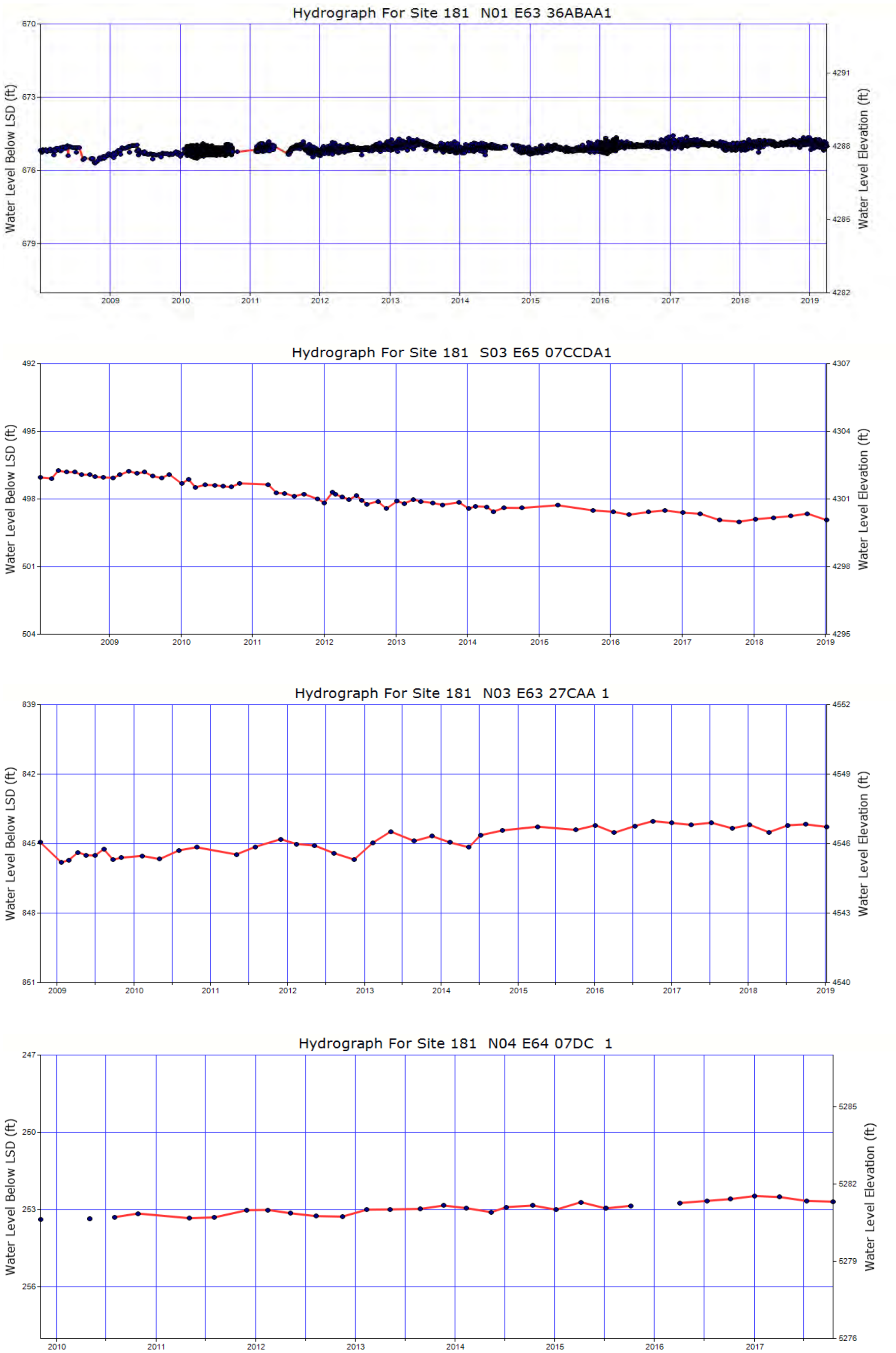

Figure 7. Water levels in four monitoring wells in Dry Lake Valley (Basin 181) for the period 2008-2019.

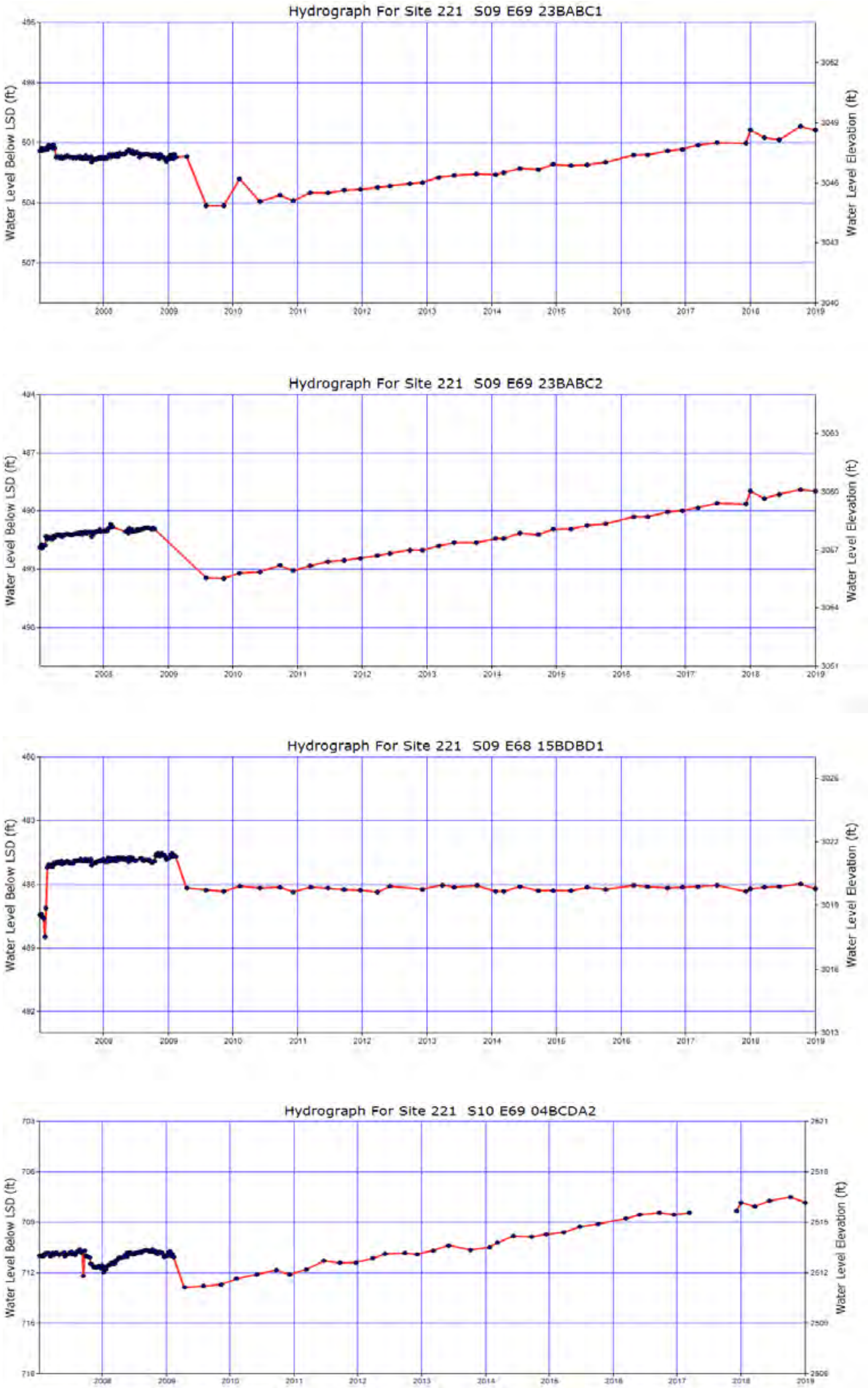

Figure 8. Water levels in four of 13 monitoring wells in Tule Desert (Basin 221) for the period 2008-2019.

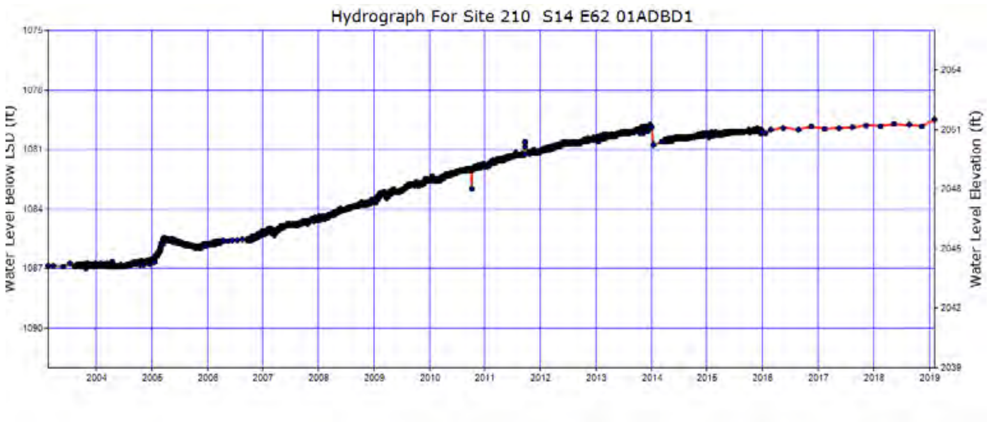

Figure 9. Water levels in CSVM-5 in Coyote Spring Valley (Basin 210) from 2003-2019.

Because of their proximity, water levels in all of these basins are expected to be responding to the same regional climate forcings as wells in the LWRFS, forcings represented by Climate Divisions 3 and 4. None of the basins show any a consistent, long-term decline, as would be expected if there was a regional drought over an extended period. It is unreasonable to expect that a regional drought would affect water levels in the LWRFS alone. This is perhaps the strongest evidence yet for the lack of a regional, long-term drought and the absence of any major drought impacts on regional groundwater levels. A recent presentation at the 2017 NWRA conference provocatively titled “What Drought? Water Levels on the Rise in Southern Nevada” (Jackson et al., 2017) provides further evidence for the lack of drought and supports the conclusions here. The continued, widespread decline in groundwater levels that is observed in most wells in the LWRFS, and by extension the decline in high elevation springflow that is strongly correlated with the groundwater levels, cannot primarily be a response to drought because there isn’t any long-term drought. The declines in groundwater levels and springflows must be primarily a response to pumping.

The climate impacts most easily demonstrated in the record for EH-4 and other LWRFS wells are responses to extreme wet years like 1993, 1998, and 2005 (although 1998 may be obscured by increased carbonate pumping at the Arrow Canyon well that began that year). Both climate divisions showed extremely wet conditions in these three specific years and the water levels in the LWRFS responded strongly (see Figures 1, 3, 5, and 9). The question that should be asked is: Should we expect a similar response to extremely dry conditions? More generally, should we expect the response to climate (wet and dry conditions) to be linear? Does a water level response to extremely wet years portend a proportionate response to extremely dry years? The answer to these questions is “no” and the reasons for this are explored in Mayer and Congdon (2008).

To summarize the discussion in Mayer and Congdon (2008), the authors stated that recharge as a proportion of precipitation is likely to be much greater in wet years than in dry years. This is because precipitation that lands on the soil surface must infiltrate and saturate the soil, as well as meet any evapotranspiration demands, in most cases prior to recharging the aquifer. One can think of this as an “overhead” cost that must be paid first. But the cost is limited, since there is only so much capacity for soil saturation and plant evapotranspiration demand. The proportion of precipitation lost to these processes will be relatively high in drier years but much lower in wet years. In dry years, there is very little water left for recharge of the aquifer whereas in wet years, there will be a lot of water left to recharge the aquifer.

Therefore, one can expect a much greater water level response to wet years than dry years, a non-linear response, particularly in arid systems. Mayer and Congdon (2008) cite several other papers that describe a similar wet year groundwater response in other arid systems. Modeling the groundwater level vs. precipitation relationship as linear may not be appropriate for this reason, since it is likely to be more exponential or concave up as opposed to linear. This is why Mayer and Congdon (2008) used a cubic transform of precipitation as an explanatory variable in the regression modeling of the response of groundwater levels to precipitation.[2] Such a transform emphasizes the water level response to high precipitation compared to low precipitation and changes the relationship between water levels versus precipitation from a concave-up curve (with non-transformed precipitation) to a straight line (with the cube of precipitation). Transforms (meaning square roots, squares, cubes, log) are frequently used in regression modeling to linearize relationships and deal with the issue of non-constant variance and heteroscedasticity (increasing variance).

North Fork Virgin River as Climate Index

Johnson and Mifflin (2019) did not present precipitation data or data from any of the standard drought indicators (Standardized Precipitation Index, PDSI, PDHI) typically used to measure drought (https://drought.unl.edu/ranchplan/DroughtBasics/WeatherandDrought/MeasuringDrought.aspx). They appear to be relying on the long-term flow record for the North Fork of the Virgin River (USGS Site No. 9405500) as a climate index site and as evidence of the long-term drought. However, there is no analysis to show readers that this site is responding to climate or that it has declined over the long-term. They should show readers that the site is an appropriate climate index and provide documentation that this site solely represents climate impacts and is not affected by diversions, regulation, or groundwater pumping. They should also show (graphically, at a minimum but more appropriately, through a statistical analysis) that the site is responding to precipitation or some kind of precipitation or drought index (SPI, PDSI, etc.). Based on a graph (not shown here) we produced of monthly baseflow for this site as a function of monthly PDSI for NV Climate Div 4 or 3, there was not a meaningful relationship.

They also need to show that the baseflow is declining, assuming that we are correct in interpreting this is the basis for their contention that there is a long-term drought. The report should have presented a time-series plot of baseflow, possibly with some sort of a smooth and/or trend analysis. In statistics, a smooth is an approximating function that attempts to capture important patterns in data, while omitting noise or other variability. We prepared such a plot for this site for monthly baseflow data from 1970-2019, using the software program WHAT (Kim et al., 2005) to derive the baseflow. We also applied

[2] Johnson and Mifflin (2019, pg 29) referred to the cubic transform of precipitation as a "*unique explanatory variable*." They may not be aware that it is common practice to use such transformations in regression modeling.

two commonly-used smooths to the data in the plot: a LOESS smooth and a 2.5 yr running average (Figure 10).

There is no apparent trend or long-term decline in baseflow observed in the figure, based on those smooths. There is also no similarity between the smoothed pattern in data from EH-4 water levels (Figure 1) and the smoothed pattern for the North Fork Virgin River site here (Figure 10). It is not clear that there is a relationship between the two sites, especially one that would explain what is essentially a 20-year decline in EH-4 water levels. It would have been helpful for the authors to have presented an x-y graph showing the relationship they derived between EH-4 and baseflows. This is standard practice in any regression analysis. While this can be challenging with multiple variables, the footnote below suggests a method for obtaining a single flow index that could be employed in such an x-y scatterplot. [3]

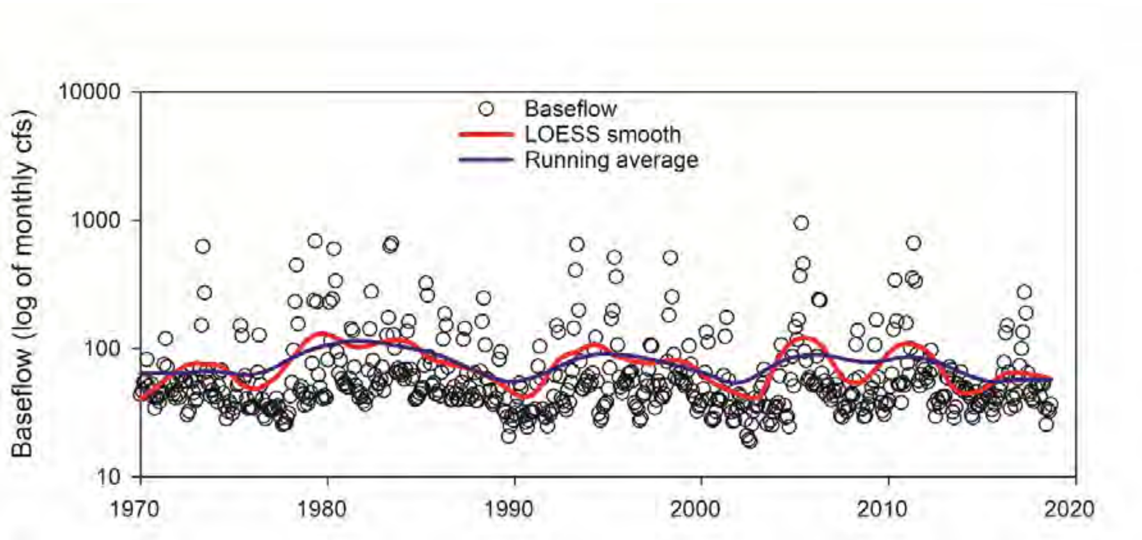

Figure 10. Monthly average baseflow for the North Fork Virgin River (USGS Site No. 9405500) along with two smoothing functions, LOESS and running average, for the period 1970-2018.

The long-term record of baseflow at the site may be represented by the "hindcast" plot in Figure 3 of Appendix 2 (pg 45), if we are interpreting the graph correctly. However, the only units on the graph are water level and the text does not explain how the parameter "hindcast" in the graph was derived, how it was smoothed, or exactly what it represents. In addition, the plot of "hindcast" bears little similarity to the smooths of the baseflow data that we derived for the same site (Figure 10).

[3] The authors should provide a graph of the dependent variable (EH-4 levels) versus the explanatory variables (N Fk Virgin R baseflow), as is standard practice in regression analysis. This is challenging with multiple variables and normally requires individual plots for each explanatory variable but in this case, since all explanatory variables have the same units, they could derive a weighted average flow index (the weights being based on the regression coefficients of all statistically significant coefficients) and provide an x-y scatterplot of EH-4 levels versus that single flow index.

In summary, there is no evidence of a long-term, regional drought in any of the information presented in Johnson and Mifflin (2019). The analysis in this rebuttal shows that the divisional precipitation and PDSI data, the monitoring well data from several undeveloped basins located immediately to the north of the LWFRS, and the baseflow from the North Fork of the Virgin River all lack any kind of consistent decline that would be indicative of a long-term, regional drought. The multi-decadal declines in water levels that have been observed in the LFWRS cannot be attributed to long-term drought because no such drought exists.

Review of Statistical Analysis

The statistical analysis in Johnson and Mifflin (2019) suffers from a lack of information to help readers fully assess and review results. For example, there is no information on how the authors selected variables and models in their regression analysis. In multiple regression, variable selection is a very important process, fraught with problems and pitfalls. Variable and model selection is a balance between underfitting and overfitting the data. Simply relying on r-squared (also called the coefficient of determination, which is a statistical measure of the goodness of fit or how close the data fit the regression line) as may have been done in the report, is not valid since adding additional explanatory variables will always increase the value of r-squared, even if the additional explanatory variable has no relationship to the response variable.

There are several tools that can be used to examine and select variables and models in multiple regression. The Akaike Information Criterion (AIC) is one of the most common means to select the "best" model among several multiple regression models representing different sets of explanatory variables. The AIC rewards goodness of fit (as assessed by a likelihood function), but it also includes a penalty for increasing the number of explanatory variables. The penalty discourages overfitting because increasing the number of explanatory variables will almost always improve the goodness of fit, as noted above. The optimum regression model is the model with the minimum AIC. The AIC is standard output in several regression functions in R.

The authors provided very little statistical output and few results in the report, though they cite a number of output files. They did provide the regression output from the R software for the EH-4/N Fk Virgin R regression on pg 49 of Appendix II. From that output, one can see that the multiple regression consisted of 16 explanatory variables, representing 16 years of lagged baseflows from the N Fk Virgin River. (LV1 represents baseflow from the current year, LV2 represents baseflow from the previous year, etc.). The statistical significance or p-values for each explanatory variable or regression coefficient is shown in the last column of the output table on pg 49. The p-value is the probability of finding the particular value of the regression coefficient when the true value of the coefficient is zero. (A coefficient value of zero indicates no relationship between the explanatory variable and the response variable. This is the null hypothesis in regression modeling.) A lower p-value indicates a smaller probability of the null hypothesis being true and greater statistical significance of the value of the coefficient (meaning a greater probability that there is a relationship between the particular explanatory variable and the response variable). As a general rule of thumb, statistical significance is assumed to be represented by p values <0.05. Using this criteria for p-values, 12 of the 16 regression coefficients in the table are not significantly different from zero (the p-values are >0.05). The R software output has automatically placed an asterisk after each of the four regression coefficients in the table that are statistically significant (p-values <0.05). Explanatory variables that are not statistically significant should be eliminated from the regression model.

There are also problems with the statistical significance of the regression coefficients in the only other regression model output presented in the report, on pg 67 of App IV. This is Excel output from a regression of EH-4 water levels and Arrow Canyon pumping, with 13 weeks of lagged pumping. Each of the 13 explanatory variables represents one of 13 weeks of pumping. (Lag0 represents the current week's pumping, Lag1 represents the pumping from one week prior, etc.). The statistical significance or p-values of each explanatory variable is shown in the fifth column of this table. Only the first variable, Lag0, is statistically different from zero (p<0.05). The p-values for all the other 12 regression coefficients are all >0.50, much higher than the 0.05 threshold, indicating no relationship between the lagged pumping variables and EH-4 water levels. Again, explanatory variables that are not statistically significant should be eliminated from the regression model. The authors either neglected or didn't understand the meaning of this output.

The report also lacked any analysis of residuals (remaining errors) from the regressions. Helsel and Hirsch (2002) state that "*it is important to use graphical tools to diagnose deficiencies in MLR. The following residuals plots are very important: normal probability plots of residuals, residuals versus predicted (to identify curvature or heteroscedasticity), residuals versus time sequence or location (to identify trends), and residuals versus any candidate explanatory variables not in the model (to identify variables, or appropriate transformations of them, which may be used to improve the model fit)*." Ordinary least squares regression assumes that y is linearly related to x and that residuals are independent, normally distributed, and have constant variance. No plots were presented to check these assumptions and there was no discussion of these assumptions in the report. It is not clear if the authors were aware of these assumptions or if they used any of these tools to evaluate their regression models.

Helsel and Hirsch (2002) also warn of multicollinearity in multiple regression, the condition where at least one explanatory variable is closely related to one or more other explanatory variable. Regression models require independent explanatory or predictor variables. Helsel and Hirsch (2002) note that this condition can result in slope coefficients that are unrealistically large; slope coefficients that are not statistically significant or are unrealistic in sign (ex. negative when they should be positive), or are generally unstable (a small change in the values of the data results in a large change in the coefficients). Multicollinearity is likely to be an issue with lagged annual baseflow data as used by Johnson and Mifflin (2019) since annual baseflows are almost certainly correlated with themselves. The issue probably explains the unexpected negative signs for regression coefficients commented on by the authors on pg 44:

"The significance of over half (17 of 27) the regression coefficients being negative in the combined model is not understood."

This is an indicative of problems with multicollinearity (the correlation of explanatory variables with each other).

There are several diagnostic tools and solutions for dealing with multicollinearity as explained in Helsel and Hirsch (2002). One way to measure multicollinearity is with the Variance Inflation Factor (VIF), which assesses how much the variance of an estimated regression coefficient increases if your predictors are correlated. If no explanatory variables are correlated, the VIFs will all be 1. Variables with high VIFs (greater than 10) are strongly correlated with other variables and should be removed. No VIFs were presented by the authors in the report. It seems they were unaware of this issue.

Autocorrelation is another issue in regression of time series data. This is the condition where observations from the dependent variable are correlated with themselves. In autocorrelated data, there is a lot of information in prior measurements, which means there are essentially far fewer observations than there appear to be. There may be N observations but not N independent observations. This violates the assumption of independent error terms and affects statistical significance testing, inflating the statistical significance of regression coefficients. Water level data tend to be grouped into wet and dry periods and are therefore likely autocorrelated to some degree. Autocorrelation in time series analysis can be diagnosed with residual plots and can be handled appropriately with several advanced regression methods. Again, it's not clear if the authors were aware of this issue and whether they did anything to diagnose it.

In summary, the inadequacy of results that are presented limits review of the statistical analysis in the report. However, the lack of any discussion on variable/model selection, residual analysis, heteroscedasticity (increasing variance), multicollinearity, or autocorrelation in Johnson and Mifflin (2019) is concerning. There are erroneous or questionable results in the limited output provided. Specifically, the statistical non-significance of many of the explanatory variables was either neglected or not understood by the authors. In addition, multicollinearity appears to have been an issue in the regression modelling as well, judging from the type of variables used and the unreasonable signs for regression coefficient signs that were hinted at in the report. However, without seeing all the graphs, data, methods, and results, it is difficult to fully review the statistical analysis in the report.

Conclusions

Johnson and Mifflin (2019) assert that there has been long-term drought in the region but fail to provide any evidence of this drought in their report. The analysis in this rebuttal shows that the divisional precipitation and PDSI data, the monitoring well data from several undeveloped basins located immediately to the north of the LWFRS, and the baseflow from the North Fork of the Virgin River all lack any kind of consistent decline that would be indicative of a long-term, regional drought.

The statistical analysis of Johnson and Mifflin (2019) is confusing and questionable for a number of reasons given above. The lack of any discussion on variable/model selection, residual analysis, heteroscedasticity (increasing variance), multicollinearity, or autocorrelation in the report is concerning. Some of the results and statements in the report demonstrate a lack of understanding of the assumptions and diagnostic tools used in multiple regression and statistical analyses. However, without access to output files or more information, it is difficult to fully evaluate their analysis.

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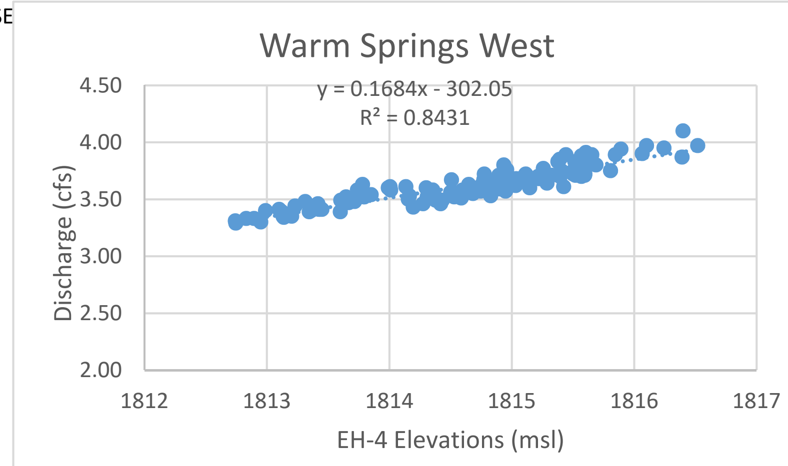
TM - data for regressions of monthly avg spr discharge at Warm Springs West with monthly avg EH4

Month/yr	Avg WSW flow (cfs)	Date	EH-4 avg WSE
May-01	3.75	May-01	1815.81
Jun-01	3.71	Jun-01	1815.60
Jul-01	3.70	Jul-01	1815.40
Aug-01	3.70	Aug-01	1815.22
Sep-01	3.70	Sep-01	1815.10
Oct-01	3.68	Oct-01	1815.08
Nov-01	3.67	Nov-01	1815.15
Dec-01	3.64	Dec-01	1815.29
Jan-02	3.71	Jan-02	1815.52
Feb-02	3.79	Feb-02	1815.61
Mar-02	3.72	Mar-02	1815.60
Apr-02	3.70	Apr-02	1815.57
May-02	3.61	May-02	1815.43
Jun-02	3.60	Jun-02	1815.15
Jul-02	3.60	Jul-02	1814.90
Aug-02	3.57	Aug-02	1814.75
Sep-02	3.58	Sep-02	1814.68
Oct-02	3.58	Oct-02	1814.60
Nov-02	3.57	Nov-02	1814.69
Dec-02	3.59	Dec-02	1814.89
Jan-03	3.62	Jan-03	1814.95
Feb-03	3.68	Feb-03	1815.04
Mar-03	3.65	Mar-03	1815.13
Apr-03	3.67	Apr-03	1815.13
May-03	3.62	May-03	1815.03
Jun-03	3.53	Jun-03	1814.83
Jul-03	3.51	Jul-03	1814.59
Aug-03	3.46	Aug-03	1814.42
Sep-03	3.49	Sep-03	1814.38
Oct-03	3.51	Oct-03	1814.34
Nov-03	3.49	Nov-03	1814.43



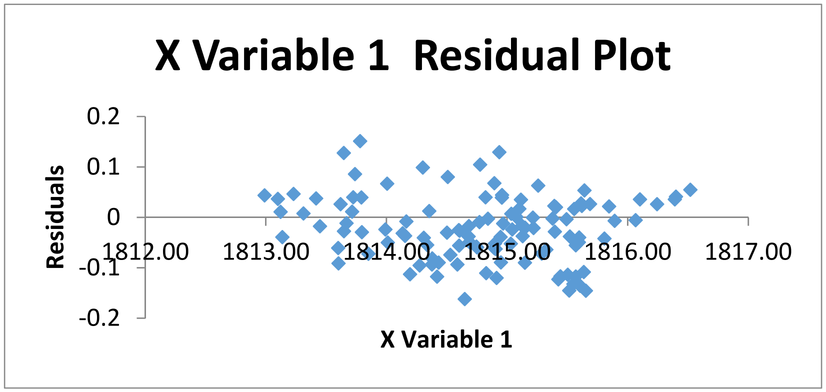
Dec-03	3.52	Dec-03	1814.53	cont:	Nov-06	3.82	Nov-06	1815.43
Jan-04	3.56	Jan-04	1814.50		Dec-06	3.82	Dec-06	1815.53
Feb-04	3.58	Feb-04	1814.61		Jan-07	3.82	Jan-07	1815.65
Mar-04	3.57	Mar-04	1814.95		Feb-07	3.87	Feb-07	1815.90
Apr-04	3.58	Apr-04	1814.36		Mar-07	3.91	Mar-07	1816.11
May-04	3.59	May-04	1814.91		Apr-07	3.88	Apr-07	1816.24
Jun-04	3.55	Jun-04	1814.60		May-07	3.81	May-07	1816.19
Jul-04	3.52	Jul-04	1814.31		Jun-07	3.70	Jun-07	1815.89
Aug-04	3.43	Aug-04	1814.20		Jul-07	3.66	Jul-07	1815.54
Sep-04	3.50	Sep-04	1814.16		Aug-07	3.65	Aug-07	1815.29
Oct-04	3.53	Oct-04	1814.17		Sep-07	3.62	Sep-07	1815.07
Nov-04	3.46	Nov-04	1814.28		Oct-07	3.58	Oct-07	1814.92
Dec-04	3.52	Dec-04	1814.38		Nov-07	3.58	Nov-07	1815.04
Jan-05	3.63	Jan-05	1814.65		Dec-07	3.57	Dec-07	1815.42
Feb-05	3.63	Feb-05	1814.91		Jan-08	3.61	Jan-08	1815.41
Mar-05	3.71	Mar-05	1815.33		Feb-08	3.64	Feb-08	1815.24
Apr-05	3.83	Apr-05	1815.52		Mar-08	3.65	Mar-08	1815.83
May-05	3.89	May-05	1815.65		Apr-08	3.65	Apr-08	1815.83
Jun-05	3.91	Jun-05	1815.61		May-08	3.64	May-08	1815.70
Jul-05	3.88	Jul-05	1815.57		Jun-08	3.63	Jun-08	1815.52
Aug-05	3.89	Aug-05	1815.44		Jul-08	3.58	Jul-08	1815.19
Sep-05	3.73	Sep-05	1815.55		Aug-08	3.53	Aug-08	1814.97
Oct-05	3.72	Oct-05	1815.50		Sep-08	3.52	Sep-08	1814.78
Nov-05	3.85	Nov-05	1815.64		Oct-08	3.51	Oct-08	1814.69
Dec-05	3.94	Dec-05	1815.89		Nov-08	3.63	Nov-08	1814.80
Jan-06	3.90	Jan-06	1816.07		Dec-08	3.66	Dec-08	1814.99
Feb-06	3.95	Feb-06	1816.24		Jan-09	3.71	Jan-09	1815.11
Mar-06	3.87	Mar-06	1816.39		Feb-09	3.73	Feb-09	1815.18
Apr-06	3.97	Apr-06	1816.52		Mar-09	3.76	Mar-09	1815.25
May-06	4.10	May-06	1816.40		Apr-09	3.76	Apr-09	1815.34
Jun-06	3.97	Jun-06	1816.10		May-09	3.78	May-09	1815.50
Jul-06	3.89	Jul-06	1815.85		Jun-09	3.74	Jun-09	1815.33
Aug-06	3.87	Aug-06	1815.62		Jul-09	3.73	Jul-09	1815.26
Sep-06	3.85	Sep-06	1815.39		Aug-09	3.69	Aug-09	1815.00
Oct-06	3.83	Oct-06	1815.38		Sep-09	3.66	Sep-09	1814.97

Oct-09	3.65	Oct-09	1814.97	cont:	Sep-12	3.37	Sep-12	1813.00
Nov-09	3.65	Nov-09	1815.04		Oct-12	3.41	Oct-12	1812.90
Dec-09	3.72	Dec-09	1815.12		Nov-12	3.45	Nov-12	1812.81
Jan-10	3.77	Jan-10	1815.26		Dec-12	3.43	Dec-12	1812.84
Feb-10	3.75	Feb-10	1815.41		Jan-13	3.41	Jan-13	1812.87
Mar-10	3.77	Mar-10	1815.56		Feb-13	3.41	Feb-13	1812.94
Apr-10	3.80	Apr-10	1815.69		Mar-13	3.41	Mar-13	1812.97
May-10	3.82	May-10	1815.64		Apr-13	3.39	Apr-13	1812.94
Jun-10	3.74	Jun-10	1815.49		May-13	3.35	May-13	1812.86
Jul-10	3.68	Jul-10	1815.22		Jun-13	3.33	Jun-13	1812.72
Aug-10	3.70	Aug-10	1814.96		Jul-13	3.34	Jul-13	1812.54
Sep-10	3.64	Sep-10	1814.84		Aug-13	3.30	Aug-13	1812.54
Oct-10	3.55	Oct-10	1814.68		Sep-13	3.27	Sep-13	1812.54
Nov-10	3.62	Nov-10	1814.75		Oct-13	3.24	Oct-13	1812.62
Dec-10	3.67	Dec-10	1814.77		Nov-13	3.32	Nov-13	1812.81
Jan-11	3.66	Jan-11	1814.82		Dec-13	3.40	Dec-13	1813.02
Feb-11	3.71	Feb-11	1814.90		Jan-14	3.45	Jan-14	1813.16
Mar-11	3.76	Mar-11	1814.96		Feb-14	3.44	Feb-14	1813.24
Apr-11	3.80	Apr-11	1814.94		Mar-14	3.54	Mar-14	1813.34
May-11	3.72	May-11	1814.78		Apr-14	3.54	Apr-14	1813.50
Jun-11	3.67	Jun-11	1814.51		May-14	3.52	May-14	1813.53
Jul-11	3.60	Jul-11	1814.30		Jun-14	3.52	Jun-14	1813.41
Aug-11	3.61	Aug-11	1814.01		Jul-14	3.45	Jul-14	1813.16
Sep-11	3.58	Sep-11	1813.74		Aug-14	3.46	Aug-14	1813.10
Oct-11	3.52	Oct-11	1813.65		Sep-14	3.50	Sep-14	1813.09
Nov-11	3.47	Nov-11	1813.67		Oct-14	3.38	Oct-14	1813.22
Dec-11	3.47	Dec-11	1813.65		Nov-14	3.37	Nov-14	1813.25
Jan-12	3.49	Jan-12	1813.60		Dec-14	3.31	Dec-14	1813.28
Feb-12	3.54	Feb-12	1813.85		Jan-15	3.36	Jan-15	1813.48
Mar-12	3.60	Mar-12	1813.99		Feb-15	3.45	Feb-15	1813.75
Apr-12	3.61	Apr-12	1814.14		Mar-15	3.43	Mar-15	1813.67
May-12	3.58	May-12	1814.01		Apr-15	3.41	Apr-15	1813.66
Jun-12	3.52	Jun-12	1813.80		May-15	3.44	May-15	1813.72
Jul-12	3.48	Jul-12	1813.31		Jun-15	3.46	Jun-15	1813.61
Aug-12	3.39	Aug-12	1813.12		Jul-15	3.44	Jul-15	1813.46

Aug-15	3.44	Aug-15	1813.23	cont:	Jul-17	3.32	Jul-17	1813.01
Sep-15	3.41	Sep-15	1813.10		Aug-17	3.29	Aug-17	1812.90
Oct-15	3.40	Oct-15	1812.99		Sep-17	3.31	Sep-17	1813.09
Nov-15	3.41	Nov-15	1813.45		Oct-17	3.35	Oct-17	1813.37
Dec-15	3.39	Dec-15	1813.60		Nov-17	3.35	Nov-17	1813.45
Jan-16	3.48	Jan-16	1813.62		Dec-17	3.34	Dec-17	1813.51
Feb-16	3.48	Feb-16	1813.72		Jan-18	3.37	Jan-18	1813.42
Mar-16	3.52	Mar-16	1813.79		Feb-18	3.41	Feb-18	1813.55
Apr-16	3.63	Apr-16	1813.78		Mar-18	3.43	Mar-18	1813.62
May-16	3.51	May-16	1813.73		Apr-18	3.45	Apr-18	1813.69
Jun-16	3.46	Jun-16	1813.42		May-18	3.43	May-18	1813.63
Jul-16	3.34	Jul-16	1813.14		Jun-18	3.38	Jun-18	1813.50
Aug-16	3.33	Aug-16	1812.90		Jul-18	3.36	Jul-18	1813.37
Sep-16	3.31	Sep-16	1812.74		Aug-18	3.35	Aug-18	1813.27
Oct-16	3.29	Oct-16	1812.75		Sep-18	3.35	Sep-18	1813.18
Nov-16	3.33	Nov-16	1812.83		Oct-18	3.34	Oct-18	1813.14
Dec-16	3.30	Dec-16	1812.95		Nov-18	3.36	Nov-18	1813.14
Jan-17	3.35	Jan-17	1813.13		Dec-18	3.38	Dec-18	1813.25
Feb-17	3.40	Feb-17	1813.36		Jan-19	3.35	Jan-19	1813.30
Mar-17	3.41	Mar-17	1813.43					
Apr-17	3.41	Apr-17	1813.43					
May-17	3.39	May-17	1813.35					
Jun-17	3.35	Jun-17	1813.20					

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.918728
R Square	0.844062
Adjusted R Square	0.843323
Standard Error	0.069500
Observations	213



ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.516644153	5.51664415	1142.10076	4.2874E-87
Residual	211	1.019184955	0.00483026		
Total	212	6.535829108			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-276.98491	8.301769682	-33.364562	4.1927E-86	-293.34995	-260.61988
X Variable 1	0.15462937	0.004575513	33.7949814	4.2874E-87	0.1456098	0.16364895

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	3.79225861	-0.042258608
2	3.7595545	-0.049554496
3	3.72862862	-0.028628622
4	3.70064071	-0.000640706
5	3.68316759	0.016832413
6	3.67950802	0.000491975
7	3.6905898	-0.020589797
8	3.71192865	-0.07192865

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9	3.74806038	-0.038060379	cont:	44	3.57121592	-0.0512159
10	3.76233782	0.027662175		45	3.61327511	0.01672489
11	3.75986375	-0.039863755		46	3.65409726	-0.0240973
12	3.75553413	-0.055534132		47	3.71790765	-0.0079077
13	3.73311287	-0.123112874		48	3.74718415	0.08281585
14	3.69028054	-0.090280538		49	3.768523	0.121477
15	3.65193245	-0.051932454		50	3.76110079	0.14889921
16	3.62811953	-0.058119531		51	3.75553413	0.12446587
17	3.61822325	-0.038223251		52	3.73581889	0.15418111
18	3.60554364	-0.025543642		53	3.75244154	-0.0224415
19	3.61915103	-0.049151027		54	3.74522551	-0.0252255
20	3.65100468	-0.061004678		55	3.76584276	0.08415724
21	3.65914849	-0.039148491		56	3.80532479	0.13467521
22	3.67296205	0.007037952		57	3.8322303	0.0677697
23	3.68749721	-0.037497209		58	3.85975433	0.09024567
24	3.68672406	-0.016724062		59	3.88258793	-0.0125879
25	3.67234353	-0.052343531		60	3.90243203	0.06756797
26	3.64079914	-0.110799139		61	3.88387651	0.21612349
27	3.60373963	-0.093739633		62	3.83779696	0.13220304
28	3.57771036	-0.117710356		63	3.79821184	0.09178816
29	3.57152518	-0.081525181		64	3.7632656	0.1067344
30	3.56508229	-0.05508229		65	3.7280101	0.1219899
31	3.57987517	-0.089875167		66	3.72584529	0.10415471
32	3.59471959	-0.074719586		67	3.73337059	0.08662941
33	3.59038996	-0.030389964		68	3.7490397	0.0709603
34	3.6065745	-0.026574505		69	3.76841991	0.05158009
35	3.65966392	-0.089663922		70	3.80687108	0.06312892
36	3.56765945	0.012340553		71	3.83903399	0.07096601
37	3.65286023	-0.06286023		72	3.85882655	0.02117345
38	3.60605907	-0.056059074		73	3.85191977	-0.0419198
39	3.56070112	-0.040701125		74	3.80439701	-0.104397
40	3.54307338	-0.113073377		75	3.75120451	-0.0912045
41	3.53673357	-0.036733572		76	3.71146476	-0.0614648
42	3.53827987	-0.008279866		77	3.67821945	-0.0582194
43	3.55544373	-0.095443726		78	3.65476733	-0.0747673

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79	3.67358057	-0.093580566	cont:	114	3.61851256	-0.0685126
80	3.73233973	-0.162339727		115	3.62899576	-0.0089958
81	3.730278	-0.120278002		116	3.63216889	0.03783111
82	3.70419718	-0.064197181		117	3.639997	0.020003
83	3.79542851	-0.14542851		118	3.65123929	0.05876071
84	3.79573777	-0.145737769		119	3.66098932	0.09901068
85	3.77594521	-0.135945209		120	3.65751906	0.14248094
86	3.74741609	-0.11741609		121	3.6328615	0.0871385
87	3.69721677	-0.11721677		122	3.59144508	0.07855492
88	3.66244725	-0.132447251		123	3.55944476	0.04055524
89	3.63399545	-0.113995447		124	3.51373245	0.09626755
90	3.61868714	-0.108687139		125	3.47251406	0.10748594
91	3.63708803	-0.007088034		126	3.45821084	0.06178916
92	3.6658491	-0.005849097		127	3.46163857	0.00836143
93	3.68414691	0.025853094		128	3.45843957	0.01156043
94	3.69461016	0.03538984		129	3.45144581	0.03855419
95	3.70543422	0.054565784		130	3.48982933	0.05017067
96	3.71919623	0.04080377		131	3.51145401	0.08854599
97	3.74435664	0.035643362		132	3.53371581	0.07628419
98	3.71842308	0.021576917		133	3.5145056	0.0654944
99	3.70734131	0.022658688		134	3.48126869	0.03873131
100	3.66739539	0.022604609		135	3.40655497	0.07344503
101	3.66249879	-0.002498794		136	3.37717539	0.01282461
102	3.66244725	-0.012447251		137	3.35753808	0.01246192
103	3.67419908	-0.024199083		138	3.34209385	0.06790615
104	3.68517777	0.034822231		139	3.32950528	0.12049472
105	3.70728977	0.062710231		140	3.33349571	0.09650429
106	3.73017492	0.019825085		141	3.33878455	0.07121545
107	3.75347241	0.016527593		142	3.34816572	0.06183428
108	3.7737804	0.026219602		143	3.35413963	0.05586037
109	3.76666745	0.053332553		144	3.34959522	0.04040478
110	3.74367921	-0.003679214		145	3.33644022	0.01355978
111	3.70141385	-0.021413852		146	3.31523947	0.01476053
112	3.66090096	0.039099043		147	3.28652392	0.05347608
113	3.64288664	-0.002886636		148	3.28652392	0.01347608

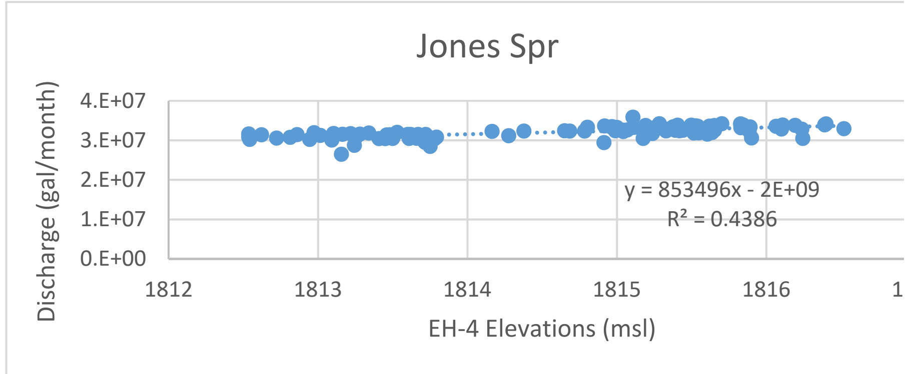
149	3.28750594	-0.017505943
150	3.29981238	-0.059812383
151	3.32940551	-0.009405514
152	3.36050441	0.039495589
153	3.38232866	0.067671337
154	3.39585517	0.04414483
155	3.41076052	0.129239485
156	3.43545133	0.104548666
157	3.43999357	0.080006428
158	3.42133517	0.098664831
159	3.38347591	0.066524086
160	3.37427609	0.085723911
161	3.37246261	0.127537395
162	3.39176854	-0.011768537
163	3.39749685	-0.027496852
164	3.40143287	-0.091432873
165	3.43235875	-0.072358747
166	3.47410868	-0.024108677
167	3.46173833	-0.031738327
168	3.46019203	-0.050192034
169	3.4694698	-0.029469796
170	3.45246057	0.007539435
171	3.42926616	0.01073384
172	3.3937014	0.046298596
173	3.37359959	0.036400414
174	3.35659036	0.043409645
175	3.42771987	-0.017719866
176	3.45091427	-0.060914271
177	3.45400686	0.025993141
178	3.46893659	0.011063409
179	3.48079266	0.039207344
180	3.47903749	0.150962512
181	3.47029126	0.039708735
182	3.42264609	0.03735391
183	3.3795196	-0.039519596

cont:

184	3.34191567	-0.0119157
185	3.3182271	-0.0082271
186	3.31886784	-0.0288678
187	3.33211979	-0.0021198
188	3.35043304	-0.050433
189	3.3785284	-0.0285284
190	3.41390986	-0.0139099
191	3.42535553	-0.0153555
192	3.42388946	-0.0138895
193	3.41178821	-0.0217882
194	3.38941543	-0.0394154
195	3.35915178	-0.0391518
196	3.34277358	-0.0527736
197	3.37256041	-0.0625604
198	3.41544576	-0.0654458
199	3.4271398	-0.0771398
200	3.43650229	-0.0965023
201	3.42259636	-0.0525964
202	3.44342697	-0.033427
203	3.45400646	-0.0240065
204	3.46524201	-0.015242
205	3.45562121	-0.0256212
206	3.43617032	-0.0561703
207	3.41474749	-0.0547475
208	3.40025491	-0.0502549
209	3.38671033	-0.0367103
210	3.37989764	-0.0398976
211	3.37985274	-0.0198527
212	3.39662436	-0.0166244
213	3.40416317	-0.0541632

2004-2019

Month_Year	Jones_Discharge(gal)	Month_Yr	Avg EH-4 WSE
October-04	32,251,000	Oct-04	1814.165
November-04	31,130,000	Nov-04	1814.276
December-04	32,334,000	Dec-04	1814.378
January-05	32,382,000	Jan-05	1814.65
February-05	29,414,000	Feb-05	1814.914
March-05	32,852,000	Mar-05	1815.326667
April-05	31,841,000	Apr-05	1815.516
May-05	32,556,000	May-05	1815.654
June-05	31,550,000	Jun-05	1815.606
July-05	32,687,000	Jul-05	1815.57
August-05	32,527,000	Aug-05	1815.4425
September-05	31,864,000	Sep-05	1815.55
October-05	32,890,000	Oct-05	1815.503333
November-05	31,958,000	Nov-05	1815.636667
December-05	33,384,000	Dec-05	1815.892
January-06	33,525,000	Jan-06	1816.066
February-06	30,441,000	Feb-06	1816.244
March-06	33,882,000	Mar-06	1816.391667
April-06	32,936,000	Apr-06	1816.52
May-06	34,151,000	May-06	1816.4
June-06	32,847,000	Jun-06	1816.102
July-06	33,839,000	Jul-06	1815.846
August-06	33,574,000	Aug-06	1815.62
September-06	32,500,000	Sep-06	1815.392
October-06	33,401,000	Oct-06	1815.378
November-06	32,549,000	Nov-06	1815.426667
December-06	33,670,000	Dec-06	1815.528
January-07	33,723,000	Jan-07	1815.653333
February-07	30,561,000	Feb-07	1815.902
March-07	33,856,000	Mar-07	1816.11
April-07	32,793,000	Apr-07	1816.238



SE ROA 48800

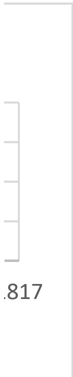
May-07	33,787,000	May-07	1816.193333
June-07	32,359,000	Jun-07	1815.886
July-07	33,524,000	Jul-07	1815.542
August-07	34,165,000	Aug-07	1815.285
September-07	32,608,000	Sep-07	1815.07
October-07	33,604,000	Oct-07	1814.918333
November-07	32,540,000	Nov-07	1815.04
December-07	32,414,000	Dec-07	1815.42
January-08	33,812,000	Jan-08	1815.406667
February-08	31,696,000	Feb-08	1815.238
March-08	34,134,000	Mar-08	1815.828
April-08	33,165,000	Apr-08	1815.83
May-08	34,160,000	May-08	1815.702
June-08	32,880,000	Jun-08	1815.5175
July-08	33,741,000	Jul-08	1815.192857
August-08	33,464,000	Aug-08	1814.968
September-08	32,302,000	Sep-08	1814.784
October-08	32,302,000	Oct-08	1814.685
November-08	33,286,000	Nov-08	1814.804
December-08	32,377,000	Dec-08	1814.99
January-09	35,824,896	Jan-09	1815.108333
February-09	30,463,616	Feb-09	1815.176
March-09	32,518,784	Mar-09	1815.246
April-09	32,722,432	Apr-09	1815.335
May-09	33,802,640	May-09	1815.497714
June-09	32,344,304	Jun-09	1815.33
July-09	33,263,000	Jul-09	1815.258333
August-09	33,263,000	Aug-09	1815
September-09	33,263,000	Sep-09	1814.968333
October-09	33,263,000	Oct-09	1814.968
November-09	32,190,000	Nov-09	1815.044
December-09	33,263,000	Dec-09	1815.115
January-10	33,263,000	Jan-10	1815.258
February-10	33,263,000	Feb-10	1815.406
March-10	32,715,332	Mar-10	1815.556667

cont:	April-10	31,371,200	Apr-10	1815.688
	May-10	32,628,800	May-10	1815.642
	June-10	31,352,160	Jun-10	1815.49333
	July-10	30,826,480	Jul-10	1815.22
	August-10	31,563,792	Aug-10	1814.958
	September-10	30,974,192	Sep-10	1814.8415
	October-10	31,991,520	Oct-10	1814.68387
	November-10	31,148,932	Nov-10	1814.75167
	December-10	30,965,440	Dec-10	1814.77219
	January-11	33,197,748	Jan-11	1814.82281
	February-11	29,103,376	Feb-11	1814.89552
	March-11	32,030,904	Mar-11	1814.95857
	April-11	30,988,432	Apr-11	1814.93613
	May-11	32,088,176	May-11	1814.77667
	June-11	30,786,320	Jun-11	1814.50882
	July-11	31,898,192	Jul-11	1814.30188
	August-11	31,564,864	Aug-11	1814.00625
	September-11	29,987,888	Sep-11	1813.73969
	October-11	32,277,102	Oct-11	1813.64719
	November-11	31,046,814	Nov-11	1813.66935
	December-11	32,238,100	Dec-11	1813.64867
	January-12	31,872,171	Jan-12	1813.60344
	February-12	30,257,956	Feb-12	1813.85167
	March-12	32,268,960	Mar-12	1813.99152
	April-12	31,319,531	Apr-12	1814.13548
	May-12	32,803,408	May-12	1814.01125
	June-12	30,614,124	Jun-12	1813.7963
	July-12	31,583,939	Jul-12	1813.31313
	August-12	31,344,604	Aug-12	1813.12313
	September-12	30,973,360	Sep-12	1812.99613
	October-12	31,398,313	Oct-12	1812.89625
	November-12	30,730,610	Nov-12	1812.81484
	December-12	31,211,780	Dec-12	1812.84065
	January-13	31,733,887	Jan-13	1812.87485
	February-13	28,411,817	Feb-13	1812.93552

March-13	31,931,367	Mar-13	1812.974151
April-13	30,218,504	Apr-13	1812.944762
May-13	31,420,025	May-13	1812.859688
June-13	30,556,126	Jun-13	1812.722581
July-13	30,760,732	Jul-13	1812.536875
August-13	31,588,299	Aug-13	1812.536875
September-13	30,226,196	Sep-13	1812.543226
October-13	31,398,313	Oct-13	1812.622813
November-13	30,730,610	Nov-13	1812.814194
December-13	31,211,780	Dec-13	1813.015313
January-14	26,470,704	Jan-14	1813.156452
February-14	28,706,736	Feb-14	1813.243929
March-14	31,836,973	Mar-14	1813.340323
April-14	30,450,850	Apr-14	1813.5
May-14	31,989,728	May-14	1813.529375
June-14	30,402,627	Jun-14	1813.40871
July-14	31,527,824	Jul-14	1813.163871
August-14	31,700,084	Aug-14	1813.104375
September-14	30,061,940	Sep-14	1813.092647
October-14	31,679,087	Oct-14	1813.2175
November-14	30,795,924	Nov-14	1813.254545
December-14	31,555,955	Dec-14	1813.28
January-15	31,376,000	Jan-15	1813.48
February-15	28,447,000	Feb-15	1813.75
March-15	31,450,000	Mar-15	1813.67
April-15	30,491,000	Apr-15	1813.66
May-15	31,474,000	May-15	1813.72
June-15	30,455,000	Jun-15	1813.61
July-15	31,326,000	Jul-15	1813.46
November-15	30,413,000	Nov-15	1813.45
December-15	31,480,000	Dec-15	1813.6
January-16	31,464,000	Jan-16	1813.62
February-16	29,498,000	Feb-16	1813.716552
March-16	30,765,000	Mar-16	1813.793226
April-16	30,401,000	Apr-16	1813.781875

cont:	May-16	31,326,000	May-16	1813.72531
	June-16	30,206,000	Jun-16	1813.41719
	July-16	31,067,000	Jul-16	1813.13829
	August-16	30,967,000	Aug-16	1812.8951
	September-16	29,979,000	Sep-16	1812.7419
	October-16	30,840,000	Oct-16	1812.74605
	November-16	29,969,000	Nov-16	1812.83175
	December-16	31,044,000	Dec-16	1812.95018
	January-17	31,127,000	Jan-17	1813.13188
	February-17	28,159,000	Feb-17	1813.36069
	March-17	31,213,000	Mar-17	1813.43471
	April-17	30,193,000	Apr-17	1813.42523
	May-17	31,181,000	May-17	1813.34697
	June-17	30,061,000	Jun-17	1813.20228
	July-17	30,943,000	Jul-17	1813.00656
	August-17	30,894,000	Aug-17	1812.90065
	September-17	29,823,000	Sep-17	1813.09328
	October-17	30,842,000	Oct-17	1813.37062
	November-17	29,947,000	Nov-17	1813.44625
	December-17	30,375,000	Dec-17	1813.5068
	January-18	30,661,000	Jan-18	1813.41687
	February-18	28,152,000	Feb-18	1813.55158
	March-18	31,119,000	Mar-18	1813.62
	April-18	30,177,000	Apr-18	1813.69266
	May-18	31,108,000	May-18	1813.63044
	June-18	30,041,000	Jun-18	1813.50465
	July-18	30,925,000	Jul-18	1813.36611
	August-18	30,843,000	Aug-18	1813.27238
	September-18	29,807,000	Sep-18	1813.18479
	October-18	30,806,000	Oct-18	1813.14073
	November-18	29,204,000	Nov-18	1813.14044
	December-18	30,921,000	Dec-18	1813.2489
	January-19	30,955,000	Jan-19	1813.29766
	February-19	27,981,000	Feb-19	1813.33
	March-19	30,997,000	Mar-19	1813.46

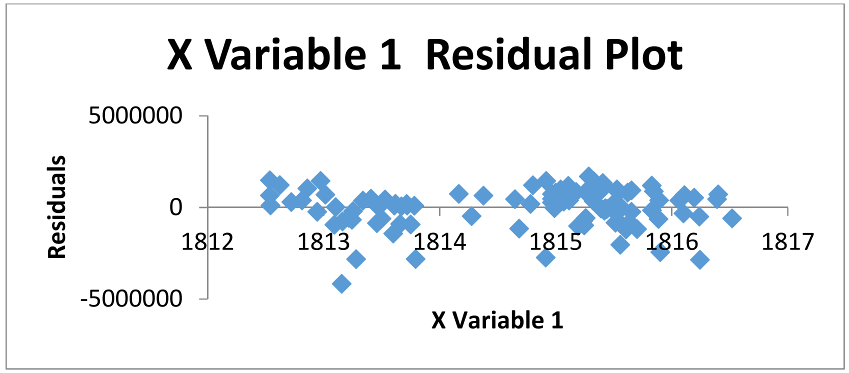
SE ROA 48803



2004-2019

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.662324
R Square	0.438673
Adjusted R Square	0.435352
Standard Error	1077314.030
Observations	171



ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.53284E+14	1.53284E+14	132.0723673	5.91327E-23
Residual	169	1.96142E+14	1.16061E+12		
Total	170	3.49426E+14			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1531077916	135976756.4	-11.25985026	2.67316E-22	-1799509692	-1262646141
X Variable 1	861324.999	74948.17655	11.49227424	5.91327E-23	713369.7701	1009280.228

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	31507750.4	743249.5974
2	31603357.48	-473357.4775
3	31691212.63	642787.3726
4	31925493.03	456506.9729
5	32152882.83	-2738882.827
6	32508322.94	343677.0569
7	32671400.48	-830400.4762

SE ROA 48804

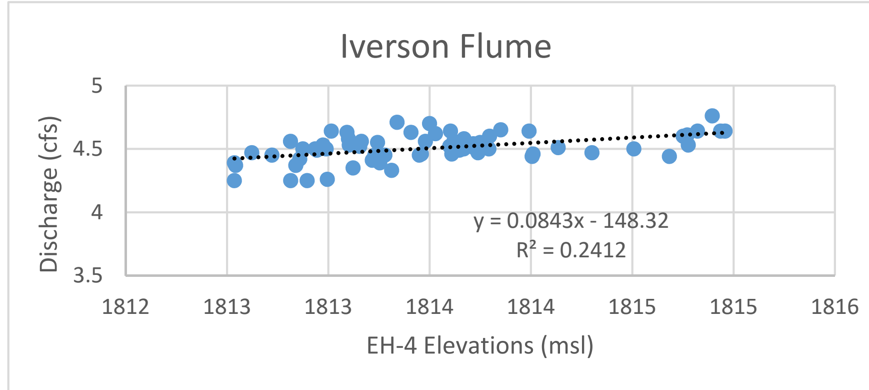
8	32790263.33	-234263.3261	cont:	43	32941856.53	223143.4741
9	32748919.73	-1198919.726		44	32831606.93	1328393.074
10	32717912.03	-30912.02614		45	32672692.46	207307.5363
11	32608093.09	-81093.08877		46	32393069.46	1347930.545
12	32700685.53	-836685.5262		47	32199394.38	1264605.623
13	32660490.36	229509.6405		48	32040910.58	261089.4231
14	32775333.69	-817333.6927		49	31955639.4	346360.5979
15	32995258.68	388741.3242		50	32058137.08	1227862.923
16	33145129.23	379870.7744		51	32218343.53	158656.4733
17	33298445.08	-2857445.075		52	32320266.98	3504629.015
18	33425634.07	456365.933		53	32378549.98	-1914933.977
19	33536170.78	-600170.7752		54	32438842.73	79941.27353
20	33432811.78	718188.2247		55	32515500.65	206931.3486
21	33176136.93	-329136.9256		56	32655650.53	1146989.467
22	32955637.73	883362.2741		57	32511194.03	-166890.0264
23	32760978.28	813021.7239		58	32449465.73	813534.2652
24	32564596.18	-64596.17632		59	32226956.78	1036043.223
25	32552537.63	848462.3737		60	32199681.49	1063318.515
26	32594455.44	-45455.44295		61	32199394.38	1063605.623
27	32681736.38	988263.6238		62	32264855.08	-74855.07668
28	32789689.11	933310.8906		63	32326009.15	936990.8484
29	33003871.93	-2442871.926		64	32449178.63	813821.3735
30	33183027.53	672972.4744		65	32576654.73	686345.2737
31	33293277.13	-500277.1255		66	32706427.69	8904.30718
32	33254804.61	532195.3912		67	32819548.38	-1448348.376
33	32990090.73	-631090.7258		68	32779927.43	-151127.4261
34	32693794.93	830205.0738		69	32651877.11	-1299717.11
35	32472434.4	1692565.599		70	32416448.28	-1589968.277
36	32287249.53	320750.4733		71	32190781.13	-626989.1268
37	32156615.24	1447384.765		72	32090436.76	-1116244.764
38	32261409.78	278590.2233		73	31954666.94	36853.06166
39	32588713.28	-174713.2763		74	32013061.07	-864129.0687
40	32577228.94	1234771.057		75	32030736.18	-1065296.175
41	32431952.13	-735952.1265		76	32074340.75	1123407.247
42	32940133.88	1193866.124		77	32136963.16	-3033587.165

78	32191273.31	-160369.3125	cont:	113	30714408.56	-2007672.555
79	32171943.12	-1183511.116		114	30797435.13	1039537.875
80	32034594.19	53581.80638		115	30934969.28	-484119.2783
81	31803894.2	-1017574.204		116	30960270.7	1029457.3
82	31625644.26	272547.7382		117	30856338.64	-453711.6413
83	31371015.06	193848.941		118	30645452.94	882371.0601
84	31141418.11	-1153530.114		119	30594207.58	1105876.424
85	31061745.55	1215356.448		120	30584106.01	-522166.0066
86	31080838.83	-34024.83455		121	30691644.97	987442.0339
87	31063019.59	1175080.405		122	30723553.14	72370.85784
88	31024062.58	848108.4171		123	30745477.78	810477.2215
89	31237868.57	-979912.5696		124	30917742.78	458257.2217
90	31358323.57	910636.4344		125	31150300.53	-2703300.528
91	31482327.42	-162796.4228		126	31081394.53	368605.4719
92	31375321.68	1428086.316		127	31072781.28	-581781.2781
93	31190183.62	-576059.6204		128	31124460.78	349539.222
94	30774009.17	809929.8309		129	31029715.03	-574715.0282
95	30610357.42	734246.5807		130	30900516.28	425483.7217
96	30500972.62	472387.3825		131	30891903.03	-478903.0283
97	30414944.31	983368.6899		132	31021101.78	458898.2218
98	30344822.73	385787.2694		133	31038328.28	425671.7219
99	30367050.47	844729.5275		134	31121490.69	-1623490.692
100	30396510.65	1337376.35		135	31187532	-422531.9957
101	30448766.17	-2036949.167		136	31177755.26	-776755.2624
102	30482042.34	1449324.66		137	31129036.57	196963.4329
103	30456728.83	-238224.8265		138	30863640.8	-657640.8018
104	30383452.11	1036572.885		139	30623415.24	443584.7591
105	30265358.55	290767.4467		140	30413951.77	553048.2323
106	30105405.64	655326.3614		141	30282000.42	-303000.4173
107	30105405.64	1482893.361		142	30285569.48	554430.5179
108	30110875.75	115320.253		143	30359386.25	-390386.2545
109	30179425.76	1218887.244		144	30461395.74	582604.2649
110	30344267.04	386342.963		145	30617894.01	509105.987
111	30517495.82	694284.1822		146	30814977.8	-2655977.796
112	30639062.46	-4168358.464		147	30878733.06	334266.9449

148	30870566.71	-677566.7115
149	30803159.64	377840.3631
150	30678537.54	-617537.5445
151	30509961.3	433038.6997
152	30418730.55	475269.4487
153	30584650.82	-761650.8158
154	30823533.11	18466.88652
155	30888671.9	-941671.902
156	30940823.34	-565823.3436
157	30863363.79	-202363.7871
158	30979395.58	-2827395.58
159	31038326.04	80673.96488
160	31100910.95	-923910.9486
161	31047320.6	60679.39914
162	30938974.21	-897974.208
163	30819643.58	105356.4194
164	30738916.23	104083.7684
165	30663469.45	-856469.4509
166	30625521.02	180478.9765
167	30625270.96	-1421270.961
168	30718693.12	202306.881
169	30760686.22	194313.7791
170	30791025.04	-2810025.04
171	30900808.23	96191.7684

TM - data for regressions of monthly avg spr discharge at Iverson flume with monthly avg EH4

Month/yr	Avg Iverson flow (cfs)	Date	EH-4 avg WSE
Oct-10	4.44	Oct-10	1814.68
Nov-10	4.6	Nov-10	1814.75
Dec-10	4.61	Dec-10	1814.77
Jan-11	4.64	Jan-11	1814.82
Feb-11	4.76	Feb-11	1814.90
Mar-11	4.64	Mar-11	1814.96
Apr-11	4.64	Apr-11	1814.94
May-11	4.53	May-11	1814.78
Jun-11	4.5	Jun-11	1814.51
Jul-11	4.47	Jul-11	1814.30
Aug-11	4.44	Aug-11	1814.01
Sep-11	4.47	Sep-11	1813.74
Oct-11	4.49	Oct-11	1813.65
Nov-11	4.5	Nov-11	1813.67
Dec-11	4.51	Dec-11	1813.65
Jan-12	4.64	Jan-12	1813.60
Feb-12	4.65	Feb-12	1813.85
Mar-12	4.64	Mar-12	1813.99
Apr-12	4.51	Apr-12	1814.14
May-12	4.46	May-12	1814.01
Jun-12	4.6	Jun-12	1813.80
Jul-12	4.33	Jul-12	1813.31
Aug-12	4.35	Aug-12	1813.12
Sep-12	4.26	Sep-12	1813.00
Oct-12	4.25	Oct-12	1812.90
Nov-12	4.25	Nov-12	1812.81
Dec-12	4.37	Dec-12	1812.84
Jan-13	4.5	Jan-13	1812.87
Feb-13	4.5	Feb-13	1812.94
Mar-13	4.53	Mar-13	1812.97
Apr-13	4.49	Apr-13	1812.94



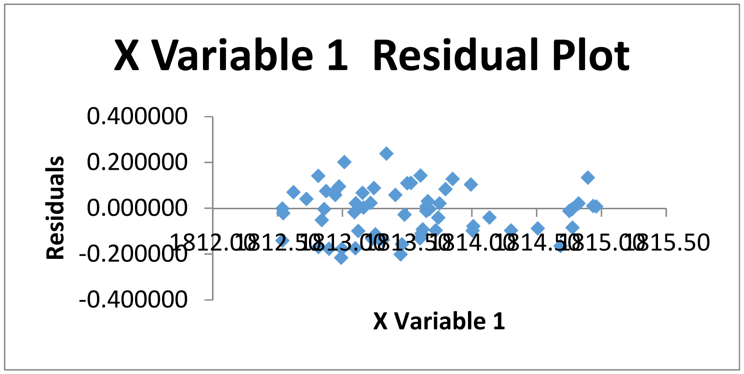
May-13	4.42	May-13	1812.86
Jun-13	4.45	Jun-13	1812.72
Jul-13	4.39	Jul-13	1812.54
Aug-13	4.25	Aug-13	1812.54
Sep-13	4.37	Sep-13	1812.54
Oct-13	4.47	Oct-13	1812.62
Nov-13	4.56	Nov-13	1812.81
Dec-13	4.64	Dec-13	1813.02
Jan-14	4.52	Jan-14	1813.16
Feb-14	4.55	Feb-14	1813.24
Mar-14	4.71	Mar-14	1813.34
Apr-14	4.7	Apr-14	1813.50
May-14	4.62	May-14	1813.53
Jun-14	4.63	Jun-14	1813.41
Jul-14	4.56	Jul-14	1813.16
Aug-14	4.53	Aug-14	1813.10
Sep-14	4.63	Sep-14	1813.09
Oct-14	4.41	Oct-14	1813.22
Nov-14	4.39	Nov-14	1813.25
Dec-14	4.45	Dec-14	1813.28
Jan-15	4.56	Jan-15	1813.48
Feb-15	4.55	Feb-15	1813.75
Mar-15	4.58	Mar-15	1813.67
Apr-15	4.5	Apr-15	1813.66
May-15	4.51	May-15	1813.72
Jun-15	4.46	Jun-15	1813.61
Jul-15	4.46	Jul-15	1813.46
Aug-15	4.45	Aug-15	1813.23
Sep-15	4.58	Sep-15	1813.10
Oct-15	4.5	Oct-15	1812.99
Nov-15	4.45	Nov-15	1813.45
Dec-15	4.52	Dec-15	1813.60
Jan-16	4.56	Jan-16	1813.62
Feb-16	4.54	Feb-16	1813.72
Mar-16	4.5	Mar-16	1813.79

cont:	Apr-16	4.64	Apr-16	1813.78
	May-16	4.62	May-16	1813.73
	Jun-16	4.46	Jun-16	1813.42
	Jul-16	4.39	Jul-16	1813.14
	Aug-16	4.42	Aug-16	1812.90
	Sep-16	4.39	Sep-16	1812.74
	Oct-16	4.4	Oct-16	1812.75
	Nov-16	4.37	Nov-16	1812.83
	Dec-16	4.39	Dec-16	1812.95
	Jan-17	4.49	Jan-17	1813.13
	Feb-17	4.44	Feb-17	1813.36
	Mar-17	4.59	Mar-17	1813.43
	Apr-17	4.59	Apr-17	1813.43
	May-17	4.53	May-17	1813.35
	Jun-17	4.46	Jun-17	1813.20
	Jul-17	4.46	Jul-17	1813.01
	Aug-17	4.41	Aug-17	1812.90
	Sep-17	4.47	Sep-17	1813.09
	Oct-17	4.36	Oct-17	1813.37
	Nov-17	4.35	Nov-17	1813.45
	Dec-17	4.46	Dec-17	1813.51
	Jan-18	4.5	Jan-18	1813.42
	Feb-18	4.49	Feb-18	1813.55
	Mar-18	4.53	Mar-18	1813.62
	Apr-18	4.41	Apr-18	1813.69
	May-18	4.39	May-18	1813.63
	Jun-18	4.33	Jun-18	1813.50
	Jul-18	4.34	Jul-18	1813.37
	Aug-18	4.29	Aug-18	1813.27
	Sep-18	4.24	Sep-18	1813.18
	Oct-18	4.25	Oct-18	1813.14
	Nov-18	4.32	Nov-18	1813.14
	Dec-18	4.37	Dec-18	1813.25

SE ROA 48810

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.49691
R Square	0.24692
Adjusted R Square	0.23916
Standard Error	0.09858
Observations	99



ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.309047329	0.30904733	31.8044125	1.68054E-07
Residual	97	0.942560752	0.00971712		
Total	98	1.251608081			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-176.330234	32.06147257	-5.49975469	3.0853E-07	-239.9633822	-112.69709
X Variable 1	0.09970623	0.017679851	5.63954009	1.6805E-07	0.06461662	0.13479584

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	4.605056	-0.165056
2	4.611815	-0.011815
3	4.613861	-0.003861
4	4.618909	0.021091
5	4.626158	0.133842
6	4.632445	0.007555
7	4.630207	0.009793

8	4.614308	-0.084308	cont:	43	4.487016	0.212984
9	4.587602	-0.087602		44	4.489945	0.130055
10	4.566968	-0.096968		45	4.477914	0.152086
11	4.537493	-0.097493		46	4.453502	0.106498
12	4.510915	-0.040915		47	4.447570	0.082430
13	4.501692	-0.011692		48	4.446401	0.183599
14	4.503902	-0.003902		49	4.458849	-0.048849
15	4.501839	0.008161		50	4.462543	-0.072543
16	4.497330	0.142670		51	4.465081	-0.015081
17	4.522080	0.127920		52	4.485022	0.074978
18	4.536023	0.103977		53	4.511943	0.038057
19	4.550378	-0.040378		54	4.503966	0.076034
20	4.537991	-0.077991		55	4.502969	-0.002969
21	4.516560	0.083440		56	4.508952	0.001048
22	4.468384	-0.138384		57	4.497984	-0.037984
23	4.449439	-0.099439		58	4.483028	-0.023028
24	4.436777	-0.176777		59	4.460096	-0.010096
25	4.426819	-0.176819		60	4.447134	0.132866
26	4.418701	-0.168701		61	4.436166	0.063834
27	4.421274	-0.051274		62	4.482031	-0.032031
28	4.424685	0.075315		63	4.496987	0.023013
29	4.430734	0.069266		64	4.498981	0.061019
30	4.434586	0.095414		65	4.508608	0.031392
31	4.431656	0.058344		66	4.516253	-0.016253
32	4.423173	-0.003173		67	4.515121	0.124879
33	4.409503	0.040497		68	4.509481	0.110519
34	4.390987	-0.000987		69	4.478759	-0.018759
35	4.390987	-0.140987		70	4.450951	-0.060951
36	4.391620	-0.021620		71	4.426704	-0.006704
37	4.399555	0.070445		72	4.411429	-0.021429
38	4.418637	0.141363		73	4.411842	-0.011842
39	4.438690	0.201310		74	4.420387	-0.050387
40	4.452762	0.067238		75	4.432196	-0.042196
41	4.461484	0.088516		76	4.450312	0.039688
42	4.471095	0.238905		77	4.473126	-0.033126

78	4.480506	0.109494
79	4.479561	0.110439
80	4.471758	0.058242
81	4.457332	0.002668
82	4.437818	0.022182
83	4.427257	-0.017257
84	4.446464	0.023536
85	4.474116	-0.114116
86	4.481657	-0.131657
87	4.487694	-0.027694
88	4.478727	0.021273
89	4.492159	-0.002159
90	4.498981	0.031019
91	4.506226	-0.096226
92	4.500022	-0.110022
93	4.487480	-0.157480
94	4.473666	-0.133666
95	4.464321	-0.174321
96	4.455588	-0.215588
97	4.451195	-0.201195
98	4.451166	-0.131166
99	4.461980	-0.091980

Summary of Direct Testimony of

Richard K. Waddell, Jr., Ph.D., PG

Dr. Waddell will testify in the following areas:

Review of the sources of water to a well: depletion and capture

When a well is pumped, water is provided by reduction of the amount of water in storage in the groundwater system, and from reductions in the natural discharge from the system, and in cases where there are surface bodies of water or permeable boundaries connected to the groundwater system, increases in the recharge rate. Reduction of the amount of water in the system may impact other groundwater users, with increased pumping costs. Capture of natural discharge can impact users of surface water and ecological systems dependent on the discharge. In the Lower White River Flow System (LWRFS), the senior water rights holders are dependent on the groundwater discharge, and capture impacts those rights.

Opinions related to matters posed by the State Engineer

The geographic boundary of the hydrologically connected groundwater and surface water systems comprising the Lower White River Flow System

The NSE should consider adding Kane Springs Valley (KSV) to the LWRFS, based on the observed responses to pumping of MX-5 in KPW-1 and CSVM-4. The water levels observed before, during, and after the Order 1169 testing show a clear response to pumping of MX-5 during the test. Information is lacking on water-level changes that may have occurred to the northeast of KPW-1 in the KSV Hydrographic Area (HA). Vidler/Lincoln County is correct in concluding that there is a reduction in transmissivity in the carbonate aquifer in the northern part of Coyote Spring Valley (CSV), based on (1) higher hydraulic gradient than is present to the south and (2) the absence of a well-pronounced seasonal change in water levels in these wells. The decrease in transmissivity is insufficient to have prevented the MX-5 effects from affecting water levels in these two northern wells. Vidler/Lincoln County provided useful geophysical data but has overstated the effects of geologic faults detected in these data. These structures may have a role in reduction of transmissivity, but if so, the reduction is too small to separate KSV from CSV. KSV provides water that flows into CSV, which demonstrates a hydraulic connection between these two basins.

Several parties have suggested that water flows from the LWRFS into Las Vegas Valley, or the reverse. These suggestions are different from the long-held view that there is little flow across the Las Vegas Valley shear zone. Tetra Tech simulated the shear zone as a no-flow boundary based on the recommendations of Jim Harrill, formerly of the USGS and a hydrologist with decades of experience in Nevada hydrology (see NSE Exhibit No. 332). Having said that, we know that the shear zone is not impermeable, and some flow across it should be expected. If the flow across the shear zone is substantial, as argued by the Moapa Band of Paiute Indians to justify increasing pumpage in the LWRFS, this water is tributary to the Las Vegas basin and capturing this flow would impact water users in the Las Vegas basin. It would be prudent to install monitor wells between the basins included in the southern

LWRFS and Las Vegas basin to determine if the effects of pumping are propagated southward, and to collect information on the permeability of the shear zone.

Rogers and Blue Point Springs (and others in their vicinity) are important habitat resources in the Lake Mead National Recreation Area, and are protected by water rights. These springs are located along the Rogers Spring Fault. Several alternatives have been proposed for the sources of these springs. One involves upflow along the fault from the carbonate aquifer that is present at depth, with mixing of water that has been in the overlying Mesozoic rocks. A second alternative is flow of water from the carbonate aquifer in California Wash through the Paleozoic carbonate and Mesozoic rocks to exit at the springs because of the low permeability of the younger sedimentary rocks present on the southeast side of the Rogers Spring Fault. Both of these alternatives involve the carbonate aquifer in the defined LWRFS. A third alternative, based on similarity of stable isotopic compositions of the water discharging from the springs with waters sampled in EH-3 and EH-7 in Weiser Wash, located in the Lower Moapa Valley HA. Based on (1) geochemical data and modeling which indicate that the geochemical character of the water discharging at Rogers and Blue Point springs can be explained by mixing of (a)carbonate water sampled from wells west of the springs in California Wash and Garnet Valley with (b) a small amount of local recharge and (c) reaction with minerals contained in the Mesozoic rocks, and (2) hydrologic-head data which indicate that flow beneath the Muddy Mountains is from west to east toward the spring but that flow from Weiser Wash is likely toward the Muddy River or the Virgin River, my interpretation is that the third alternative is unlikely. Which of the first two alternatives is correct, or whether there is a combination of these two alternatives, is unknown. Based on the observed spring flows during the Order 1169 test and the relatively high hydraulic gradient between California Wash and the springs, the degree of hydraulic connection is low, and the effects of pumping in the currently defined LWRFS will take a long time to be observable. Nevertheless, the springs require protection, and installation of additional monitoring wells in carbonate rocks in the upper plate of the thrust fault is recommended.

The information obtained from the Order 1169 aquifer test and subsequent to the aquifer test and Muddy River headwater spring flow as it relates to aquifer recovery since the completion of the aquifer test

Several parties have stated that drought conditions over the last 2 to 3 decades have caused water levels to decline, and therefore that interpretations of the effects of the Order 1169 pumping have been overestimated. I disagree, based on long-term winter precipitation data, and the many, many observations of rising water levels in southern Nevada, including in Coyote Spring Valley. Water levels were declining prior to and after the Order 1169 test because of pumping in the LWRFS. In addition, they were declining prior to a recharge pulse that occurred in 2005 and 2006 that caused an increase in water levels over a large area. The design of the Order 1169 test purposely included a pumping schedule distinctly different than the seasonal pumping that creates a seasonal water-level response through much of the LWRFS, so that the effects of MX-5 pumping could be distinguished from other pumping effects. A surprising result of the Order 1169 test was that pumping effects were quickly transmitted over a very large area.

With cessation of pumping, recovery of water levels from pumping effects began to be propagated away from MX-5, in the same manner that drawdown was propagated with the beginning of pumping. The further away an observation point is from MX-5, the greater the delays to observe these water level changes are, subject to the effects of inhomogeneity in the aquifer. This explains the simulated effects of moving pumping from the Muddy River Springs Area (MRSA) to Garnet Valley investigated in Tetra Tech's 2019 modeling submitted as part of the reported submitted by the Nation Park Service related to Order 1313. Moving the location of pumping delayed the effects of pumping on the MRSA but did not prevent the effects.

In summary, recovery from the Order 1169 test occurred relatively rapidly after completion of MX-5 pumping, but because of the long-term decline in water levels caused by other pumping in the LWRFS, this recovery appears to have occurred more slowly than actually occurred.

<u>The long-term annual quantity of groundwater that may be pumped from the Lower White River Flow System, including the relationships between the location of pumping on discharge to the Muddy River Springs, and the capture of Muddy River flow</u>

And

<u>The effect of movement of water rights between alluvial wells and carbonate wells on deliveries of senior decreed rights to the Muddy River</u>

Based on the concepts of depletion and capture and the widespread and quick propagation of drawdown during the Order 1169 test, any pumping within the connected portions of the carbonate aquifer will eventually result in capture of surface discharge. Whether this capture is significant to use of the water is dependent on many factors, such as legal rights and sensitivity to decline of flow, whether for human or ecological uses. I have not evaluated what is "significant" in this sense. Clearly, some impact must be considered acceptable, or use of groundwater would not be acceptable.

Modeling simulations were performed under my direction to evaluate the effects of changing locations of pumping, but not the total rate of pumping. Because our groundwater model underestimated the effects of the Order 1169 pumping, I did not believe it would be appropriate to use the model to estimate the "allowable" pumping that could be pumped, without additional calibration work. Thus, we used it to estimate the effects of changing the locations of pumping, keeping the total pumping constant. These simulations showed that the beneficial effects on the Muddy River springs and Muddy River flow of moving pumping away from the MRSA would be temporary. Looked at another way, there would be a benefit to moving the pumping, but not for long.

My interpretation of the data is that pumping at historical rates has noticeably decreased natural discharge rates. The USGS has interpreted winter precipitation data and has suggested that recharge rates over the period since approximately 1970 have been higher than in the preceding decades. Further, significant recharge occurs more frequently when there are wet winters. When there is a return to drier conditions, such as occurred in early and middle 20th century, the reduction in recharge will further reduce natural discharge.

Responses to Comments on the NPS Order 1303 Submittal

<u>The Tetra Tech 2012 model should not be used</u>

I disagree with this comment, but strongly urge the user of this (or any) model to be aware of the strengths and weaknesses in the model so that decisions can be made about how much weight to apply to the modeling results. The National Park System has taken the position that it is important to be transparent in this process. It is for this reason that we did the post-audit report on the model, comparing simulated effects of the Order 1169 pumping with the observed effects. We found that the model generally undersimulated the effects of the pumping. It did, however, predict the distribution of the effects well, indicating that the geologic framework model on which the flow model is based is a reasonable model of the geologic environment. It includes many processes of interest, such as head-dependent spring discharge, simulation of stream flow resulting from groundwater discharge, and evapotranspiration. We also provided copies of the model to the State Engineer and to many interested parties in the groundwater system, for their inspection and use. Several parties have provided comments, but we have not been able to evaluate and implement their comments and suggestions. The model was used by hydrologists at the Argonne National Laboratory in 2014 to predict effects of pumping associated with the proposed Dry Lake Solar Energy Zone for the BLM National Renewable Energy Coordination Office in Washington.

I support continued development of the model because of its current limitations and the collection of new information on the hydrologic system. The effects of changes in recharge need to be included, as well as implementation of effects of structural features where the data justify their inclusion. An example would be to include the hydrologic barrier that causes the different water-level behavior of CSVM-5 from other wells in Coyote Spring Valley. Because of the thickness and depth of the carbonate aquifer and basin-fill aquifer, I recommend implementation of a subsidence package to calculate depth-caused reductions in specific storage, even though subsidence due to pumping in the carbonate aquifer will be minimal. Modification of kriging parameters used in the pilot point process is also recommended to avoid the "bulls eye" distribution of hydraulic conductivity that currently exists in the model. The external boundary conditions surrounding the LWFRS should be modified to allow capture of water when pumping causes drawdown along these boundaries.

This continued development of this model, or perhaps a different model, should be done in an open forum so that there are open discussions between hydrologists with differing interests, with participation (and perhaps oversight) by the State Engineers Office. The goal is that everyone participates in the development and improvement of the model, and therefore "owns" it. This could be done in the context of a "public process to develop a conjunctive management plan." (Interim Order #1303, bottom of page 1).

The differences in the isotopic composition of Rogers and Blue Point spring discharge from the average computed value in the carbonate aquifer can be explained by evaporation.

This comment was provided by a contractor for Vidler/Lincoln County. While it suggests an agreement with our conclusion that water discharging from the Rogers and Blue Point springs is from the carbonate aquifer, I disagree that the differences can be explained by evaporation. Isotopic fraction occurs during evaporation. However, it affects both hydrogen and oxygen isotopic composition, and causes a shift to the upper right from the non-evaporated composition, to the right of the Meteoric Water Line (MWL). The samples from the springs have isotopic compositions that plot very close to the MWL and do not show indications of evaporation from the carbonate-water samples collected from the carbonate aquifer in the LWRFS. Therefore, another explanation is required.

In addition, very little evaporation occurs from groundwater, unless it is very shallow. Most evaporation occurs prior to recharge (precipitation events, evaporation from snowpacks, or in the shallow soil zone), or after discharge.

Comments on Reports or Rebuttal Reports by other parties

I believe it is worthwhile to reiterate a few of my comments on the reports of some of the other parties but will only provide a summary of the most important comments. Other parties have stated:

Kane Springs Valley should not be included in the LWRFS

I disagree with this conclusion by Vidler/Lincoln County, based on several sets of data:

a. Water-level measurements in CSVM-4 and KMW-1 show a definite response to pumping of MX-5 during the Order 1169 test, imposed on a general decline of water levels in the aquifer. However, the seasonal signal from pumping in the MRSA is absent. I interpret these data to indicate that shorter term effects are present but smoothed by the reduction in transmissivity in northern Coyote Spring Valley (CSV). I agree with Vidler/Lincoln County that there is a lower transmissivity in the carbonate aquifer in this area than further south based on this smoothing and the higher hydraulic gradient in the northern part of CSV, but do not agree that the reduction is enough to isolate the effects of any pumping in KSV from the rest of the system. The Controlled Source Audio-frequency Magnetotellurics (CSAMT) data do document the presence of faults crossed by the survey lines, but there does not appear to be evidence of a "Northern LWRFS Boundary fault" [underlining added].
b. Temperature data evaluated by Coyote Springs Investment show that water from Kane Springs Valley (KSV) flows along the eastern side of CSV, showing a hydraulic connection between CSV and KSV.
c. The one-week pumping test performed in KPW-1 produced water at a rate of 1,800 gpm with less than 200 feet of drawdown, much of which appears to be the result of entrance losses, indicating that the formation is permeable.

Pumping can occur in California Wash because it is not in the capture zone of the MRSA

I strongly disagree with this conclusion reached on behalf of the Moapa Band of Paiute Indians. The capture area of a discharge point or area has nothing to do with the area in which pumping can affect water levels or discharge rates. While many hydrologists commonly make the mistake of assuming that the pumping needs to be removing the source of the water (i.e., along the flow path toward the well) in order to have effect on the discharge, this is a fundamental mistake and shows a lack of understanding about how groundwater systems behave. This assumption would mean that pumping downgradient from another well would have no effects on water levels in the upgradient well, yet well interference is a common problem that has nothing to do with the ambient hydraulic gradient or directions of flow. Peter Mock prepared a very good discussion of this that is included in Attachment B on pages 5-7 of Vidler/Lincoln County's Rebuttal Submittal.

However, if it can be demonstrated that if a discharge point or area receives water along flow paths, it can be concluded that there is a hydraulic connection between the areas through which this flow occurs and the discharge point. But the areas hydraulically connected to the discharge point include not only the areas along the flow paths, but other areas as well. Thus, pumping at MX-5 affected the MRSA even though the MRSA is downgradient of MX-5 and was not in the capture area of MX-5.

While my comment here is not dependent on the heat-transport model prepared as part of the Moapa Band of Paiute Indian's argument, I believe that the model was presented prematurely, and a great deal of work is required to make it a realistic model of the groundwater system. I support the effort to include heat transport to improve the understanding of the system, but that goal has not been accomplished with this model. It lacks geologic complexity, does not consider vertical flow or transport, is completely uncalibrated, and produces unrealistic results.

Water levels are declining because of drought conditions

While much of the western U.S. has been experiencing drought conditions for 10 to 20 years, water levels are not currently declining in the carbonate aquifer because of drought. The primary evidence for this conclusion is the observed multi-decade increase in water levels throughout much of southern Nevada. Approximately 100 examples of this were found in southern Nevada. In contrast, water levels in the carbonate aquifer in the LWRFS have been declining with few exceptions. The most likely cause of the different water-level trends is the pumping that has been occurring in the LWRFS.

The increases in water levels in other areas are likely the result of an increase in the amount of winter precipitation that began in approximately 1970. Greater volumes of melting snowpack and melt-water runoff provide a supply of water that can become recharge to the groundwater system rather than just infiltration into shallow soils. Thus, an increase in winter precipitation produces more favorable conditions for recharge than occur in times of lower winter precipitation. The resulting increase in recharge rates caused the widespread rise in water levels observed throughout most of southern Nevada.

SUMMARY

The establishment of the joint administrative unit for the LWRFS is a significant step forward. Successful management of the carbonate aquifer will depend on collection and interpretation of data in the manner of the Order 1169 test, and the monitoring that is now ongoing. Because of the sensitivity of the MRSA and senior water rights on the Muddy River, and the ongoing changes to the system under the current pumping situation, it will be important to assume that hydraulic connectivity exists between the area of proposed pumping and the MRSA, and to manage the system accordingly.

Additional pumping should not be allowed until there has been a demonstration, in the manner used for the Order 1169 test, that the new areas or pumping are not hydraulically connected with the MRSA. For example, although CSVM-5 water levels respond differently from those in other wells in CSV, the location of the barrier is not known at this time. [It is unlikely that it is the structurally high block of carbonate rock observed in outcrop and in CSAMT soundings.] Therefore, extended pumping with appropriate monitoring throughout the aquifer should be performed before a decision to grant a long-term water right. Similar comments apply to other areas, including KSV.

In addition, in other areas where there are springs that require protection from the effects of pumping, additional monitoring is prudent to allow detection of conditions that will cause adverse impacts prior to the impacts occurring at the springs. Recovery from pumping occurs more slowly than propagation of drawdown, if pumping has been occurring for a long period of time.

Month-Yr	Pcp (in)	PDSI
Jan-90	1.22	-3.62
Feb-90	0.66	-3.36
Mar-90	0.16	-3.63
Apr-90	0.28	-3.94
May-90	0.37	-3.71
Jun-90	0.46	-3.04
Jul-90	1.16	-1.97
Aug-90	0.84	-1.66
Sep-90	0.82	-0.61
Oct-90	0.12	-0.98
Nov-90	0.16	-1.25
Dec-90	0.04	-1.61
Jan-91	0.56	-1.87
Feb-91	0.77	-2.68
Mar-91	2.36	-0.42
Apr-91	0	-0.12
May-91	0.38	-0.11
Jun-91	0.29	0.18
Jul-91	0.35	-0.27
Aug-91	0.61	-0.51
Sep-91	0.56	-0.2
Oct-91	0.29	-0.77
Nov-91	0.31	-0.98
Dec-91	0.82	-0.7
Jan-92	1.1	-0.43
Feb-92	2.3	1.11
Mar-92	3.77	3.96
Apr-92	0.07	4.14
May-92	0.62	4.41
Jun-92	0.06	3.84
Jul-92	0.17	3.15
Aug-92	0.35	2.33
Sep-92	0.07	1.38
Oct-92	1.71	2.16
Nov-92	0	1.45
Dec-92	1.86	2.5
Jan-93	3.3	4.64
Feb-93	3.68	6.75
Mar-93	0.73	6.26
Apr-93	0.05	5.99
May-93	0.2	5.73
Jun-93	0.46	5.6
Jul-93	0	4.4
Aug-93	0.47	3.68
Sep-93	0.01	2.72
Oct-93	0.14	2.08

NV Climate Division 4 (Extreme South Nevada)

Year	CY Pcp (in)	WY Pcp (in)	3-yr moving avg (in)
1990	6.29	6.07	6.40
1991	7.3	6.2	5.19
1992	12.08	9.93	7.40
1993	9.98	12.47	9.53
1994	5.42	4.37	8.92
1995	8.04	10.05	8.96
1996	4.89	2.86	5.76
1997	5.07	6.29	6.40
1998	11.83	12.02	7.06
1999	5	5.74	8.02
2000	5.88	4.64	7.47
2001	6.27	6.95	5.78
2002	1.68	1.29	4.29
2003	7.49	6.59	4.94
2004	11.18	6.72	4.87
2005	11.07	15.83	9.71
2006	4.66	4.64	9.06
2007	5.09	5	8.49
2008	4.98	4.4	4.68
2009	3.69	5.07	4.82
2010	10.35	6.35	5.27
2011	4.83	8.2	6.54
2012	7.17	6.43	6.99
2013	5.35	6.04	6.89
2014	4.71	5.29	5.92
2015	6.67	5.45	5.59
2016	8.38	7.93	6.22
2017	5.79	8.39	7.26
2018	6.07	4.7	7.01
2019	8	9.4	7.50

Nov-93	0.6	2.09	cont:	Oct-97	0.04	-0.98
Dec-93	0.34	1.4		Nov-97	0.58	-0.88
Jan-94	0.2	-0.33		Dec-97	0.31	-1.08
Feb-94	0.88	-0.51		Jan-98	0.35	-1.6
Mar-94	0.59	-1.62		Feb-98	4.33	2.62
Apr-94	0.3	-2.31		Mar-98	1.36	3.09
May-94	0.14	-2.65		Apr-98	0.63	3.64
Jun-94	0	-2.81		May-98	0.47	4.49
Jul-94	0.29	-3.09		Jun-98	0.34	5.33
Aug-94	0.6	-3.23		Jul-98	1.57	6.02
Sep-94	0.29	-3.12		Aug-98	0.67	5.09
Oct-94	0.09	-3.05		Sep-98	1.37	6.06
Nov-94	0.57	-2.16		Oct-98	0.45	5.62
Dec-94	1.47	-1.11		Nov-98	0.2	4.87
Jan-95	3.71	3.22		Dec-98	0.09	3.69
Feb-95	0.47	2.35		Jan-99	0.32	2.5
Mar-95	1.95	3.35		Feb-99	0.18	0.92
Apr-95	0.46	3.81		Mar-99	0.03	-2.51
May-95	0.65	4.8		Apr-99	1.44	-1.78
Jun-95	0.17	5.17		May-99	0.13	-2.18
Jul-95	0.05	4.06		Jun-99	0.43	-1.62
Aug-95	0.35	3.17		Jul-99	1.63	1.05
Sep-95	0.11	2.22		Aug-99	0.26	0.48
Oct-95	0	1.06		Sep-99	0.58	0.44
Nov-95	0.02	-0.6		Oct-99	0	-0.96
Dec-95	0.1	-2.14		Nov-99	0	-1.99
Jan-96	0.18	-3.38		Dec-99	0	-2.62
Feb-96	1.04	-3.52		Jan-00	0.27	-3.09
Mar-96	0.2	-4.02		Feb-00	2.21	-2.22
Apr-96	0.02	-4.75		Mar-00	0.81	-1.97
May-96	0.47	-4.82		Apr-00	0.12	-2.49
Jun-96	0.01	-4.71		May-00	0.02	-3.04
Jul-96	0.63	-4.43		Jun-00	0.09	-2.99
Aug-96	0.09	-4.77		Jul-00	0.01	-3.45
Sep-96	0.1	-4.64		Aug-00	1.09	-2.66
Oct-96	0.6	-4.13		Sep-00	0.02	-2.91
Nov-96	1.06	-3.01		Oct-00	1.16	-1.79
Dec-96	0.49	-2.8		Nov-00	0.06	-1.79
Jan-97	0.97	-2.15		Dec-00	0.02	-2.46
Feb-97	0.23	-2.5		Jan-01	1.83	-1.68
Mar-97	0	-3.48		Feb-01	1.89	-0.66
Apr-97	0.09	-3.84		Mar-01	0.71	0.01
May-97	0.03	-4.32		Apr-01	0.35	0.56
Jun-97	0.22	-3.84		May-01	0.07	0.18
Jul-97	0.3	-3.77		Jun-01	0	-0.45
Aug-97	0.37	-3.56		Jul-01	0.43	-0.57
Sep-97	1.93	-0.6		Aug-01	0.38	-1.28

Sep-01	0.05	-1.75	cont:	Aug-05	0.95	6.01
Oct-01	0.06	-2.21		Sep-05	0.15	5.05
Nov-01	0.29	-2.27		Oct-05	1.45	5.45
Dec-01	0.21	-2.33		Nov-05	0.08	4.24
Jan-02	0.07	-2.85		Dec-05	0.02	3.02
Feb-02	0.01	-3.66		Jan-06	0.28	2.04
Mar-02	0.16	-4.1		Feb-06	0.23	-0.59
Apr-02	0.02	-4.98		Mar-06	1.41	-0.07
May-02	0	-5.26		Apr-06	0.27	-0.36
Jun-02	0.01	-5.15		May-06	0.01	-1.86
Jul-02	0.23	-5.2		Jun-06	0.15	-2.32
Aug-02	0	-5.5		Jul-06	0.62	-2.11
Sep-02	0.23	-5.11		Aug-06	0.02	-2.8
Oct-02	0.47	-4.58		Sep-06	0.1	-2.84
Nov-02	0.29	-4.3		Oct-06	1.28	-1.74
Dec-02	0.19	-4.24		Nov-06	0	-2.24
Jan-03	0.09	-5.01		Dec-06	0.29	-2.4
Feb-03	2.29	-3.81		Jan-07	0.08	-2.78
Mar-03	0.86	-3.23		Feb-07	0.26	-3.45
Apr-03	0.85	-2.46		Mar-07	0.05	-4.6
May-03	0.1	-2.49		Apr-07	0.28	-5.06
Jun-03	0	-2.6		May-07	0	-5.44
Jul-03	0.4	-2.83		Jun-07	0	-5.29
Aug-03	0.89	-2.49		Jul-07	0.75	-4.65
Sep-03	0.16	-2.6		Aug-07	0.92	-4.2
Oct-03	0.02	-3.16		Sep-07	1.09	-2.93
Nov-03	0.79	-2.47		Oct-07	0	-3.17
Dec-03	1.04	-1.92		Nov-07	0.21	-3.59
Jan-04	0.1	-2.3		Dec-07	1.45	-2.25
Feb-04	2.39	-0.87		Jan-08	1	-1.44
Mar-04	0.39	-1.79		Feb-08	0.56	-1.43
Apr-04	1.04	-1.27		Mar-08	0.08	-1.92
May-04	0.01	-1.64		Apr-08	0	-2.35
Jun-04	0.04	-1.86		May-08	0.39	-2.24
Jul-04	0.1	-2.19		Jun-08	0.01	-2.34
Aug-04	0.65	-2.1		Jul-08	0.33	-2.32
Sep-04	0.15	-2.2		Aug-08	0.33	-2.55
Oct-04	2.03	1.76		Sep-08	0.04	-2.81
Nov-04	1.99	3.45		Oct-08	0.23	-2.92
Dec-04	2.29	4.68		Nov-08	0.8	-2.62
Jan-05	3.35	6.38		Dec-08	1.21	-1.93
Feb-05	3.08	7.66		Jan-09	0.31	-2.31
Mar-05	0.68	7.19		Feb-09	1.65	-1.65
Apr-05	0.47	7.5		Mar-09	0.01	-2.11
May-05	0.12	7.82		Apr-09	0.18	-2.38
Jun-05	0.15	7.13		May-09	0.05	-2.98
Jul-05	0.57	6.32		Jun-09	0.14	-2.85

Jul-09	0.31	-2.99	cont:	Jun-13	0	-3.82
Aug-09	0.14	-3.35		Jul-13	0.61	-3.29
Sep-09	0.04	-3.51		Aug-13	0.94	-2.95
Oct-09	0.01	-3.6		Sep-13	0.81	-0.91
Nov-09	0.07	-3.86		Oct-13	0.13	-0.96
Dec-09	0.78	-3.26		Nov-13	1.3	0.29
Jan-10	2.67	-1.49		Dec-13	0.11	-0.29
Feb-10	1.53	0.35		Jan-14	0.05	-2.12
Mar-10	0.45	0.94		Feb-14	0.24	-3.22
Apr-10	0.2	1.76		Mar-14	0.37	-3.87
May-10	0.04	2.13		Apr-14	0.15	-4.53
Jun-10	0.05	1.94		May-14	0.12	-4.82
Jul-10	0.06	0.9		Jun-14	0	-4.74
Aug-10	0.47	0.21		Jul-14	0.46	-4.44
Sep-10	0.02	-1.12		Aug-14	1.37	-3.34
Oct-10	1.09	0.63		Sep-14	0.99	-1.84
Nov-10	0.15	-0.04		Oct-14	0.01	-2.38
Dec-10	3.62	3.3		Nov-14	0.04	-2.77
Jan-11	0.08	2.49		Dec-14	0.91	-2.5
Feb-11	0.81	2.47		Jan-15	0.89	-2.62
Mar-11	0.42	1.9		Feb-15	0.62	-3.33
Apr-11	0.15	1.53		Mar-15	0.66	-4.21
May-11	0.39	1.6		Apr-15	0.27	-4.65
Jun-11	0	1.31		May-15	0.52	-4.38
Jul-11	0.61	1		Jun-15	0.04	-4.27
Aug-11	0.22	-0.04		Jul-15	0.75	-3.8
Sep-11	0.66	0.1		Aug-15	0.67	-3.76
Oct-11	0.98	0.72		Sep-15	0.07	-3.89
Nov-11	0.27	0.47		Oct-15	1.67	-2.33
Dec-11	0.24	-0.2		Nov-15	0.28	-2.27
Jan-12	0.17	-1.57		Dec-15	0.23	-2.5
Feb-12	0.3	-2.26		Jan-16	1.41	-2.16
Mar-12	0.46	-2.81		Feb-16	0.52	-2.66
Apr-12	0.43	-3.26		Mar-16	0.15	-3.61
May-12	0	-3.85		Apr-16	1.43	-2.82
Jun-12	0	-3.87		May-16	0.56	-2.56
Jul-12	0.65	-3.3		Jun-16	0.25	-2.46
Aug-12	2.12	-2.02		Jul-16	0.57	-2.49
Sep-12	0.81	-1.93		Aug-16	0.8	-2.33
Oct-12	1.24	-1.06		Sep-16	0.06	-2.6
Nov-12	0.02	-1.67		Oct-16	0.55	-2.51
Dec-12	0.97	-1.31		Nov-16	0.23	-2.82
Jan-13	0.57	-1.4		Dec-16	1.85	-1.68
Feb-13	0.14	-2		Jan-17	2.02	-1.05
Mar-13	0.53	-2.73		Feb-17	1.05	-1.63
Apr-13	0.09	-3.46		Mar-17	0.18	-1.75
May-13	0.12	-3.77		Apr-17	0.14	-2.49

May-17	0.1	-2.65
Jun-17	0	-2.83
Jul-17	1.1	-1.73
Aug-17	0.64	-2.47
Sep-17	0.53	-2.81
Oct-17	0	-2.26
Nov-17	0.01	-2.51
Dec-17	0.02	-2.85
Jan-18	1.71	-2.54
Feb-18	0.12	-3.09
Mar-18	0.76	-3.26
Apr-18	0.05	-4.22
May-18	0.43	-4.26
Jun-18	0	-4.26
Jul-18	1.09	-3.67
Aug-18	0.4	-3.61
Sep-18	0.11	-3.81
Oct-18	0.8	-3.17
Nov-18	0.3	-3.15
Dec-18	0.3	-3.42
Jan-19	1.65	-2.82
Feb-19	3.01	0.01
Mar-19	1.62	1.21
Apr-19	0.51	1.9
May-19	1.18	3.42
Jun-19	0.03	

Mo-Yr	Pcp (in)	PDSI
Jan-90	0.99	0.99
Feb-90	0.68	0.68
Mar-90	0.4	0.40
Apr-90	1.25	1.25
May-90	1.05	1.05
Jun-90	0.53	0.53
Jul-90	0.72	0.72
Aug-90	0.48	0.48
Sep-90	1.07	1.07
Oct-90	0.29	0.29
Nov-90	0.21	0.21
Dec-90	0.27	0.27
Jan-91	0.37	0.37
Feb-91	0.48	0.48
Mar-91	2.1	2.10
Apr-91	0.18	0.18
May-91	1.07	1.07
Jun-91	0.28	0.28
Jul-91	0.35	0.35
Aug-91	0.7	0.70
Sep-91	0.9	0.90
Oct-91	0.59	0.59
Nov-91	0.31	0.31
Dec-91	0.71	0.71
Jan-92	0.93	0.93
Feb-92	1.43	1.43
Mar-92	2.56	2.56
Apr-92	0.1	0.10
May-92	0.44	0.44
Jun-92	0.31	0.31
Jul-92	0.65	0.65
Aug-92	0.5	0.50
Sep-92	0.3	0.30
Oct-92	0.99	0.99
Nov-92	0.06	0.06
Dec-92	1.21	1.21
Jan-93	2.41	2.41
Feb-93	2.34	2.34
Mar-93	1.06	1.06
Apr-93	0.07	0.07
May-93	0.25	0.25
Jun-93	1.14	1.14
Jul-93	0.05	0.05
Aug-93	0.4	0.40
Sep-93	0.05	0.05
Oct-93	0.65	0.65

NV Climate Division 3 (South Central Nevada)

Water Year	WY Pcp	3-yr moving avg
1990	7.54	8.8
1991	7.2	7.1
1992	8.83	7.9
1993	10.03	8.7
1994	7.08	8.6
1995	13.17	10.1
1996	5.62	8.6
1997	10.08	9.6
1998	14.71	10.1
1999	8.13	11.0
2000	7.47	10.1
2001	8.56	8.1
2002	3.78	6.6
2003	7.39	6.6
2004	7.13	6.1
2005	14.81	9.8
2006	7.28	9.7
2007	6.38	9.5
2008	5.71	6.5
2009	7.12	6.4
2010	6.93	6.6
2011	10.41	8.2
2012	7.64	8.3
2013	7.89	8.6
2014	8.03	7.9
2015	6.6	7.5
2016	9.85	8.2
2017	10.16	8.9
2018	5.44	8.5
2019	10.72	8.8

Nov-93	0.65	0.65	cont:	Oct-97	0.2	0.20
Dec-93	0.44	0.44		Nov-97	0.85	0.85
Jan-94	0.26	0.26		Dec-97	0.44	0.44
Feb-94	0.95	0.95		Jan-98	0.62	0.62
Mar-94	0.81	0.81		Feb-98	3.54	3.54
Apr-94	0.95	0.95		Mar-98	1.56	1.56
May-94	1.07	1.07		Apr-98	0.96	0.96
Jun-94	0.03	0.03		May-98	1.57	1.57
Jul-94	0.14	0.14		Jun-98	1.56	1.56
Aug-94	0.59	0.59		Jul-98	1.04	1.04
Sep-94	0.54	0.54		Aug-98	0.46	0.46
Oct-94	0.61	0.61		Sep-98	1.91	1.91
Nov-94	1.01	1.01		Oct-98	1.09	1.09
Dec-94	1.13	1.13		Nov-98	0.39	0.39
Jan-95	2.79	2.79		Dec-98	0.1	0.10
Feb-95	0.35	0.35		Jan-99	0.87	0.87
Mar-95	2.48	2.48		Feb-99	0.32	0.32
Apr-95	1.09	1.09		Mar-99	0.21	0.21
May-95	2.18	2.18		Apr-99	1.78	1.78
Jun-95	0.95	0.95		May-99	0.54	0.54
Jul-95	0.16	0.16		Jun-99	0.71	0.71
Aug-95	0.35	0.35		Jul-99	0.97	0.97
Sep-95	0.07	0.07		Aug-99	0.7	0.70
Oct-95	0.01	0.01		Sep-99	0.45	0.45
Nov-95	0.02	0.02		Oct-99	0.02	0.02
Dec-95	0.8	0.80		Nov-99	0.07	0.07
Jan-96	0.54	0.54		Dec-99	0.02	0.02
Feb-96	1.06	1.06		Jan-00	0.75	0.75
Mar-96	0.98	0.98		Feb-00	2.38	2.38
Apr-96	0.19	0.19		Mar-00	0.83	0.83
May-96	0.88	0.88		Apr-00	0.48	0.48
Jun-96	0.19	0.19		May-00	0.46	0.46
Jul-96	0.76	0.76		Jun-00	0.28	0.28
Aug-96	0.09	0.09		Jul-00	0.01	0.01
Sep-96	0.1	0.10		Aug-00	1.97	1.97
Oct-96	0.87	0.87		Sep-00	0.2	0.20
Nov-96	1.35	1.35		Oct-00	1.67	1.67
Dec-96	1.3	1.30		Nov-00	0.25	0.25
Jan-97	1.64	1.64		Dec-00	0.12	0.12
Feb-97	0.35	0.35		Jan-01	1.33	1.33
Mar-97	0.03	0.03		Feb-01	1.25	1.25
Apr-97	0.2	0.20		Mar-01	0.9	0.90
May-97	0.26	0.26		Apr-01	1.21	1.21
Jun-97	1.12	1.12		May-01	0.21	0.21
Jul-97	0.6	0.60		Jun-01	0.03	0.03
Aug-97	0.45	0.45		Jul-01	1.09	1.09
Sep-97	1.91	1.91		Aug-01	0.3	0.30

Sep-01	0.2	0.20	cont:	Aug-05	1.08	1.08
Oct-01	0.23	0.23		Sep-05	0.39	0.39
Nov-01	0.66	0.66		Oct-05	0.82	0.82
Dec-01	0.79	0.79		Nov-05	0.2	0.20
Jan-02	0.25	0.25		Dec-05	0.58	0.58
Feb-02	0.26	0.26		Jan-06	0.92	0.92
Mar-02	0.29	0.29		Feb-06	0.45	0.45
Apr-02	0.39	0.39		Mar-06	1.7	1.70
May-02	0.13	0.13		Apr-06	1.08	1.08
Jun-02	0.1	0.10		May-06	0.21	0.21
Jul-02	0.32	0.32		Jun-06	0.12	0.12
Aug-02	0.03	0.03		Jul-06	0.99	0.99
Sep-02	0.33	0.33		Aug-06	0.04	0.04
Oct-02	0.35	0.35		Sep-06	0.17	0.17
Nov-02	0.59	0.59		Oct-06	0.94	0.94
Dec-02	0.52	0.52		Nov-06	0.08	0.08
Jan-03	0.2	0.20		Dec-06	0.49	0.49
Feb-03	1.38	1.38		Jan-07	0.24	0.24
Mar-03	0.55	0.55		Feb-07	0.56	0.56
Apr-03	1.17	1.17		Mar-07	0.45	0.45
May-03	0.51	0.51		Apr-07	0.77	0.77
Jun-03	0.04	0.04		May-07	0.08	0.08
Jul-03	0.48	0.48		Jun-07	0.13	0.13
Aug-03	1.31	1.31		Jul-07	0.43	0.43
Sep-03	0.29	0.29		Aug-07	1	1.00
Oct-03	0.1	0.10		Sep-07	1.21	1.21
Nov-03	0.85	0.85		Oct-07	0.11	0.11
Dec-03	1.11	1.11		Nov-07	0.11	0.11
Jan-04	0.18	0.18		Dec-07	1.28	1.28
Feb-04	1.75	1.75		Jan-08	1.27	1.27
Mar-04	0.22	0.22		Feb-08	1.09	1.09
Apr-04	0.98	0.98		Mar-08	0.17	0.17
May-04	0.16	0.16		Apr-08	0.01	0.01
Jun-04	0.17	0.17		May-08	0.73	0.73
Jul-04	0.47	0.47		Jun-08	0.04	0.04
Aug-04	0.91	0.91		Jul-08	0.55	0.55
Sep-04	0.23	0.23		Aug-08	0.21	0.21
Oct-04	2.73	2.73		Sep-08	0.14	0.14
Nov-04	1.2	1.20		Oct-08	0.33	0.33
Dec-04	1.34	1.34		Nov-08	0.96	0.96
Jan-05	2.66	2.66		Dec-08	0.66	0.66
Feb-05	1.84	1.84		Jan-09	0.57	0.57
Mar-05	0.85	0.85		Feb-09	1.62	1.62
Apr-05	0.88	0.88		Mar-09	0.22	0.22
May-05	1.01	1.01		Apr-09	0.6	0.60
Jun-05	0.28	0.28		May-09	0.29	0.29
Jul-05	0.55	0.55		Jun-09	0.95	0.95

Jul-09	0.54	0.54	cont:	Jun-13	0.01	0.01
Aug-09	0.31	0.31		Jul-13	1.14	1.14
Sep-09	0.07	0.07		Aug-13	0.75	0.75
Oct-09	0.39	0.39		Sep-13	1.7	1.70
Nov-09	0.09	0.09		Oct-13	0.36	0.36
Dec-09	1.1	1.10		Nov-13	0.8	0.80
Jan-10	1.34	1.34		Dec-13	0.57	0.57
Feb-10	1.22	1.22		Jan-14	0.28	0.28
Mar-10	0.74	0.74		Feb-14	0.56	0.56
Apr-10	0.76	0.76		Mar-14	0.61	0.61
May-10	0.35	0.35		Apr-14	0.37	0.37
Jun-10	0.09	0.09		May-14	0.48	0.48
Jul-10	0.41	0.41		Jun-14	0.01	0.01
Aug-10	0.4	0.40		Jul-14	0.99	0.99
Sep-10	0.04	0.04		Aug-14	1.6	1.60
Oct-10	2.14	2.14		Sep-14	1.4	1.40
Nov-10	0.72	0.72		Oct-14	0.01	0.01
Dec-10	2.77	2.77		Nov-14	0.19	0.19
Jan-11	0.15	0.15		Dec-14	1.01	1.01
Feb-11	0.6	0.60		Jan-15	0.52	0.52
Mar-11	0.89	0.89		Feb-15	0.27	0.27
Apr-11	0.38	0.38		Mar-15	0.41	0.41
May-11	0.87	0.87		Apr-15	0.31	0.31
Jun-11	0.16	0.16		May-15	1.66	1.66
Jul-11	0.75	0.75		Jun-15	0.38	0.38
Aug-11	0.32	0.32		Jul-15	1.11	1.11
Sep-11	0.66	0.66		Aug-15	0.52	0.52
Oct-11	1.02	1.02		Sep-15	0.21	0.21
Nov-11	0.21	0.21		Oct-15	2.21	2.21
Dec-11	0.09	0.09		Nov-15	0.73	0.73
Jan-12	0.48	0.48		Dec-15	0.59	0.59
Feb-12	0.51	0.51		Jan-16	1.51	1.51
Mar-12	0.95	0.95		Feb-16	0.53	0.53
Apr-12	0.55	0.55		Mar-16	0.51	0.51
May-12	0.17	0.17		Apr-16	1.27	1.27
Jun-12	0.01	0.01		May-16	0.71	0.71
Jul-12	1.42	1.42		Jun-16	0.61	0.61
Aug-12	1.6	1.60		Jul-16	0.38	0.38
Sep-12	0.63	0.63		Aug-16	0.56	0.56
Oct-12	0.92	0.92		Sep-16	0.24	0.24
Nov-12	0.21	0.21		Oct-16	0.59	0.59
Dec-12	1.29	1.29		Nov-16	0.3	0.30
Jan-13	0.54	0.54		Dec-16	1.42	1.42
Feb-13	0.27	0.27		Jan-17	2.3	2.30
Mar-13	0.49	0.49		Feb-17	1.15	1.15
Apr-13	0.15	0.15		Mar-17	0.78	0.78
May-13	0.42	0.42		Apr-17	0.46	0.46

May-17	0.45	0.45
Jun-17	0.05	0.05
Jul-17	0.9	0.90
Aug-17	0.94	0.94
Sep-17	0.82	0.82
Oct-17	0.01	0.01
Nov-17	0.21	0.21
Dec-17	0.05	0.05
Jan-18	0.84	0.84
Feb-18	0.19	0.19
Mar-18	1.02	1.02
Apr-18	0.49	0.49
May-18	1.04	1.04
Jun-18	0	0.00
Jul-18	1.19	1.19
Aug-18	0.34	0.34
Sep-18	0.06	0.06
Oct-18	1.35	1.35
Nov-18	0.43	0.43
Dec-18	0.33	0.33
Jan-19	1.13	1.13
Feb-19	1.81	1.81
Mar-19	2.36	2.36
Apr-19	0.6	0.60
May-19	2.47	2.47
Jun-19	0.24	0.24

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Chapter A3

Statistical Methods in Water Resources

By D.R. Helsel and R.M. Hirsch

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U.S. Department of the Interior
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Conversion Factors

Multiply	By	To obtain
acre	4,047	square meter
acre-foot (acre-ft)	1,233	cubic meter
centimeter (cm)	0.10	millimeter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
inch (in.)	2.54	centimeter
mile (mi)	1.609	kilometer
square foot	0.09290	square meter
square mile (mi^2)	2.590	square kilometer

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C=(°F-32)/1.8$$

Conversion Factors, Datums, Discharge or Flow, Instantaneous Discharge, and Abbreviations and Acronyms—Continued

Datums

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27) and the North American Datum of 1983 (NAD 83).

Discharge or Flow

The rate that matter passes through a cross section of a stream channel or other water body per unit of time. The term commonly refers to the volume of water (including, unless otherwise stated, any sediment or other constituents suspended or dissolved in the water) that passes a cross section in a stream channel, flume, weir, canal, pipeline, etc., within a given period of time (cubic feet per second).

Instantaneous Discharge

The discharge at a particular instant of time (see also “Discharge”).

Abbreviations and Acronyms

Abbreviations and Acronyms	Meaning
BM	bench mark
DGPS	Differential Global Positioning System
DRI	Desert Research Institute
FWS	U.S. Fish and Wildlife Service
GPS	global positioning system
LVVWD	Las Vegas Valley Water District
MVID	Muddy Valley Irrigation District
MVWD	Moapa Valley Water District
NDWR	Nevada Division of Water Resources
NGS	National Geodetic Survey
NPC	Nevada Power Company
NWIS	National Water Information System
OPUS	Online Positioning User Service
Reclamation	Bureau of Reclamation
RM	reference mark
RP	reference point
SNWA	Southern Nevada Water Authority
UNAES	University of Nevada Agricultural Experiment station
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator

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Water-Surface Elevations, Discharge, and Water-Quality Data for Selected Sites in the Warm Springs Area near Moapa, Nevada

By David A. Beck, Roslyn Ryan, Ronald J. Veley, Donald P. Harper, and Daron J. Tanko

Abstract

The U.S. Geological Survey, in cooperation with Southern Nevada Water Authority and the Nevada Division of Water Resources, operates and maintains a surface-water monitoring network of 6 continuous-record stream-flow gaging stations and 11 partial-record stations in the Warm Springs area near Moapa, Nevada. Permanent land-surface bench marks were installed within the Warm Springs area by the Las Vegas Valley Water District, the Southern Nevada Water Authority, and the U.S. Geological Survey to determine water-surface elevations at all network monitoring sites. Vertical datum elevation and horizontal coordinates were established for all bench marks through a series of Differential Global Positioning System surveys. Optical theodolite surveys were made to transfer Differential Global Positioning System vertical datums to reference marks installed at each monitoring site. The surveys were completed in June 2004 and water-surface elevations were measured on August 17, 2004. Water-surface elevations ranged from 1,810.33 feet above North American Vertical Datum of 1988 at a stream-gaging station in the Pederson Springs area to 1,706.31 feet at a station on the Muddy River near Moapa.

Discharge and water-quality data were compiled for the Warm Springs area and include data provided by the U.S. Geological Survey, Nevada Division of Water Resources, U.S. Fish and Wildlife Service, Moapa Valley Water District, Desert Research Institute, and Converse Consultants. Historical and current hydrologic data-collection networks primarily are related to changes in land- and water-use activities in the Warm Springs area. These changes include declines in ranching and agricultural use, the exportation of water to other areas of Moapa Valley, and the creation of a national wildlife refuge. Water-surface elevations, discharge, and water-quality data compiled for the Warm Springs area will help identify (1) effects of changing vegetation within the former agricultural lands, (2) effects of restoration activities in the wildlife refuge, and (3) potential impacts of ground-water withdrawals.

Introduction

The Warm Springs area, located in the northwestern end of Moapa Valley, Nev., (fig. 1) consists of a network of springs and seeps that form the headwaters of the Muddy River. Over time, this area has been home to the Anasazi and the Southern Paiute Indian tribes, outlaws, prospectors, Mormon settlers, and others (Baxter and Haworth, 1996; U.S. Fish and Wildlife, 1991). The availability of water has provided past and current inhabitants with the resource necessary to sustain life in a desert setting. In addition, nearby entities, such as the Moapa River Indian Reservation, the Moapa Valley Water District (MVWD), and the Nevada Power Company (NPC), use water obtained from the area. The Warm Springs area is home to the Moapa Valley National Wildlife Refuge. The refuge was established in 1979 to protect and secure the riparian habitat of an endangered native minnow, the Moapa dace (*Moapa coriacea*) (U.S. Fish and Wildlife, 1991). A brief history of water-resources development in the Warm Springs area is included in Appendix A.

The Warm Springs area is located approximately 60 mi northeast of Las Vegas, which is one of the fastest growing metropolitan areas in the country. For more than 50 years, Las Vegas has used Lake Mead as its main source of drinking water. The ongoing growth of Las Vegas and the effects of the recent drought on the Colorado River have prompted water-resource managers to seek out and investigate additional sources of water. Presently (2006), the Nevada State Engineer is considering numerous applications to develop ground-water resources in basins adjacent to the upper Moapa Valley that would provide additional water to Las Vegas and Moapa Valley. It is not known what effects these proposed ground-water withdrawals will have on the riparian habitats and springs that form the Warm Springs area. Efforts are underway to acquire additional data to monitor for potential effects of these ground-water withdrawals.

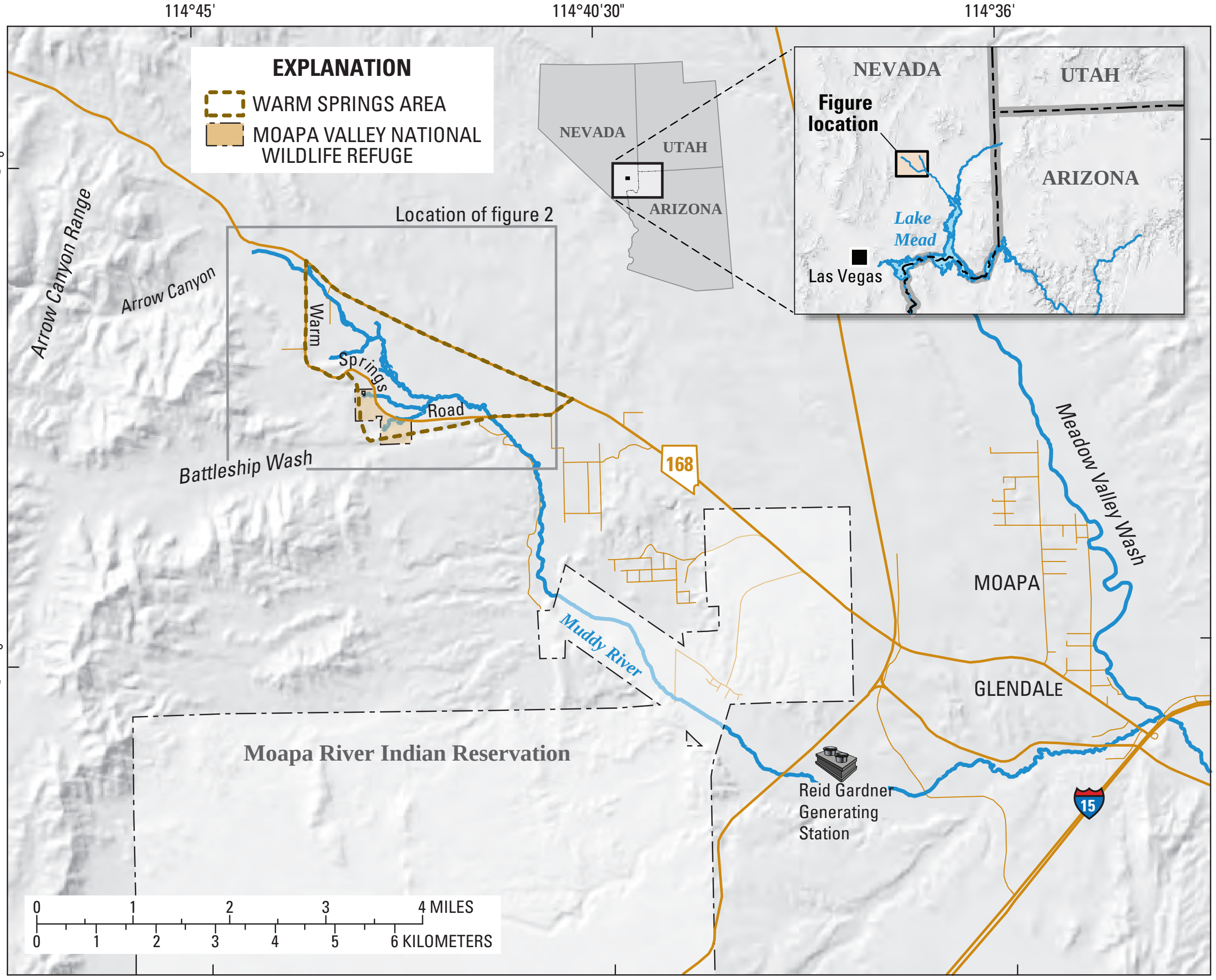

Figure 1. Location of study area and local features, Moapa Valley, Nevada.

As part of these efforts, the U.S. Geological Survey (USGS), in cooperation with the Southern Nevada Water Authority (SNWA), has completed a survey of water-surface elevations in the Warm Springs area. Bench marks (BMs), reference marks (RMs), reference points (RPs), and staff plates were established that will provide resource managers with tools to determine water-surface elevations at numerous monitoring sites in the area. These data will be used to assist in the efforts to determine what effects, if any, nearby ground-water withdrawals may have on the springs within the Warm Springs area.

Purpose and Scope

The primary purposes of this study are (1) to determine water-surface elevations in spring-fed pools and channels that currently are monitored by the USGS, and (2) to compile existing discharge and water-quality data within the Warm Springs area. For the purposes of this report, the Warm Springs area is defined as the area of the upper Moapa Valley upstream of the Muddy River Bridge at Warm Springs Road. The principle areas include the Muddy River flood plain and all the springs and seeps that are generally bounded by State Highway 168 and Warm Springs Road (fig. 2).

Permanent RMs and staff plates were installed near each of the hydrologic monitoring sites so that water-surface elevations could easily be obtained and related to land-surface datum. Land-surface datums used in this study were derived from permanent BMs established by the Las Vegas Valley Water District (LVVWD), SNWA, and USGS adjacent to the major spring groups and other monitoring sites. The elevations of these BMs were determined from a series of Differential Global Positioning System (DGPS) surveys. The elevations were transferred to the monitoring sites by optical theodolite surveys.

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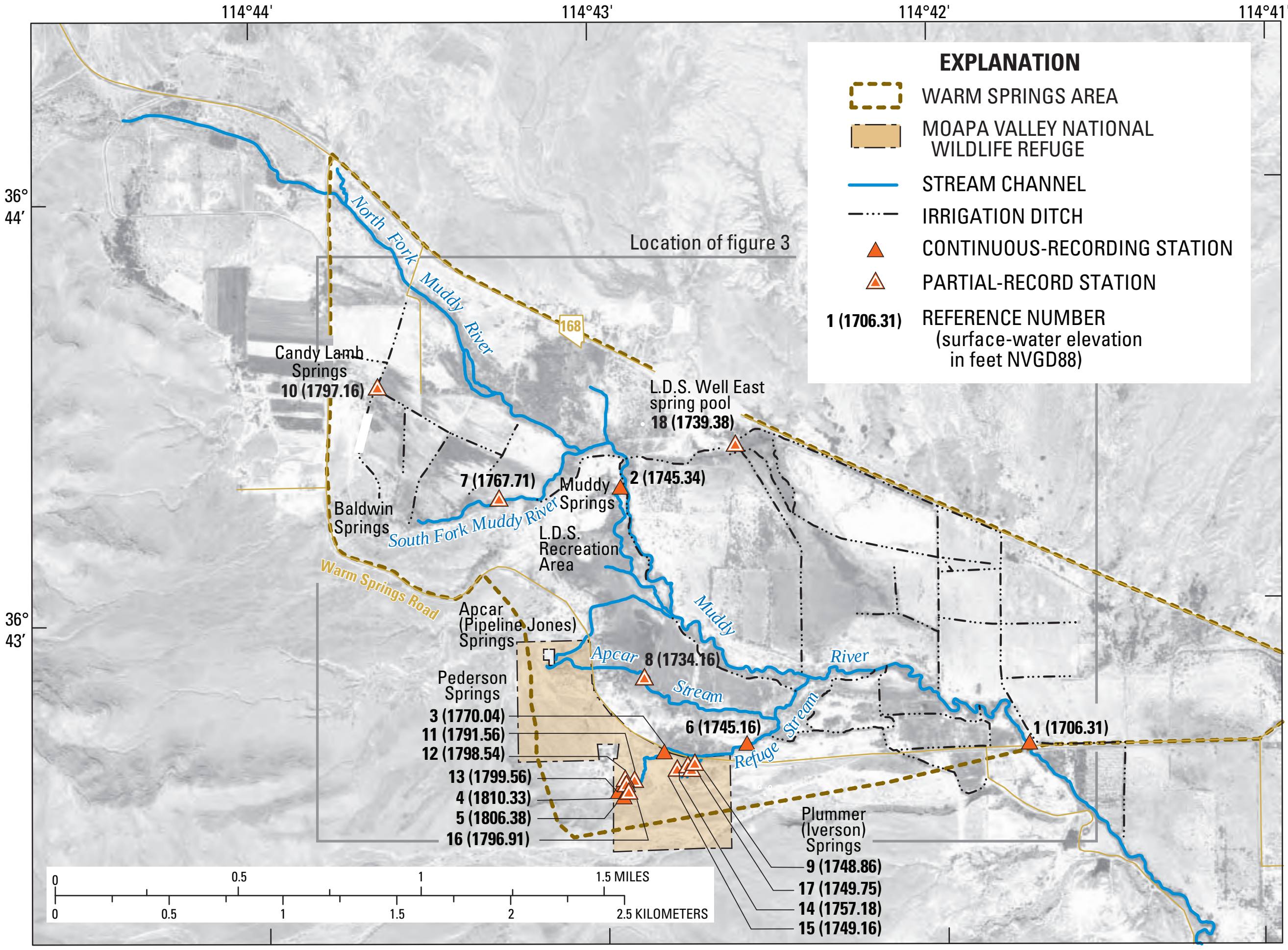

Figure 2. Location of major spring groups, U.S. Geological Survey monitoring stations, and water-surface elevations on August 17, 2004, in the Warm Springs area near Moapa, Nevada.

Existing discharge and water-quality data compiled for the Warm Springs area include data collected by the USGS and other agencies that manage, regulate, study, or use the water resources of the area. These data are included in this report, with measurements of water-surface elevations throughout the Warm Springs area made during this study, to support studies relating the condition of the springs to the regional ground-water flow system. Evaluation of the quality-assurance procedures for data collection by the other agencies is beyond the scope of this study. As a result, the USGS cannot verify the accuracy of the data provided.

As a supplement to data compilation, compendiums of water-resources development and data-collection networks are presented. Historical perspectives were based on (1) available data and references, (2) telephone interviews with many government and municipal officials, and (3) personal interviews with long-term residents within the Warm Springs area. Inclusion of the two compendiums in this report is intended to relate the historical development of the hydrologic monitoring network with land- and water-use changes in Moapa Valley.

Description of Study Area

The Warm Springs area, also known as the Muddy Springs area, is a network of springs and seeps that are located along the northeast slope of the Arrow Canyon Range (fig. 1). The area is bounded by Highway 168 to the north and northeast, Battleship Wash to the south, and Warm Springs Road to the west and southeast (fig. 1). There are six major spring groups within the study area that are generally aligned in a northwest-southeast direction: Cardy Lamb, Baldwin, Apcar, Muddy, Pederson, and Plummer (fig. 2). An unnamed spring area is located adjacent to Highway 168 near L.D.S. East well (fig 2, site 18); however, flow from this area discharges only intermittently.

The Warm Springs area is located near the southern boundary of the White River ground-water flow system (Prudic and others, 1995). Discharge from the springs and seeps of the Warm Springs area is believed to be the largest and most southerly outflow from this ground-water system (Eakin, 1966). The physiography of the study area is characterized by north-trending mountains to the west and a broad alluvial basin to the east. The topography consists of normal-faulted terrains that form complex, heterogeneous geologic settings with unique local and regional characteristics.

The primary aquifers in the area generally are made up of carbonate rocks of Paleozoic age and sedimentary rocks of Tertiary age. The carbonate rocks form complex aquifers whose extents and thicknesses are largely unknown. These aquifers interconnect with aquifers of other rock types and, where deformed or fractured, have the potential to transmit ground water (Prudic and others, 1995).

The climate of the area is semiarid to arid with approximately 5 in. of annual precipitation, low humidity, and high evapotranspiration rates (Eakin, 1966; Mozejko, 1981). Recharge to the ground-water system supplying the Warm Springs area is primarily from precipitation in the high mountain ranges in east-central Nevada (Eakin, 1966). Ground-water discharge within the Warm Springs area is from evaporation, transpiration by plants, and flow from the springs.

The discharge channels of springs in the area and the main stem of the Muddy River primarily are meandering and shallow and contain moderate amounts of fine silt and organic debris. Vegetation within and along the channel banks include cattails (*Typha* spp.), willows (*Salix* spp.), mesquite (*Prosopis* pubescens), reeds, and non-native palm trees (*Washingtonia filifera* and *Phoenix dactylifera*) and Tamarisk (*Tamarix* spp.). Aquatic plants such as algae, spike rush (*Eleocharis* spp.), water nymph (*Najas* spp.), watercress (*Nasturtium* spp.), pondweed (*Potamogeton* spp.), and non-native eel grass (*Vallisneria* spp.) are abundant in most spring pools and slack water areas (Mozejko, 1981; U.S. Fish and Wildlife Service, 1995).

The Warm Springs area is home to numerous birds, mammals, and reptiles, including quail (*Callipepla gambelii*), roadrunners (*Geococcyx californianus*), songbirds, shorebirds, cottontail rabbits (*Sylvilagus* spp.), coyotes (*Canis latrans*), foxes, spiny soft-shell turtles (*Amyda spinifera*), and snakes. In addition to the aforementioned endangered Moapa dace, several other species in the area's waterways are listed as sensitive. These include the Moapa White River springfish (*Crenichthys baileyi moapae*), Moapa pebblesnail (*Fluminicola avernalis*), and the Moapa Warm Spring riffle beetle (*Stenelmis moapa*) (U.S. Fish and Wildlife Service, 1991, 1995).

Water-Surface Elevations

The USGS, in cooperation with SNWA and Nevada Division of Water Resources (NDWR), operates and maintains a surface-water network of 6 continuous-record stream-gaging stations and 11 partial-record stations in the Warm Springs area near Moapa, Nev. (table 1). To determine the elevation of the water surface at each monitoring site, BMs, RMs, and RPs were established at strategic locations within the Warm Springs area. For this report, a BM is defined as a permanent marker that was installed in the ground or on a structure and that has an established elevation based on the North American Vertical Datum of 1988 (NAVD 88). The elevations of these markers were derived from survey-grade differential global positioning system (GPS) instrumentation. A RM is defined as a permanent marker installed in the ground or on a structure in the vicinity of a gaging station. The elevations of the RMs were determined by optical theodolite surveys from a nearby bench mark. A RP is a permanent marker installed on a structure at a gaging station that allows direct measurement of water-surface elevation using a graduated measuring tape or ruler. The elevation of the RP also is determined by optical theodolite survey from a nearby bench mark. The elevations of the RMs and RPs in this report also were based on the NAVD 88.

Water-surface elevations at each of the monitoring stations were determined by reading the water level (stage) at the staff plate installed at each site. The elevation of each staff plate was determined from optical theodolite survey using nearby reference marks as control. Because staff plates have their own scale, the elevation of a water surface is obtained by converting stage value to differential GPS elevation.

Bench Marks

Permanent land-surface BMs used for this study were established by the LVVWD, Stantec (on contract with SNWA), and the USGS. BMs consist of either brass plates, steel bolts, or rebar set in concrete structures or survey-grade earth anchors. Photographs and descriptions of selected BMs used for this study are included in Appendix B and table 2, respectively. The locations of these BMs were selected on the basis of the long-term stability of the area or of the structure a BM was installed on and the proximity of each BM to each of the monitoring sites. The location of each BM is shown in figure 3.

Table 1. Index to continuous-record and partial-record stream-gaging stations and miscellaneous sites in the Warm Springs area near Moapa, Nevada.

[Map site numbers for station locations are shown on figure 2. Latitude and longitude are shown in degrees, minutes, and seconds. **Abbreviations:** USGS, U.S. Geological Survey; NAD27, North American Vertical Datum of 1927; NV, Nevada; ft, foot]

Map site No.	USGS site identification	Station name	Coordinates NAD27 Latitude	Coordinates NAD27 Longitude	Period of record	Remarks
			Continuous-record stations			
1	09416000	Muddy River near Moapa, NV	36°42'40"	114°41'40"	July 1913 to September 1915 April 1916 to September 1918 June 1928 to October 1931 April to July 1932 October 1944 to September 2004	Gage at 10-ft Cipolletti weir
2	09415900	Muddy Springs at L.D.S. Farm near Moapa, NV	36°43'18"	114°42'53"	August 1985 to September 1994 June 1996 to September 2004	Gage at flume (3-ft throat)
3	09415920	Warm Springs West near Moapa, NV	36°42'41"	114°42'48"	August 1985 to September 1994 June 1996 to September 2004	Gage at flume (1-ft throat)
4	09415910	Pederson Spring near Moapa, NV	36°42'35"	114°42'54"	October 1985 to September 1994 June 1996 to September 2004	Gage at weir (45° v-notch)
5	09415908	Pederson East Springs near Moapa, NV	36°42'34"	114°42'56"	May 2002 to September 2004	Gage at weir (45° v-notch)
6	09415927	Warm Springs Confluence at Iverson Flume near Moapa, NV	36°42'41"	114°42'32"	October 2001 to September 2004	Gage at flume (3-ft throat)
			Partial-record stations			
7	09415875	Baldwin Springs near Moapa, NV	36°43'16"	114°43'14"	February 2001	Flume (3-ft throat)
8	09415940	Apcar Stream at Pipeline Jones Flume near Moapa, NV	36°42'51"	114°42'53"	February 2001	Flume (3-ft throat)
9	364236-114424301	Warm Springs East (Plummer Main)	36°42'36"	114°42'43"	August 1982 to September 2004	Near Eakin site #10 (Appendix D; fig. D1)
10	364327-114430801	Muddy River Springs 10 (M-10)	36°43'27"	114°43'08"	January 1986 to September 2004	Concrete irrigation channel near Eakin site #38 (Appendix D; fig. D1)
11	364235-114425201	Muddy River Springs 11 (M-11)	36°42'38"	114°42'52"	September 1963 March 1987 to September 2004	Downstream of Pederson Spring
12	364237-114425401	Muddy River Springs 12 (M-12)	36°42'37"	114°42'54"	March 1987 to September 2004	Downstream of Pederson Spring
13	364236-114425401	Muddy River Springs 13 (M-13)	36°42'36"	114°42'54"	January 1986 to September 2004	Downstream of Pederson Spring
14	364238-114424201	Muddy River Springs 16 (M-16)	36°42'38"	114°42'44"	March 1987 to September 2004	Plummer west (90° v-notch weir)
15	364238-114424401	Muddy River Springs 15 (M-15)	36°42’38"	114°42’42"	March 1987 to September 2004	Plummer central
16	364235-114425301	Muddy River Springs 19 (M-19)	36°42'35"	114°42'53"	April 1998 to September 2004	Downstream of Pederson East Spring
17	364238-114424301	Muddy River Springs 20 (M-20)	36°42'37"	114°42'40"	October 1994 to September 2004	Plummer east
			Miscellaneous sites			
18	364329 114423501	Unnamed spring pool at L.D.S. Well East near Moapa, NV	36°43'29"	114°42'35"	August 2004	100 ft east of well

Table 2. Elevation and location information for permanent land-surface bench marks in the Warm Springs area near Moapa, Nevada.

[Map site numbers for bench mark locations are shown on figure 3. Elevation Ortho height is referenced to the North American Vertical Datum of 1988. Latitude and longitude are shown in degrees, minutes, and seconds. **Occupation time:** time, in hours, Global Positioning System was set up over a bench mark. **Abbreviations:** NAD 83, North American Datum of 1983; OPUS, Online Positioning User Service; USGS, U.S. Geological Survey; LVVWD, Las Vegas Valley Water District]

Map site No.	Site name (as in OPUS)	Date	Surveyed by	Elevation Ortho height (feet)	Horizontal Coordinates NAD 83		Occupation time (hours)	Description
					Latitude	Longitude		
WSBM-1	Jones Spring Box	05-05-04	Stantec	1,775.72	36°42'54.57129"N	114°43'09.63383"W	3.17	5/8 inch rebar with no cap, about 140 ft northwest of pumphouse, about 6 ft west of overhead powerline.
WSMB-2	Pipeline Jones Flume	07-20-04	USGS	1,735.52	36°42'50.36476"N	114°42'52.30915"W	2.75	Brass tablet in concrete on northeast side of flume, about 0.2 mi northeast of Warm Spring Road.
WSBM-3	Baldwin Spring	05-05-04	Stantec	1,175.68	36°43'13.68711"N	114°43'25.45556"W	3.48	5/8 inch rebar with no cap, about 100 ft east of the pumphouse, about 3 ft north of dirt road, and about 3 ft west of wooden fence post.
WSBM-4	Warm Springs Road near Iverson Flume	05-07-04	Stantec	1,759.90	36°42'37.69617"N	114°42'37.73940"W	3.98	5/8 inch rebar and aluminum cap in concrete, about 70 ft south of Warm Springs Road and about 30 ft east of driveway to Wildlife Refuge.
WSBM-5	Iverson Flume	05-14-02	LVVWD	1,746.17	36°42'40.81624"N	114°42'34.73365"W	3.22	Brass tablet in concrete on south side of flume on Refuge Stream, about 500 ft north of Warm Springs Road.
WSBM-6	Pederson Spring	05-06-04	Stantec	1,821.98	36°42'32.62813"N	114°42'55.32668"W	2.22	5/8 inch rebar and aluminum cap in concrete, in Wildlife Refuge about 300 ft southeast of Pederson Spring pool and about 10 ft above dirt road.
WSBM-7	Warm Springs West	05-06-04	Stantec	1,776.93	36°42'40.77093"N	114°42’51.02381"W	4.15	5/8 inch rebar and alumin cap in concrete, about 1,000 ft west of entrance to Wildlife Refuge and about 40 ft south of Warm Springs Road.
WSBM-8	Plummer Springs	05-06-04	Stantec	1,750.70	36°42'38.89120"N	114°42’44.37060"W	3.43	5/8 inch rebar and alumin cap in concrete, about 550 ft west of entrance to Wildlife Refuge and about 20 ft south of Warm Springs Road.
WSBM-9	Moapa Gage	05-07-04	Stantec	1,715.83	36°42'39.75208"N	114°41'43.35654"W	4.55	5/8 inch rebar and aluminum cap, about 5 ft north and about 4 ft west of southeast fence corner of gaging station perimeter fence.
WSBM-10	L.D.S. Well East	05-16-02	LVVWD	1,752.61	36°43'22.98995"N	114°42'37.14737"W	2.15	Brass tablet in southwest corner of concrete well pad inside fenced area.
WSBM-11	L.D.S. Gage	05-14-02	LVVWD	1,747.51	36°43'15.35091"N	114°42'55.94820"W	3.43	Brass tablet in east concrete abutment, about 0.1 mi below Muddy Springs and 30 ft west of dirt road.
WSBM-12	Baldwin Flume	06-03-04	USGS	1,769.07	36°43'16.23194"N	114°43'17.43571"W	23.98	5/8 bolt in concrete on south concrete abutment about 40 ft north of dirt road.
WSBM-13	M-10	06-03-04	USGS	1,799.25	36°43'32.65049"N	114°43'38.58223"W	18.68	5/8 bolt in concrete on top of culvert over concrete irrigation ditch, about 0.25 mi east of Warm Springs Road and about 3 ft south of dirt road.

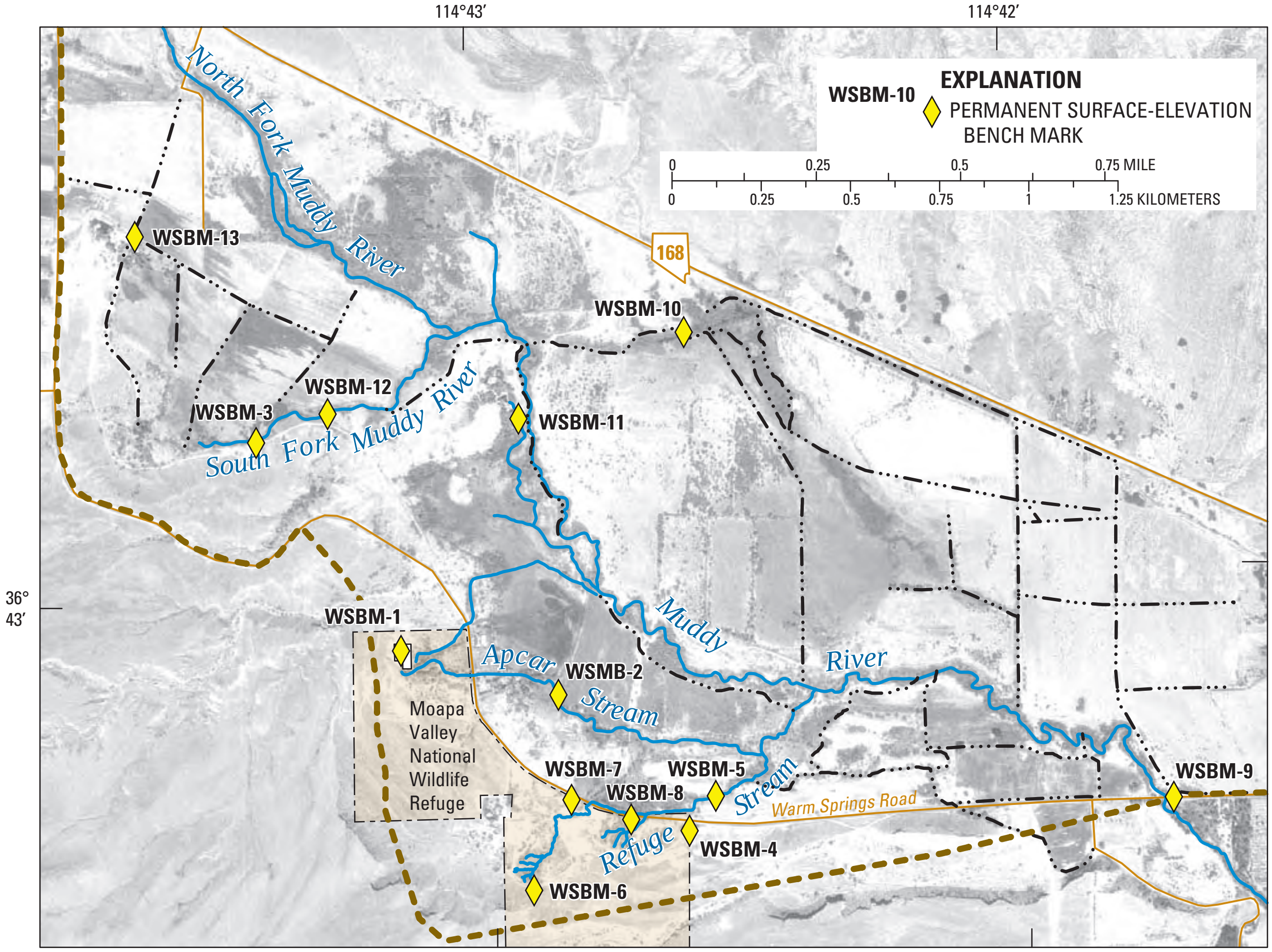

Figure 3. Location of permanent surface-elevation bench marks in the Warm Springs area near Moapa, Nevada.

Elevations and latitudes and longitudes for all the BMs in the study area were determined by applying DGPS surveying methods. The surveys consisted of setting up survey-grade DGPS equipment over each BM and processing the data through a National Geodetic Survey (NGS) web site. Equipment used by the LVVWD and Stantec and by the USGS for these surveys were the Trimble 5700™ and Ashtech ZExtreme™, respectively. According to manufacturer specifications, the relative accuracies of these units are 1 cm in the horizontal and 2 cm in the vertical.

The DGPS surveys of the study area ranged from just over 2 hours to almost 24 hours (table 2). When completed, the survey data were sent to the NGS Online Positioning User Service (OPUS) web site at http://www.ngs.noaa.gov/OPUS/. The GPS data files were then processed by OPUS using NGS computers and software to determine a BM positioning. The returned product, called the NGS OPUS Solution Report, lists the vertical datum, horizontal coordinates, and other related information. The accuracy of the OPUS corrected data is included with each individual sheet (Dave Doyle, National Geodetic Survey, oral commun., 2004). The vertical datum and horizontal coordinates for each BM are summarized in table 2. Copies of the OPUS Solution Reports are included in Appendix C.

BMs at Jones Spring Box (WSBM-1), Baldwin Spring (WSBM-3), and Warm Springs Road near Iverson flume (WSBM-4) are included in table 2 and figure 3 but were not used to determine RM elevations at USGS monitoring sites for this study. They are included in this report to document their location in the event other BMs are destroyed.

Reference Marks and Points

Following the installation and survey of the land-surface BMs in the Warm Springs area, permanent RMs or RPs were established at each of the current USGS monitoring sites. Existing or new RMs established at continuous-record stream gages typically included brass monuments or anchor bolts embedded in concrete-filled areas or on other stable structures adjacent to the site.

For the partial-record stations, staff plates were installed in the channel reaches where discharge measurements are periodically made. If there was no existing RM near the periodic site, fence posts were hammered into both banks of the channel. Where staff plates could not be installed, such as at site M-10, a RP with a 3/8-in. bolt was set into the vertical headwall of the culvert. The elevation of the water surface was then determined by measuring from the RP to the water surface using a graduated tape or ruler. Elevations and descriptions of the RMs and RPs for each site are given in table 3. Photographs of selected RMs and RPs are included in Appendix B for each site.

In addition to the RMs and RPs, optical theodolite surveys were done at each staff plate and at the top corners of each flume or weir. These additional points were surveyed to document the current conditions of existing structures and to help track changes that may occur in the future. This information also is included in table 3.

Optical theodolite surveys were used to transfer BM datum (NAVD 88) to the permanent RMs and RPs established at all the current monitoring sites. A detailed description of the concepts and procedures of optical theodolite surveying is given by Kennedy (1988). The identification number of the BM used for each survey is shown in table 3. The approximate locations of the BM relative to the USGS monitoring sites are shown in Appendix B.

The equipment used to complete the optical theodolite surveys included an engineer's automatic, or self-leveling, instrument and a "Frisco-style" aluminum rod. The precision and accuracy for each survey were in accordance with procedures described by Kennedy (1988).

Table 3. Elevations and descriptions of selected reference marks, points, and other features at continuous-recording and partial-record stations in the Warm Springs area near Moapa, Nevada.

[Map site numbers for station locations are shown on figure 2. **Reference mark-item:** RM-1, reference mark 1; RP-1, reference point 1; PZF, point of zero flow; F-1, top edge number 1 of a flume; W-1, top edge number 1 of a weir. **Land-surface benchmark used**: See table 1. **Abbreviations:** USGS, U.S. Geological Survey; NAD 83, North American Datum of 1983; NV, Nevada; ft, foot]

Map site No.	USGS site identification No.	Station name	Date surveyed	Reference mark-item	Elevation NAD 83 (feet)	Land-surface benchmark used	Description
			Continuous-recording stations				
1	9416000	Muddy River near Moapa, NV	06-02-04	RM-1	1,709.68	WSBM-9	Top of eyebolt on top of left bank wingwall above staff plate.
				RM-5	1,717.23	WSBM-9	Top center of "I" beam on top of wall on left bank downstream of gage house.
				RM-6	1,717.67	WSBM-9	Top of 2-inch pipe at the northeast corner of gage house platform.
				RM-7	1,719.74	WSBM-9	Top of large bolt securing Nevada Power large white pipe along fence on left bank.
				RP-1	1,706.69	WSBM-9	Top of fence post at left edge of water below gage house.
				Staff plate	1,709.04	WSBM-9	Top of staff plate (3.34 ft).
2	9415900	Muddy Springs at L.D.S. Farm near Moapa, NV	06-03-04	RM-3	1,745.42	WSBM-11	Top of 2-inch PVC pipe at downstream right-bank concrete abutment wall.
				RM-4	1,747.25	WSBM-11	Center round of the "9" in "93" written in the concrete abutment on the right bank.
				RM-5	1,753.55	WSBM-11	Chiseled square in concrete slab on walkway to gage.
				RP-1	1,747.93	WSBM-11	Top of upstream right-bank edge of flume.
				RP-2	1,746.97	WSBM-11	Nail in staff-plate backboard.
				PZF	1,744.93	WSBM-11	Bottom of upstream end of flume.
				F-1	1,748.04	WSBM-11	Downstream right-bank top edge of flume.
				F-2	1,748.13	WSBM-11	Upstream right-bank top edge of flume.
				F-3	1,748.06	WSBM-11	Downstream left-bank top edge of flume.
				F-4	1,748.11	WSBM-11	Upstream left-bank top edge of flume.
3	9415920	Warm Springs West near Moapa, NV	06-03-04	RM-1	1,772.94	WSBM-7	Painted circle on rock wall above gage.
				RM-3	1,770.78	WSBM-7	Upstream streamward corner of concrete pad on left bank (no mark).
				PZF	1,769.12	WSBM-7	Bottom of upstream end of flume.
				F-1	1,772.30	WSBM-7	Upstream left-bank top edge of flume.
				F-2	1,772.31	WSBM-7	Downstream left-bank top edge of flume.
				F-3	1,772.33	WSBM-7	Downstream right-bank top edge of flume.
				F-4	1,772.27	WSBM-7	Upstream right-bank top edge of flume.
				Staff plate	1,772.13	WSBM-7	Top of staff plate (3.00 ft).

Table 3. Elevations and descriptions of selected reference marks, points, and other features at continuous-recording and partial-record stations in the Warm Springs area near Moapa, Nevada.—Continued

[Map site numbers for station locations are shown on figure 2. **Reference mark-item:** RM-1, reference mark 1; RP-1, reference point 1; PZF, point of zero flow; F-1, top edge number 1 of a flume; W-1, top edge number 1 of a weir. **Land-surface benchmark used**: See table 1. **Abbreviations:** USGS, U.S. Geological Survey; NAD 83, North American Datum of 1983; NV, Nevada; ft, foot]

Map site No.	USGS site identification No.	Station name	Date surveyed	Reference mark-item	Elevation NAD 83 (feet)	Land-surface benchmark used	Description
			Continuous-recording stations–Continued				
4	9415910	Pederson Spring near Moapa, NV	06-09--04	RM-4	1,809.32	WSBM-6	Brass tablet in concrete in cylinder in ground, about 40 ft northwest of spring pool.
				RM-5	1,814.04	WSBM-6	Brass tablet in concrete in cylinder in ground, about 45 ft east of spring pool.
				RM-6	1,810.95	WSBM-6	Top of anchor bolt on left bank (west) concrete wall.
				PZF	1,809.82	WSBM-6	Notch apex of weir plate.
				Staff plate	1,812.22	WSBM-6	Top of staff plate (6.74 ft).
5	9415908	Pederson East Spring near Moapa, NV	06-09-04	RM-2	1,807.73	WSBM-6	Top of anchor bolt on west side of spring pool that anchors steel supports for gage house.
				RM-3	1,807.62	WSBM-6	Brass tablet on top of upstream end of left-bank concrete wall.
				RP-1	1,807.25	WSBM-6	Nail in staff plate backboard on left bank weir wall.
				PZF	1,806.04	WSBM-6	Notch apex of weir plate.
				Staff plate	1,807.59	WSBM-6	Top of staff plate (6.74 ft).
6	9415927	Warm Springs Confluence at Iverson Flume near Moapa, NV	06-03-04	RM-2	1,747.50	WSBM-5	"X" on the L bracket.
				RM-3	1,746.58	WSBM-5	Top of 1–2-inch concrete anchor bolt on left bank.
				RP-1	1,747.89	WSBM-5	Top of upstream staff plate (10.14 ft).
				RP-2	1,747.89	WSBM-5	Top of downstream staff plate (10.14 ft).
				PZF	1,744.45	WSBM-5	Bottom of upstream end of flume.
				F-1	1,747.65	WSBM-5	Upstream right-bank top edge of flume.
				F-2	1,747.63	WSBM-5	Upstream left-bank top edge of flume.
				F-3	1,747.59	WSBM-5	Downstream left-bank top edge of flume.
				F-4	1,747.60	WSBM-5	Downstream right bank top edge of flume.
			Partial-record stations				
7	9415875	Baldwin Springs near Moapa, NV	06-02-04	RM-1	1,769.04	WSBM-12	3–8-inch bolt in middle of concrete abutment on left bank.
				RM-2	1,771.83	WSBM-12	Top of fence post, 10 feet south of flume.
				RM-3	1,776.62	WSBM-12	Top edge of 3–8 inch lag bolt set horizontal in railroad-tie fence post, about 40 ft south of flume.
				PZF	1,767.42	WSBM-12	Bottom of upstream end of flume.
				F-1	1,770.61	WSBM-12	Upstream left-bank top edge of flume.
				F-2	1,770.58	WSBM-12	Upstream right-bank top edge of flume.
				F-3	1,770.57	WSBM-12	Downstream left-bank top edge of flume.
				F-4	1,770.59	WSBM-12	Downstream right-bank top edge of flume.
				Staff plate	1,769.31	WSBM-12	Top of staff plate (27.14 ft).
8	9415940	Apcar Stream at Pipeline Jones Flume near Moapa, NV	07-20-04	RM-1	1,735.19	WSBM-2	5–8-inch bolt in downstream end of concrete abutment on right bank.
				RM-2	1,735.33	WSBM-2	5–8-inch bolt in upstream end of concrete abutment on right bank.
				PZF	1,733.48	WSBM-2	Bottom of upstream end of flume.
				F-1	1,736.47	WSBM-2	Upstream left-bank top edge of flume.
				F-2	1,736.49	WSBM-2	Upstream right-bank top edge of flume.
				F-3	1,736.51	WSBM-2	Downstream left-bank top edge of flume.
				F-4	1,736.49	WSBM-2	Downstream right-bank top edge of flume.
				Staff plate	1,736.79	WSBM-2	Top of staff plate (3.34 ft).

Table 3. Elevations and descriptions of selected reference marks, points, and other features at continuous-recording and partial-record stations in the Warm Springs area near Moapa, Nevada.—Continued

[Map site numbers for station locations are shown on figure 2. **Reference mark-item:** RM-1, reference mark 1; RP-1, reference point 1; PZF, point of zero flow; F-1, top edge number 1 of a flume; W-1, top edge number 1 of a weir. **Land-surface benchmark used**: See table 1. **Abbreviations:** USGS, U.S. Geological Survey; NAD 83, North American Datum of 1983; NV, Nevada; ft, foot]

Map site No.	USGS site identification No.	Station name	Date surveyed	Reference mark-item	Elevation NAD 83 (feet)	Land-surface benchmark used	Description
Partial-record stations–Continued							
9	364236-114424301	Warm Springs East (Plummer Main)	06-10-04	RM-1	1,751.08	WSBM-8	Top of well casing on right bank of Plummer Main, about 15 ft southwest of gage.
				Staff plate	1,749.17	WSBM-8	Top of staff plate (3.34 ft).
10	364327-114430801	Muddy River Springs 10 (M-10)	06-03-04	RM-1	1,799.46	WSBM-13	3-8-inch bolt on top of concrete culvert, about 15 ft northwest of bench mark.
				RM-2	1,800.51	WSBM-13	Nail in south side of telephone pole, about 15 ft northwest of bench mark.
				RP-1	1,798.38	WSBM-13	3-8-inch bolt in east face of concrete culvert.
				RP-2	1,799.12	WSBM-13	3-8-inch bolt in north face of concrete culvert, about 15 ft northwest of bench mark.
11	364235-114425201	Muddy River Springs 11 (M-11)	06-09-04	RM-1	1,795.09	WSBM-6	Top of fence post on left bank.
				RM-2	1,795.09	WSBM-6	Top of fence post on right bank.
				Staff plate	1,794.10	WSBM-6	Top of staff plate (27.14 ft).
12	364237-114425401	Muddy River Springs 12 (M-12)	06-09-04	RM-1	1,801.76	WSBM-6	Top of fence post on left bank.
				RM-2	1,801.49	WSBM-6	Top of fence post on right bank.
				Staff plate	1,801.22	WSBM-6	Top of staff plate (27.14 ft).
13	364236-114425401	Muddy River Springs 13 (M-13)	06-09-04	RM-1	1,802.83	WSBM-6	Top of fence post on left bank.
				RM-2	1,804.33	WSBM-6	Top of fence post on right bank.
				Staff plate	1,801.91	WSBM-6	Top of staff plate (27.14 ft).
14	364238-114424201	Muddy River Springs 16 (Plummer West)	06-10-04	RM-1	1,758.08	WSBM-8	Top of 1-inch pipe in left bank, about 20 ft northeast of weir.
				W-1	1,757.37	WSBM-8	Top of left-bank end of weir.
				W-2	1,757.37	WSBM-8	Top of right-bank end of weir.
				Staff plate	1,757.79	WSBM-8	Top of staff plate (2.00 ft).
15	364238-114424401	Muddy River Springs 15 (Plummer Central)	06-10-04	RM-1	1,753.55	WSBM-8	Top of fence post in concrete wall, about 10 ft northwest of staff plate.
				Staff plate	1,751.24	WSBM-8	Top of staff plate (27.14 ft).
16	364235-114425301	Muddy River Springs 19 (M-19)	06-09-04	RM-1	1,800.88	WSBM-6	Top of fence post on left bank.
				RM-2	1,800.96	WSBM-6	Top of fence post on right bank.
				Staff plate	1,799.51	WSBM-6	Top of staff plate (27.14 ft).
17	364238-114424301	Muddy River Springs 20 (Plummer East)	06-10-04	RM-1	1,751.08	WSBM-8	Top of well casing on right bank of Plummer Main, about 15 ft southwest of staff plate.
				Staff plate	1,751.84	WSBM-8	Top of staff plate (27.14 ft).

Quality Assurance

To ensure the accuracy of BM datums and coordinates, OPUS Solutions for each DGPS survey were run using the NGS GEOID configuration (1999 and 2003) for computing orthometric heights. In addition, three of the BMs—Jones Spring Box, Baldwin Spring, and L.D.S. gage were resurveyed by one of the other agencies. OPUS solution reports for these three sites are included in Appendix C.

LVVWD and Stantec surveyed Jones Spring Box at Apcar on February 6, 2004, and Baldwin springs near the pump house on May 5, 2004. Differences between the Jones Spring Box surveys were 2 cm in the vertical (orthometric height) and 3 mm in the north horizontal (UTM coordinate).

Differences between the Baldwin Spring surveys were 1.4 cm in the vertical, 5 mm in the north horizontal, and 4 mm in the east horizontal (see OPUS reports, Appendix C).

Muddy Spring gage at L.D.S. Farm was surveyed by LVVWD and USGS on May 14, 2002, and June 2, 2004, respectively. Differences between the two surveys were 5 mm in the vertical, 2.1 cm in the north horizontal, and 5 mm in the east horizontal.

To ensure the accuracy of each optical theodolite survey, a series of operational checks were made on the instruments and rods. Visual inspections of equipment were made daily when in use, and peg tests were done to determine if instruments were in proper adjustment. A two-peg test was made before and after each series of levels. A complete description of the two-peg test procedure is given in a report by Kennedy (1988). At the same time the surveying instrument was peg-tested, the rod was checked by comparing it against an engineer's ruler.

Water-Surface Elevations

On August 17, 2004, water levels were obtained from the staff plates at all the USGS monitoring sites. The only exception was the water level at an unnamed spring-fed pool near well L.D.S Well East (fig. 2). The water-surface elevation of the pool which is located about 100 ft east of the well was measured using the optical theodolite survey for the BM at the well. In early July 2004, flow was observed to be discharging from several pools in the area and flowing into the Muddy River. By August 17, 2004, most of the pools had completely dried up and water no longer discharged from the area. On October 1, 2004, water was observed to be emanating from the surveyed well pond and other nearby pools and discharging to the Muddy River.

The elevation of each water surface was adjusted to NAVD 88 using the results of the differential stadia surveys. The location and water-level elevations of the readings made on August 17, 2004, are shown on figure 2 and included in table 4.

Table 4. Water-surface elevations measured on August 17, 2004, at continuous-recording and partial-record stations and miscellaneous sites in the Warm Springs area near Moapa, Nevada.

[Map site numbers for station locations are shown on figure 2. **Abbreviations:** USGS, U.S. Geological Survey; NAD83, North American Vertical Datum of 1983; NV, Nevada; ft, foot]

Map site No.	USGS site identification No.	Station name	Staff plate reading (feet)	Surface-water elevation NAD83 (feet)
		Continuous-recording stations		
1	09416000	Muddy River near Moapa, NV	0.61	1,706.31
2	09415900	Muddy Springs at L.D.S. Farm near Moapa, NV	.69	1,745.34
3	09415920	Warm Springs West near Moapa, NV	.91	1,770.04
4	09415910	Pederson Spring near Moapa, NV	4.85	1,810.33
5	09415908	Pederson East Spring near Moapa, NV	5.54	1,806.38
6	09415927	Warm Springs Confluence at Iverson Flume near Moapa, NV	7.62	1,745.16
		Partial-record stations		
7	09415875	Baldwin Springs Flume near Moapa, NV	25.54	1,767.71
8	09415940	Apcar Stream at Pipeline-Jones Flume near Moapa, NV	.71	1,734.16
9	364236114424301	Warm Springs East (Plummer Main)	3.03	1,748.86
10	364327114430801	Muddy River Springs 10 (M-10)	[1]1.22	1,797.16
11	364235114425201	Muddy River Springs 11 (M-11)	24.60	1,791.56
12	364237114425401	Muddy River Springs 12 (M-12)	24.46	1,798.54
13	364236114425401	Muddy River Springs 13 (M-13)	24.80	1,799.56
14	364238114424201	Muddy River Springs 16 (Plummer West)	1.40	1,757.18
15	364238114424401	Muddy River Springs (Plummer Central)	25.06	1,749.16
16	364235114425301	Muddy River Springs 19 (M-19)	24.55	1,796.91
17	364238114424301	Muddy River Springs 20 (M-20)	25.05	1,749.75
		Miscellaneous sites		
18		Unnamed spring pool at L.D.S. East Well near Moapa, NV		[2]1,739.38

[1]Reading is the distance from the reference point (RP) down to the water surface in the channel.

[2]Determined by optical theodolite survey from bench mark WSBM-10.

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Discharge and Water-Quality Data

History of Data Collection

In July 1913, the first continuous-record stream-gaging station was established in the Warm Springs area by the Muddy Valley Irrigation District (MVID). The gage was constructed near its current location just upstream from the culvert at Warm Springs Road (site number 1, fig. 2). Gage-height record and discharge measurements were collected by the MVID from July 1913 to September 1915 and from April 1916 to September 1918. These records were furnished to the USGS; the monthly mean discharges were subsequently published in USGS Water Supply Paper 1049 (1947). The gage was reactivated in June 1928 by the University of Nevada Agricultural Experiment Station. Daily mean gage height and monthly runoff were furnished to the USGS from June 1928 to October 1931 and from April 1932 to July 1932. Monthly mean discharges for these periods also were published in Water Supply Paper 1049 (U.S. Geological Survey, 1947). The U.S. Bureau of Reclamation (Reclamation) reactivated the gage in October 1944 and constructed the 10-ft concrete Cipolletti weir (Appendix B, fig. B2). Reclamation collected continuous streamflow data until October 1948 when operation of the gage was turned over to the USGS. Daily mean discharges from 1944 to 1948 were computed by Reclamation and reviewed by the USGS. Daily mean discharges from 1944 to 1952 were subsequently published in Water Supply Paper 1243 (U.S. Geological Survey, 1954). Since 1952, the USGS has continued to operate and maintain the gage. Daily mean discharges for water years 1953 to 1960 were published annually in Water Supply Papers 1283 (1953), 1393 (1955), 1443 (1956), 1513 (1957), 1563 (1958), 1633 (1959), and 1713 (1960). For water years 1961 to 2004, the data were published in the USGS, Nevada District annual data report series (U.S. Geological Survey, Nevada District annual data reports, 1962–2004). A water year is the 12 month period from October 1 to September 30.

To analyze the gaging-station record as a means of characterizing spring discharges, a series of discharge measurements and estimates were made by the USGS at 40 sites in the Warm Springs area during September 10–12, 1963 (Eakin, 1964). As only a sketch map of these sites was available, a field reconnaissance was made during June 2004 to verify the location of each site and to obtain accurate coordinates. The coordinates, sketch map, and discharge and specific conductance data for these sites are included in Appendix D.

By the mid-1960s, the NPC withdrew ground water from wells in the northwest corner of the Warm Springs area as water supply for the Reid Gardner Generating Station about 3 mi downstream (fig. 1). In February 1966, NPC filed application with the Nevada State Engineer to pump additional water from these wells. In an agreement with the Muddy Valley Irrigation Company, NPC agreed to fund several “non-recording type weirs” on the major springs in the Warm Springs area. As part of the agreement, these hydraulic structures were to be under the jurisdiction of the State Engineer who would then measure the water levels on a periodic basis (Testolin and others, 1993). During August and September 1967, nine steel Parshall flumes were installed by the Desert Research Institute (DRI) under the direct supervision of the Nevada Division of Water Resources (NDWR). The nine flumes were installed at the following springs: Pipeline Jones, Flowing Well (Willow), Baldwin House Spring #1 (South), Baldwin House #2 (North), Baldwin Cuts, Baldwin Channel, Muddy (Big), Iverson, and Pederson. The locations, throat dimensions, and water-level data for eight of the nine flumes are included in Appendix B; water-level data were not available for the Flowing Well (Willow). Because flow rates were not included with the data provided by NDWR, discharges were computed for each water-level measurement using standard rating equations, from Leupold and Stevens (1987) for the reported size of each Parshall flume. Graphs and tables of the discharges for the period of record for each site are included in Appendix B. All the original nine flumes installed in 1967 have either been replaced or removed. The locations of the two Baldwin House Spring flumes near Cardy Lamb Springs and the Flowing Well (Willow) Flume could not be verified during this study; therefore, their exact locations are unknown.

Although not mentioned in Testolin and others (1993), NDWR reported an additional Parshall flume, Big Wash Flume, that was installed in October 1967 on the North Fork Muddy River about 500 ft upstream of the confluence with South Fork Muddy River (fig. 2). Water-level readings from 1967 to 1984 for this site were provided by NDWR and are included in Appendix B, table B2. The flume washed out sometime after 1984 and currently is upside down on the south bank of the river (Appendix B, fig. B6). The flume dimensions, as reported by NDWR, were verified in the field, and discharges were computed for the periodic gage-height readings using the standard rating for a 3-ft Parshall flume (Leupold and Stevens, 1987). A graph and table of the computed discharges for Big Wash Flume are included in Appendix B (fig. B7, table B2).

Beginning October 1, 1977, records of flow for the Muddy River Power Diversion, about 100 ft upstream of the USGS stream-gaging station at Warm Springs Road, Moapa (Appendix B, fig. B1) were provided by NPC to the USGS. Monthly mean discharges were published in the USGS Nevada District annual data reports for water years 1977 through 1985. Daily mean discharges were retrieved from the USGS National Water Information System (NWIS) database and are included in Appendix B (fig. B8, table B3). Annual mean daily discharge from the diversion for the period of record was 3.45 ft^3/s.

In 1978, a new flume, reported by NDWR as the Garden Ditch Flume, was installed on the north spring tributary just inside the entrance gate to Apcar (Pipeline Jones) Springs

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(Appendix B, fig. B1). It is uncertain who installed the flume; however, field reconnaissance of the area in September 2004 indicated that the flume had been removed. The dimensions of the flume were obtained from a DRI report prepared for NPC as part of an evaluation of all flumes in the Warm Springs area (Wert and Pohlmann, 1992). Periodic water-level readings at this site through June 1992 also were provided by NDWR. Water levels, along with a graph and table of the computed discharges, are included in Appendix B (fig. B49, table B36).

In 1982, the USGS, in cooperation with local, State, and Federal agencies, began making periodic discharge measurements in the Warm Springs area as part of a long-term effort to characterize regional spring flow. By 1985, discharge measurements were being made at Warm Springs West (site 3, fig. 2), Muddy Springs at L.D.S. Farm (site 2, fig. 2), at Warm Springs East (site 9, fig. 2), and at Big Wash flume (fig. B5). The number of USGS periodic measurement sites continued to expand during the 1980s and 1990s and currently includes 11 partial-record stations (table 1). Graphs and tables of all discharge measurements made through September 2004 for all the sites are included in Appendix B.

In August 1985, the USGS, in cooperation with LVVWD and NDWR, installed continuous-stage recorders at the flumes at Warm Springs West and Muddy Springs at L.D.S Farm to document daily fluctuations in spring discharges. Daily mean discharges were computed for the spring flows at these gages and published in the USGS, Nevada District, annual data reports (1985–2004). Both stations are still operated and maintained by the USGS. Graphs and tables of daily mean discharges for the period of record for Warm Springs West and Muddy Springs at L.D.S Farm are included in Appendix B (fig. B42 and table B31, and fig. B46 and table B34, respectively).

In October 1986, the USGS, in cooperation with LVVWD and NDWR, installed an aluminum weir and continuous-stage recorder on the Pederson Springs pool (site 4, fig. 2). The purpose of this gage was to collect daily discharge data near the outlet of one of the major springs in the Moapa Valley National Wildlife Refuge. By early 2004, most of the palm trees surrounding the spring had been removed by the U.S. Fish and Wildlife Services (FWS), and in April 2004, a new weir was installed because water was leaking around the weir and the gage was not measuring flows accurately. Graphs and tables of daily mean discharges for the period of record are included in Appendix B (fig. B30, table B20).

By the early 1990s, only 5 of the original 10 flumes installed in 1967 were still being measured. Gage-height readings for Baldwin House #1 and #2 flumes stopped in June 1980, presumably because of construction of the L.D.S. pond at Cardy Lamb Springs (site 10, fig. 2). Readings at the Baldwin Cuts flume ended in August 1985 which was about 11 years after the MVWD began diverting flow from Baldwin Springs. Garden Ditch flume, mentioned in a report by DRI (Wert and Pohlmann, 1992), was reported to be in fair working condition in 1992; however, readings stopped after June 1992.

As conditions of the remaining flumes had significantly deteriorated, NPC contracted DRI in 1992 to evaluate the performance of each flume (Wert and Pohlmann, 1992). DRI recommended replacing the old steel flumes at Baldwin Springs Channel, Pipeline Jones, Pederson (Warm Springs West), Iverson, and Muddy (Big) Springs with new stainless-steel flumes that would be more resistive to the corrosive springflows. The DRI report by Wert and Pohlmann (1992), also discussed an “L.D.S Pool flume” which was described as downstream of the pond at Cardy Lamb Spring: Replacement of this flume was not recommended by DRI because flow was controlled by the pond, which was being used as storage for irrigation.

During the summer of 1993, NDWR replaced the five remaining flumes and continued to make periodic water-level measurements at each site. These periodic measurements are included in the flume records provided by NDWR and are given in Appendix B (figs. B42, B46, B53, B63, B66 and tables B30, B33, B41, B49, B50).

In April 1997, Converse Consultants, on contract to NPC, began making quarterly field measurements of temperature and specific conductance at 18 spring and surface-water sites within the Warm Springs area. The spring and surface-water sampling is part of a comprehensive hydrologic-monitoring program that Converse Consultants manages in the Warm Springs area and vicinity. Converse Consultants submits an annual report to NPC summarizing all surface-water, ground-water, water-quality, and water-use data collected or compiled (Converse Consultants, 2004). The location of each spring sampling site, plus data graphs and tables, are included in Appendix B (figs. B9, B18 to B26, B32, B44, B48, B50, B51, B54, B55, B57, B61, B68, B70, B71 to B74 and tables B10 to B17, B21, B32, B37, B38, B42, B48, B52 to B55).

In December 1997, MVWD began collecting water samples from the pump houses at Baldwin and Apcar (Pipeline Jones) Springs. Samples are collected at these sites annually and are analyzed for major ions and selected dissolved constituents. Analyses of the water samples for 1997 through 2004 for the Baldwin and Apcar Springs are included in Appendix B (tables B39 and B43, respectively).

On June 1, 1998, FWS installed a staff gage and steel weir at the spring on the Plummer West tributary, one of the three tributaries of the Plummer Springs Group (Appendix B, fig. B9). This site, referred to as station M-16 by the USGS, has been measured by the USGS since 1987. The staff gage was read several times a month by FWS from 1998 to 2002. Discharges were computed by applying the standard rating for a 90-degree v-notch weir (Rantz and others, 1982). Data collected at this site are given in Appendix B (tables B7 and B8). On October 26, 1998, FWS began making periodic discharge measurements in Plummer Main tributary (Appendix B, fig. B9). This site, also referred to as Warm Springs East, has been measured by the USGS since 1982. Periodic discharge measurements at this site were made by FWS using either a pygmy current meter or a Marsh-

McBirney velocity meter. Several measurements were made each year until the site was discontinued on May 30, 2001. Graphs and tables of discharge data for the Warm Springs East site are included in Appendix B (fig. B10, tables B4 and B5).

On February 6 and 7, 2001, a series of discharge measurements were made within the Warm Springs area as part of a seepage study for the Muddy River. Discharge and water-quality data were collected by USGS, SNWA, FWS, and NDWR at 14 sites, including the 5 NDWR flumes and the 9 sites measured in September 1963 (Beck and Wilson, 2006). Location information and data collected at these sites are included in Appendix E.

A continuous-stage recorder was installed by the USGS, in cooperation with SNWA, at the Iverson flume on Refuge Stream on October 1, 2001 (fig. B65). At the time the gage was installed, flow was backed up at the flume because of palm trees and other debris blocking flow downstream. The stage-discharge relation for this station was developed and is maintained using current-meter measurements of discharge. A graph and tables of computed and daily mean discharges through September 2004 are included in Appendix B (fig. B66, tables B50 and B51)

By 2002, all the palm trees that surrounded the former recreational pool at Pederson East Spring in the Moapa Valley National Wildlife Refuge had been removed by FWS. On May 10, 2002, the USGS, in cooperation with SNWA and FWS, installed a recording gage with weir control. A graph and table of the daily mean discharges collected through September 2004 are included in Appendix B (fig. B27, table B18).

Water-quality samples were collected in 2004 by DRI at Pederson East Spring, M-13, Baldwin Springs, and Muddy Springs at L.D.S Farm. Field measurements of temperature, pH, specific conductance, and dissolved oxygen were made and water samples were collected and analyzed for major ions and stable hydrogen and oxygen isotopes. Tables summarizing the field and laboratory results for each site are included in Appendix B (tables B19, B26, B35, and B44).

U.S. Geological Survey Monitoring Stations

Site identification numbers were assigned to each USGS monitoring station in this report, whether continuous or partial-record site. For all continuous-record and some partial-record sites, these numbers range from 8 to 10 digits and are designated in order of downstream direction along a main stream. For example, the complete 8-digit number for station 09416000 (Muddy River near Moapa) includes a 2-digit part number (09), plus the 6-digit downstream order number (416000). The part number refers to an area, the boundaries of which coincide with specified natural drainage boundaries. Records in this report are for sites in Part 09, the Colorado River Basin. When a station is added between two consecutively numbered stations, an additional digit is added to the upstream station number.

Most of the partial-record gaging stations in this report have site identification numbers based on the grid system of latitude and longitude. These numbers consist of 15 digits and provide a general geographic location and a unique number for each site. The first 6 digits denote the degrees, minutes, and seconds of latitude; the next 7 digits denote degrees, minutes, and seconds of longitude. The last two digits are sequential numbers for sites within a 1-second grid. For example, the site at Warm Springs East has a complete 15-digit number of 364236114424301. This site is located at 36 degrees, 42 minutes, 36 seconds latitude and 114 degrees, 42 minutes, 43 seconds longitude. It is the first station recorded in that 1-second grid. The description of geographic locations of a station may be refined, but the unique identification number remains unchanged.

Continuous-Record Stream-Gaging Stations

A continuous-record stream-gaging station is a site where data are collected with sufficient frequency to define daily mean values and variations within a day. Continuous-record gaging stations are equipped with instrumentation that records the gage height (stage) for the stream at selected frequencies, typically 15-minute intervals. These stage recordings are stored by a data logger and then later downloaded or transmitted into the USGS NWIS database. Discharge measurements are made at selected intervals, usually every 6 to 8 weeks. These data, together with supplemental information, are used to compute daily discharges (Rantz and others, 1982). The locations of the six continuous-record gaging stations currently operated within the Warm Springs area by the USGS, in cooperation with SNWA, are shown in figure 2. The sites also are listed in table 1 and include the following: Muddy River near Moapa (09416000), Muddy Springs at L.D.S. Farm near Moapa (09415900), Warm Springs West near Moapa (09415920), Pederson Spring near Moapa (09415910), Pederson East Springs near Moapa (09415908), and Warm Springs Confluence at Iverson Flume near Moapa (09415927). Site information, photographs, and graphs and tables for daily mean discharge for the period of record for these sites are included in Appendix B.

Partial-Record Stream-Gaging Stations

A partial-record stream-gaging station is a site where stage, discharge, or other hydrologic measurements are made one or more times during a year but at a frequency insufficient to develop a daily record. There is no instrumentation recording gage height at these sites. Measurements of gage height and corresponding discharge are done manually by field personnel. The USGS currently monitors 11 partial-record gaging stations in the Warm Springs area. These sites typically are visited and measured every 6 months. Eight of the 11 stations are within two of the major spring groups, Pederson and Plummer. The locations of all partial-record gaging stations are shown in figure 2 and given in table 1. Sites in the Pederson Spring Group include: Station 364235114425201 (M-11), Station 364237114425401 (M-12), Station 364236114425401 (M-13), Station 364235114425301 (M-19). Sites in the Plummer Spring Group include: Warm Springs East (364236114424301), Muddy River Springs 16 (364238114424201or M-16), 364238114424401 (M-15 or Plummer Central), and Muddy River Springs 20 (364238114424301). Other partial-record sites include Muddy River Springs M-10 (364327114430801), Baldwin Springs near Moapa (09415875), and Apcar Stream at Pipeline Jones flume near Moapa (09415940). Site information, photographs, and graphs and tables of discharge measurements for the period of record for these sites are included in Appendix B.

Summary

The U.S. Geological Survey (USGS), in cooperation with Southern Nevada Water Authority and Nevada Division of Water Resources (NDWR), operates and maintains a surface-water network of 6 continuous-record stream-gaging stations and 11 partial-record stations in the Warm Springs area near Moapa, Nevada. Permanent land-surface bench marks were installed in the Warm Springs area by the Las Vegas Valley Water District, the Southern Nevada Water Authority, and the USGS to determine water-surface elevations at these gaging-stations. Vertical datum elevations and horizontal coordinates were established for all bench marks through a series of Differential Global Positioning System (DGPS) surveys. DGPS vertical datums were transferred to reference marks and points installed at each monitoring site using optical theodolite surveys. All surveys were completed by June 2004, and water-surface elevations were measured on August 17, 2004. Water-surface elevations ranged from 1,810.33 ft at Pederson Spring to 1,706.31 ft at Muddy River near Moapa.

All USGS discharge and water-quality data published through September 30, 2004, for the Warm Springs area were compiled for this study. Additional discharge and water-quality data were provided by other agencies that manage, regulate, study, or use the water resources of the area. Periodic water-level readings for 10 flumes were provided by NDWR. U.S. Fish and Wildlife Service provided discharge data for springs within the Moapa Valley National Wildlife Refuge. Additional water-quality data were provided by the Moapa Valley Water District (MVWD), Desert Research Institute (DRI), and Converse Consultants.

Chronologies of water-resources development and hydrologic data collection are included in this report to illustrate the relation of the hydrologic monitoring network with historical and contemporary land- and water-use changes in the Warm Springs area. Prior to 1950, the Warm Springs area consisted of a few ranches that derived their water from individual springs or wells. From the 1950s to the late 1960s, most of the small ranches eventually merged into one working ranch with large land areas watered by an intricate network of irrigation ditches. Recreational facilities were established to take advantage of the warm spring waters for year-round aquatic and outdoor activities. The first exportation of water from springs in the study area was for supply to a nearby power plant and to growing communities to the south. As a result of these activities, flumes were installed near the major spring groups to monitor effects of water withdrawals and diversions.

Toward the late 1970s, environmental concerns resulted in the creation of the Moapa Valley National Wildlife Refuge that eventually terminated two of the three recreational developments. Additional hydrologic monitoring was started to characterize the water resources within the refuge for the protection and management of the Moapa dace. During the 1980s, additional ground-water and surface-water sources were tapped to meet the growing capacity of the powerplant. To provide better monitoring of the effects of water withdrawals, additional gages were installed and existing flumes were upgraded. In the 1990s, the wildlife refuge was expanded and additional monitoring sites were established.

In the past 4 years, two new recording gages were installed and major improvements were made to an existing site. With the completion of the water-surface surveys and the compilation of discharge and water quality data, this upgraded network will help identify potential effects on the water resources as a result of (1) changes in vegetation within the former agricultural lands, (2) changes within the Wildlife Refuge due to restoration activities, (3) continued withdrawal of ground water within the valley, and (4) potential withdrawals of ground water from adjacent basins.

Acknowledgments

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Appendix A. History of Water-Resources Development within the Warm Springs Area Near Moapa, Nevada

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History of Water Resources Development

The Warm Springs area has a rich history of farming, ranching, and recreation. The first known dwellers within the area were the Anasazi and the Southern Paiute Indians (Baxter and Haworth, 1996). Little is known about the Anasazi in southern Nevada. By the early 1800s, the Paiutes had sizable populations along the Muddy and Virgin Rivers (Holt, Ronald, accessed July 22, 2004 http://www.onlineutah.com/paiutehistory.shtml). Although most of these riverine and desert groups were primarily foragers and hunters, the Paiutes were known to also have irrigated crops, such as corn, squash, melons, and wheat, along the banks of the Muddy River (Mozejko, 1981). In addition to using the river as a source of irrigation and drinking supply, the Paiutes also used it for ceremonial rites, which are still practiced today within the Moapa Paiute Indian Reservation (Phil Swain, Moapa Band of Paiutes, oral commun., 2004).

From the 1870s to the early 1880s, Warm Springs was cohabited by Indians, outlaws, and prospectors. The first known ranch in the Warm Springs area was started in 1871 with several cattle and horses rustled by a fugitive bank robber from Texas. He built a rock house just north of the current Church of the Latter Day Saints (L.D.S.) Recreation Area (Baxter and Haworth, 1996). He called the ranch Stone Cabin Springs and worked it until his death in 1882.

The first Mormon settlers arrived in the Warm Springs area in 1889 and cleared and irrigated about 30 acres to grow alfalfa and cotton. Although several other ranches subsequently sprang up in the area, the longest worked ranch was the Home Ranch, which began about 1910. It was located north of Warm Springs Road, across from the Pederson Spring area. From 1910 to 1950, the Home Ranch changed ownership frequently but continued to be used primarily for farming and ranching. The largest parcel of land irrigated during this period was about 60 acres (Baxter and Haworth, 1996). By the 1940s, several of the larger springs in the area had gained popularity with locals and visitors for camping, swimming, and bathing (Jim Haworth, local resident, oral commun., 2004).

In 1950, Francis Taylor acquired the Home Ranch and changed the name to Warm Springs Ranch. Taylor eventually expanded the size of the ranch to about 1,200 acres, which was used, in part, to experiment with different pasture grasses and to breed cattle suitable for the desert environment (Baxter and Haworth, 1996). A large mansion that still exists and bears his name (fig. A1) was built adjacent to a large spring-fed pool (Muddy Springs) that is the source of flow discharging from the current L.D.S. Recreation Area. During the 1950s and early 1960s, large amounts of water were diverted from the springs when a network of approximately 6.5 miles of irrigation ditches, mostly concrete (fig. A2), were installed throughout the valley (Jim Haworth, local resident, oral commun., 2004). Only a few of these irrigation ditches are in use today as most have been abandoned or are unusable (fig. A2).

At the same time that the Warm Springs Ranch was expanding under Taylor's proprietorship, the 1950s ushered in two private recreational developments. The first was called the 7-12 Warm Springs Resort, which was located in the area currently known as the Pederson Springs area; it consisted of trailer parking, two swimming pools, a snack bar, and residential housing. The small pool (fig. A3) was filled directly by discharge from a spring below the pool, and the larger pool (fig. A4) was filled by diverting discharge from a spring. The second development became known as the Desert Oasis Warm Springs Resort, which encompassed most of the area currently called the Plummer Springs area but also included the former pool which is now known as Pederson East Spring (fig. A5). By the 1990s, the Desert Oasis Warm Springs Resort had developed into a private time-share/spa that ultimately included trailer parking, a spa, a swimming pool, ponds, a 5,000-ft^2 mansion, and a water slide (figs. A6, A7, and A8).

In 1954, the Moapa Valley Water Company and the Overton Water District entered into a joint agreement to pump water from the Warm Springs area to residential, business, and dairy establishments to the south (Hafner, 1967). A small spring on a hillside on Francis Taylor's ranch was selected for a pump house and developed to create a discharge of about 2 ft^3/s. In 1960, the pump house was installed on what is now called the Apcar (Pipeline Jones) Springs (fig. A9). Water (1 ft^3/s) and land (1 acre) at the spring were donated to the Moapa Valley Water Company by Francis Taylor (Baxter and Haworth, 1996). Frederick Apcar subsequently purchased approximately 45 acres of land surrounding the spring and used the area primarily for his own private recreation. Apcar enlarged and concreted one of the springs and constructed a large swimming pool (fig. A9; Baxter and Haworth, 1996). A new pump house was constructed at Apcar Springs during the summer of 2004 by the Moapa Valley Water District (fig. A9).

In the mid-1960s, a coal-fired powerplant (Reid Gardner Generating Station) was constructed along the east bank of the Muddy River about 3 mi southeast of the Warm Springs area (fig. 1). Water required for plant operations initially was obtained from the Muddy River near the plant and from several wells owned by Clarvid Lewis located in the northwest corner of Warm Springs area (Richard Willer, Nevada Power Company, oral commun., 2004). By the early 1970s, the NPC constructed a diversion and pumping station along the north bank of the Muddy River about 100 ft upstream of the USGS stream-gaging station at Warm Springs Road (fig. A10). Water is pumped directly from the river and transmitted by pipeline to the powerplant.

In 1968, shortly after the death of Francis Taylor, Howard Hughes, having seen the Warm Springs area during a test flight, purchased the entire Warm Springs Ranch. Although Hughes owned the Ranch for nearly 8 years, he reportedly never set foot on it (Baxter and Haworth, 1996). By the early to mid-1970s, water diverted for irrigation for ranch operations reached its maximum (Jim Haworth, local resident, oral commun., 2004). Water demand, however, continued to grow in the rest of Moapa Valley, and in 1974 the MVWD installed a pump house at Baldwin Springs (fig. A11). This pump house is still operating; however, the amount of water withdrawn, 6.5 acre-ft during 2003 (Converse Consultants, 2004), is significantly less than the amount pumped from Apcar Springs.

In 1978, 2 years after the death of Howard Hughes, the Warm Springs Ranch was purchased by the L.D.S. Church. After a couple of years, the cattle operation started to decline, and the church planted fruit and nut trees, hoping to develop the ranch as a welfare farm (Gary Holt, L.D.S. Recreation Area, oral commun., 2004). The experimental welfare farm was unsuccessful, and by the mid-1980s the Church had leased most of its water rights to NPC and sold off all but about 73 acres of the Ranch. The remaining church property, which kept the name of the Warm Springs Ranch (fig. A12) was subsequently developed into a recreational center for L.D.S. Stakes in southern Nevada. The area is now called the L.D.S. Recreational Area and includes a large swimming pool (fig. A12), campgrounds, and the renovated Francis Taylor mansion (fig. A1). The mansion survived a fire in 1987 that destroyed many of the old Warm Springs Ranch homes, barns, and corrals. The spring-fed pond is still used for swimming, and the large swimming pool is periodically filled with water from the spring-fed pond. The L.D.S. Recreation Area hosts numerous group outings and uses ground water pumped from a private well to support on-site residential and campground facilities.

In 1979, approximately 90 acres of land that included most of the 7-12 Warm Springs Resort and a small part of the Desert Oasis Warm Springs Resort was deemed by the Federal government as habitat for the endangered Moapa dace (*Moapa coriacea*). The property was purchased by the government and was designated as the Moapa Valley National Wildlife Refuge. The U.S. Fish and Wildlife Service (FWS) assumed custody of the refuge and began a long-term restoration program.

Development of another recreational area on L.D.S. church property was attempted in the early 1980s at the northwest end of the valley. Although the development reportedly was built by Lee Earl (Richard Pedersen, local resident, oral commun., 2004), the area has been called Cardy Lamb (Scoppettone and others, 1987). A large concrete pond and a bathhouse were built about 400 ft east of Warm Springs Road (fig. A13). The pond was built over one of the springs that had previously supplied irrigation water through the original concrete-ditch network to fields east of the area. The facility never materialized and the property eventually was sold (Richard Pedersen, oral commun., 2004). Water from the pond is used by the current owner to irrigate several nearby fields for livestock grazing. An underground drainage pipe connects the pond to the irrigation ditches.

In the early 1980s, NPC significantly increased the capacity of the Reid Gardner Generating Station. Although additional water was available from their Meadow Valley wells, the quality of the water was poor; consequently the company began purchasing water rights from the L.D.S. Church and other private owners in the Warm Springs area (Richard Willer, Nevada Power Company, oral commun., 2004). Currently, NPC pumps water from about 12 wells and 1 surface-water diversion from the Muddy River near Moapa (another intake pump was installed in 1999) in the Warm Springs area.

By 1986, most of the existing 7-12 Warm Springs Resort recreational facilities within the initial refuge boundary had been removed. These included the trailer hookups, swimming pools, and snackbar. The current conditions of the areas where the two swimming pools had been located are shown in figures A3 and A4. The Desert Oasis Warm Springs Resort continued to operate until a fire swept through the area in 1994. After the fire, the resort essentially remained unused until 1997 when the property was purchased by Del Webb and turned over to the FWS to be incorporated as part of the Moapa Valley National Wildlife Refuge (Amy Sprunger-Allworth, U.S. Fish and Wildlife Service, oral commun., 2004).

In 2001, the Federal government purchased the 45 acres adjacent to Apcar Spring and incorporated that property as part of the wildlife refuge. By spring 2002, the FWS had removed the former recreational pool at Pederson East Spring and many of the palm trees within the Pederson Spring Group (fig. A5) and had began restoration projects in the Plummer and Apcar Spring areas.

Farming and ranching continues today within the Warm Springs area, but land usage has dropped significantly since its peak in the mid-1970s. The set of aerial photographs in figure A14 depict the difference in the amount of acreage irrigated during 1976 and 2003. Estimated acreage irrigated in 1976 was about 600 acres compared with about 100 acres in 2003.

A. **View of the mansion during the mid-1970s. Photograph from Baxter (1996).**

B. **View of the mansion in July 2004. Photographed by D. Beck.**

Figure A1. Francis Taylor mansion, built in the 1950s in the Warm Springs area near Moapa, Nevada.

A. **Concrete irrigation ditch east of Cardy Lamb Swimming Pond.**

B. **Former concrete irrigation ditch south of Cardy Lamb Swimming Pond that has been completely filled in with dirt.**

Figure A2. Concrete irrigation ditches near Cardy Lamb Swimming Pond in the Warm Springs area near Moapa, Nevada. Both views photographed in June 2004 by D. Beck.

A. Former 7-12 Warm Springs Resort small swimming pool during the 1950s. Photograph courtesy of R. & L. Pederson.

B. Same area after small swimming pool, trailer hookups, and palm trees were removed by the U.S. Fish and Wildlife Service. Photographed in June 2004 by D. Beck.

Figure A3. Former Warm Springs Resort small swimming pool, Warm Springs area near Moapa, Nevada.

A. **Former 7-12 Warm Springs Resort large swimming pool during the 1960s. Photograph courtesy of R.& L. Pederson.**

B. **Same area after large swimming pool, bathhouse, and snackbar were removed by the U.S. Fish and Wildlife Service. Photographed in June 2004 by D. Beck.**

Figure A4. Former Warm Springs Resort large swimming pool, Warm Springs area near Moapa, Nevada.

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A. View in April 2000 of the spring and site of the former recreational pool.

B. Same view in July 2004 after the pool structure and palm trees had been removed. Photograph by D. Beck.

Figure A5. Pederson East Spring in the Moapa Valley National Wildlife Refuge near Moapa, Nevada.

A. **View of the mansion and spring area.**

B. **View of the mansion and parking area.**

Figure A6. Former Desert Oasis Warm Springs Resort in the Warm Springs area near Moapa, Nevada. Both views photographed in July 2004 by D. Beck.

A. **Spring-fed swimming pool.**

B. **Remains of a water slide and pool.**

Figure A7. Recreational facilities of the former Desert Oasis Warm Springs Resort in the Warm Springs area near Moapa, Nevada. Both views photographed in July 2004 by D. Beck.

Figure A8. View of the spa and mansion at the former Desert Oasis Warm Springs resort in the Warm Springs area near Moapa, Nevada. Photographed in July 2004 by D. Beck.

A. **View of Moapa Valley Water District's old (right) and new (left) pump houses in the foreground.**

B. **View of former swimming pool built by Frederick Apcar around 1980.**

Figure A9. View of Apcar (Pipeline Jones) Springs in the Warm Springs area near Moapa, Nevada. Both views photographed in June 2004 by D. Beck.

Figure A10. View looking downstream at Nevada Power Company water diversion and pumping station on the Muddy River, in the Warm Springs area near Moapa, Nevada. The diversion is about 100 feet upstream of the U.S. Geological Survey streamflow-gaging station at Warm Springs Road. Photographed in February 2004 by D. Beck.

Figure A11. View of the Baldwin Springs area and the Moapa Valley Water District pump house in the Warm Springs area near Moapa, Nevada. Photographed in June 2004 by D. Beck.

A. **Entrance to the recreation area.**

B. **Swimming pool in the recreation area.**

Figure A12. Church of the Latter Day Saints Recreational Area in the Warm Springs area near Moapa, Nevada. Both views photographed in June 2004 by D. Beck.

A. View of spring-fed pond and bathhouse, with pond nearly drained. Photographed in June 2004. Photographed in June 2004 by D. Beck.

B. View of pond when fully filled. Photographed in September 2004 by D. Beck.

Figure A13. Church of the Latter Day Saints Recreation Area at Cardy Lamb Springs, in the Warm Springs area, near Moapa, Nevada.

1976

2003

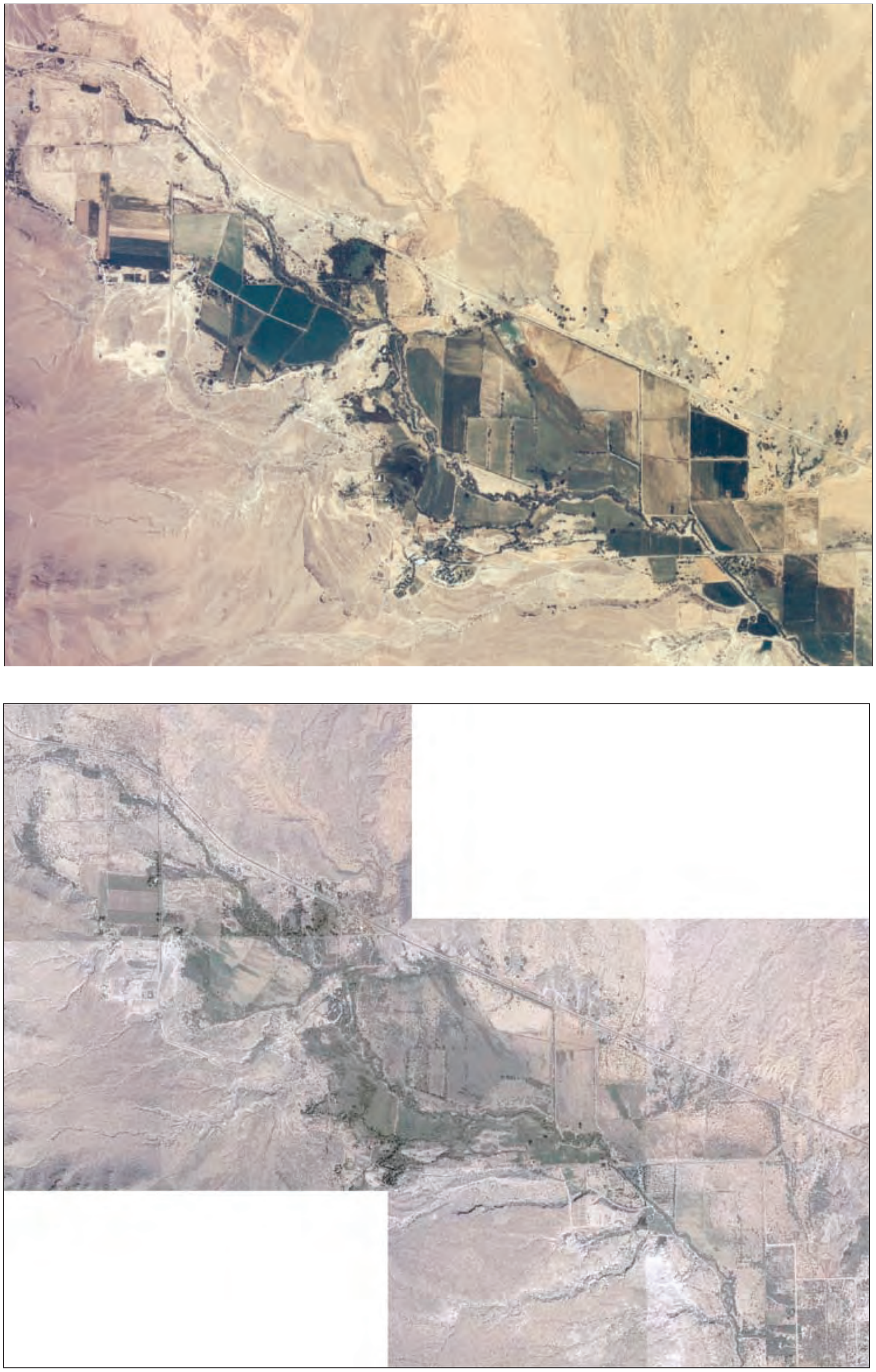

Figure A14. Irrigated acreage in the Warm Springs area near Moapa, Nevada, in 1976 and 2003.

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Appendix B. Water-Level, Discharge, and Water-Quality Data for Selected Monitoring Sites Within the Warm Springs Area Near Moapa, Nevada

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Muddy River

The following sites are included within this section:

09416000 Muddy River near Moapa, Nevada (1913–2004)
Big Wash Flume near Moapa, Nevada (1967–84)
09415950 Muddy River Power Diversion near Moapa, Nevada (1978–85)

09416000 Muddy River near Moapa, Nevada

The stream-gage at Muddy River near Moapa originally was established by the Muddy Valley Irrigation District (MVID) on July 1, 1913, at its present location upstream of Warm Springs Road (fig. B1). Water-level record and discharge measurements were collected by the MVID from July 1913 to September 1915 and from April 1916 to September 1918. The gage was reactivated in June of 1928 by the University of Nevada Agricultural Experiment Station (UNAES). Daily mean gage height and monthly discharge were collected by the UNAES from June 1928 to October 1931 and from April 1932 to July 1932. The Bureau of Reclamation (Reclamation) reactivated the gage October 21, 1944, and collected continuous streamflow data until October 1, 1948, when the operation of the gage became the responsibility of the U.S. Geological Survey. Flow is diverted about 100 ft upstream of the gage by the Nevada Power Company for use at the Reid Gardner Generating Station about 3 mi downstream of the gage (fig. 1). The hydraulic control for this site is the 10-ft concrete Cipolletti weir, which was installed by the USBR in 1944 just upstream from the Warm Springs Road crossing (fig. B2).

Daily mean discharges for the period of record are plotted on figure B3 and listed in table B1. Photographs of the bench and reference marks established for this gage on June 2, 2004, are shown in figure B4.

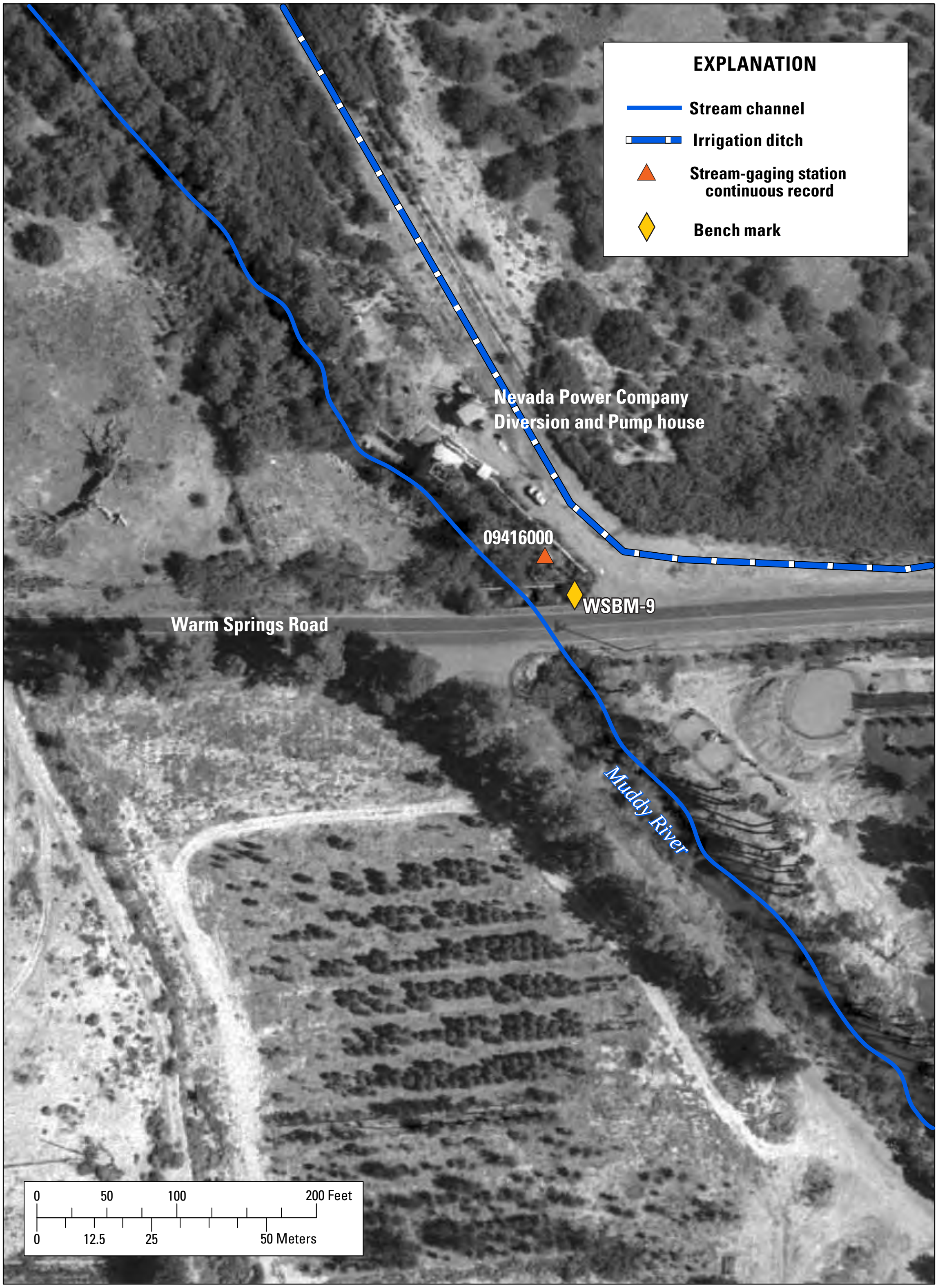

Figure B1. Location of Muddy River stream-gaging station (09416000), bench mark WSBM-9, and Nevada Power Company's diversion and pump house in the Warm Springs area near Moapa, Nevada.

Figure B2. View looking downstream of the Cipolletti weir upstream of Warm Springs Road at the Muddy River stream-gaging station (09416000) in the Warm Springs area near Moapa, Nevada. Photographed in June 2004 by D. Beck.

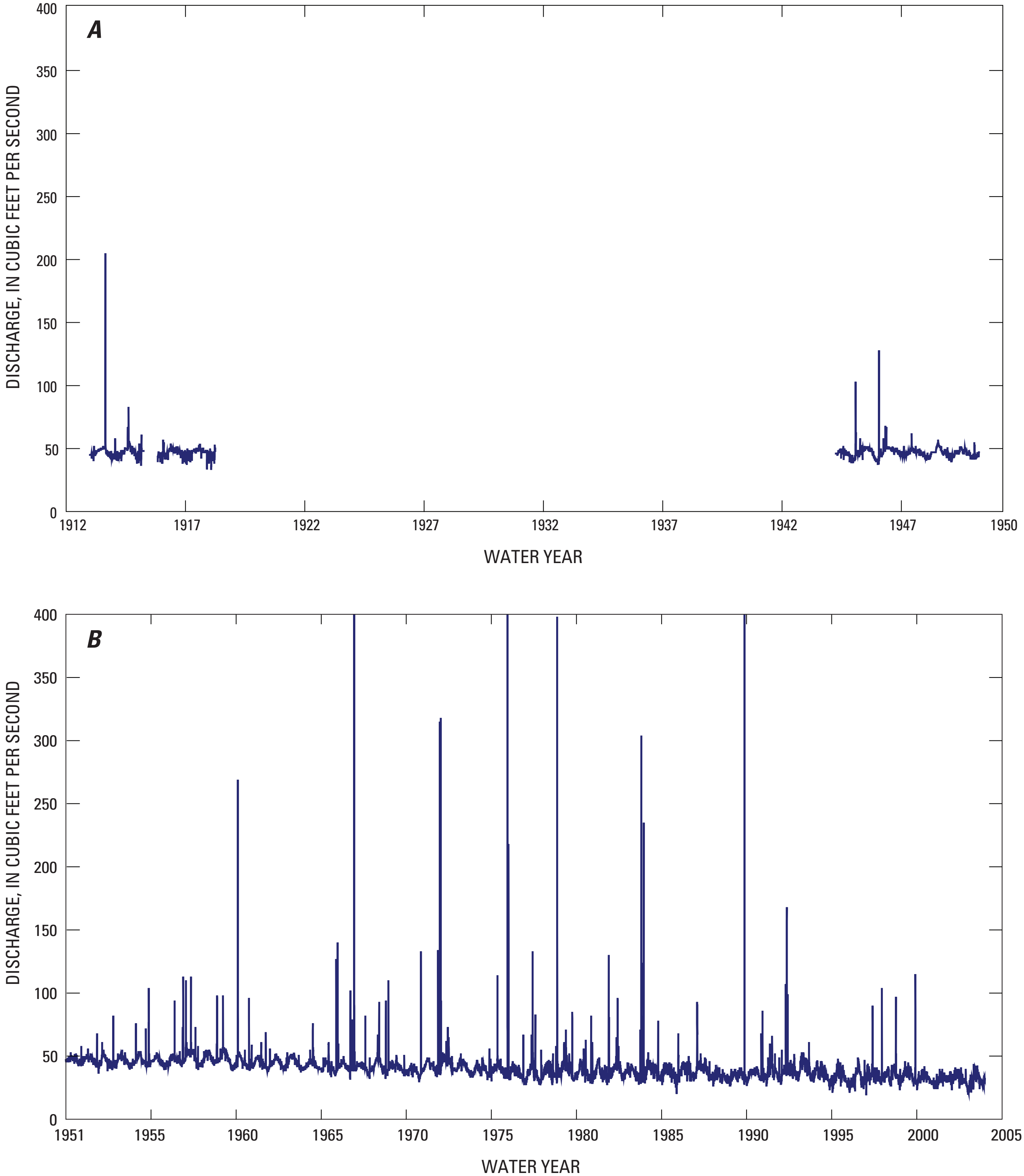

Figure B3. Daily mean discharges for stream-gaging station 09416000, Muddy River near Moapa, Nevada, for (*A*) water years 1913–15, 1916–18, and 1944–47, and (*B*) water years 1951–2004.

Table B1. Daily mean discharges for continuous-recording stream-gaging station 09416000 Muddy River near Moapa, Nevada, water years 1913–2004.

Table B1 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

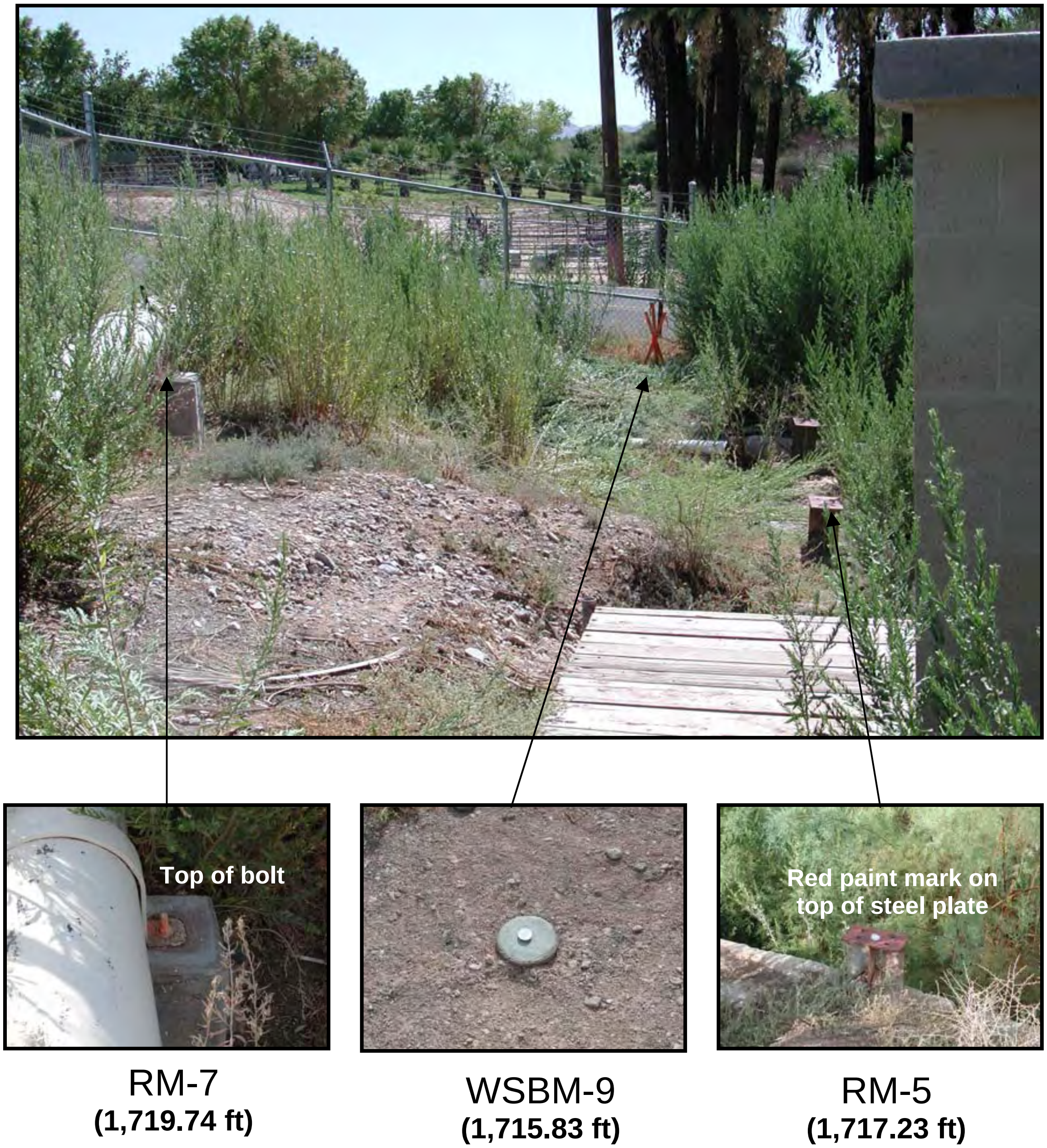

Figure B4. Location and elevation of bench mark WSBM-9 and reference marks RM-5 and RM-7 at stream-gaging station 09416000, Muddy River near Moapa, Nevada, June 2, 2004, elevation in feet above NGVD 88. Photographed by D. Beck.

Big Wash Flume near Moapa, Nevada

A 3-ft Parshall flume was installed on Big Wash (North Fork Muddy River) on October 11, 1967, by the Nevada Division of Water Resources (NDWR). The flume was located approximately 500 ft upstream of the confluence with South Fork Muddy River (fig. B5). The source of water in the river originates from springs and seeps located in the uppermost northwest drainage of the Warm Springs area.

Data provided by NDWR show that water levels in the flume were generally measured monthly from October 11, 1967 to July 18, 1984. Several gaps occur in the record, the largest two occurring from March 1969 to February 1974 and from May 1981 to March 1984. Information provided by NDWR did not indicate whether a new flume had been installed after any of these gaps, but the information did note that a 3-ft flume was in use for the entire period of record. The former flume site was visited by the U.S. Geological Survey on September 16, 2004, and a 3-ft steel Parshall flume was observed upside down on the south bank of the river (fig. B6).

As only water-level measurements were provided by NDWR, discharge rates were computed using a standard rating equation for the 3-ft Parshall flume (Leupold and Stevens, 1987). A plot of the computed discharges from October 1967 to July 1984 is shown in figure B7. A complete listing of the water-level measurements and computed discharges are included in table B2. Discharges computed from October 1967 to March 1969 are substantially less than the computed discharges for the remainder of the period. Although flow may have been bypassing the flume at that time, documentation was unavailable to verify it.

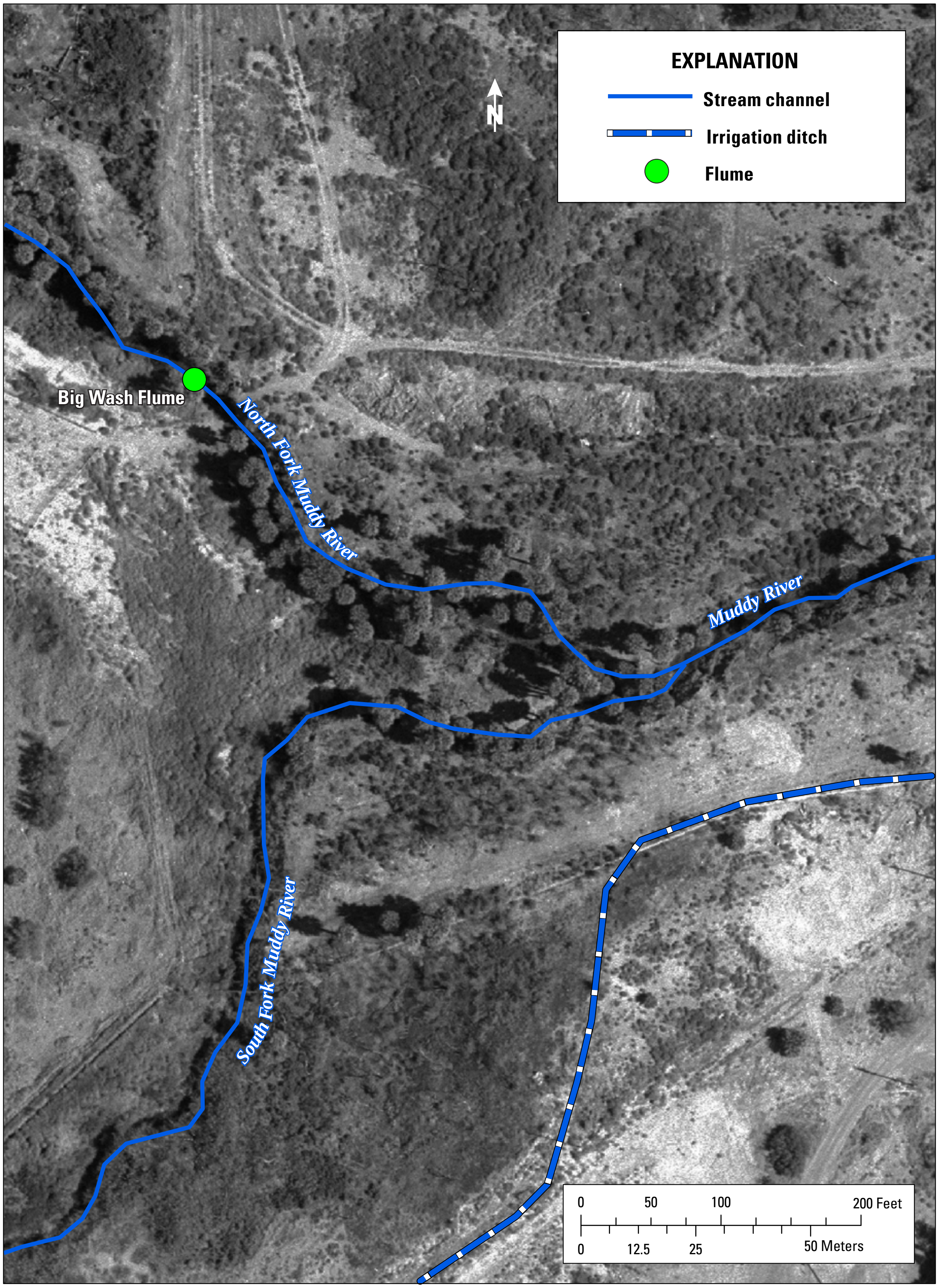

Figure B5. Location of former Big Wash flume site on the North Fork Muddy River in the Warm Springs area near Moapa, Nevada.

Figure B6. Former Big Wash flume on right bank of North Fork Muddy River in the Warm Springs area, near Moapa, Nevada. The flume is about 500 feet upstream of confluence with South Fork Muddy River. Photographed in September 2004 by D. Beck.

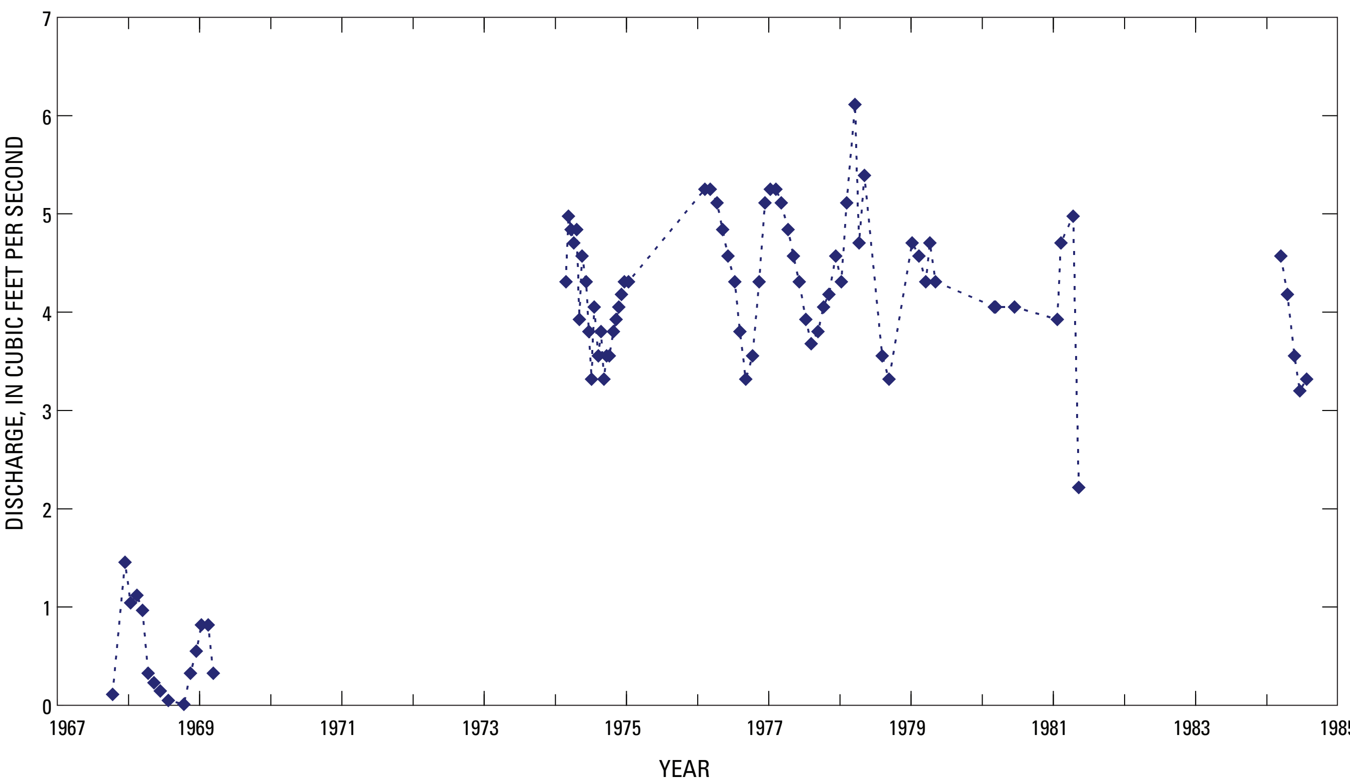

Figure B7. Instantaneous discharges for the Big Wash flume in the Warm Springs area near Moapa, Nevada, 1967–69, 1974–81, and 1984.

Table B2. Water levels and instantaneous discharges for Big Wash flume, near Moapa, Nevada, 1967–84.

Table B2 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

09415950 Muddy River Power Diversion and Pump House near Moapa, Nevada

In the early 1970s, the Nevada Power Company (NPC) constructed a diversion and pump house along the north bank of the Muddy River approximately 100 ft upstream of the U.S. Geological Survey (USGS) stream-gaging station at Warm Springs Road (fig. B1). Water is pumped directly from the stream and transmitted through a pipeline to the Reid Gardner Generating Station (fig. 1) about 3 mi southeast of the gage. The NPC provided the USGS with pumpage data from October 1, 1977, to September 30, 1985. Daily mean discharges for the period were computed and published in the USGS, Nevada District, annual data report series between water years1978 and 1986). See figure B8 and table B3 for a graph and a table, respectively, of the daily mean discharges. Annual mean daily discharge from the diversion for water years 1978 to 1985 was 3.45 ft^3/s.

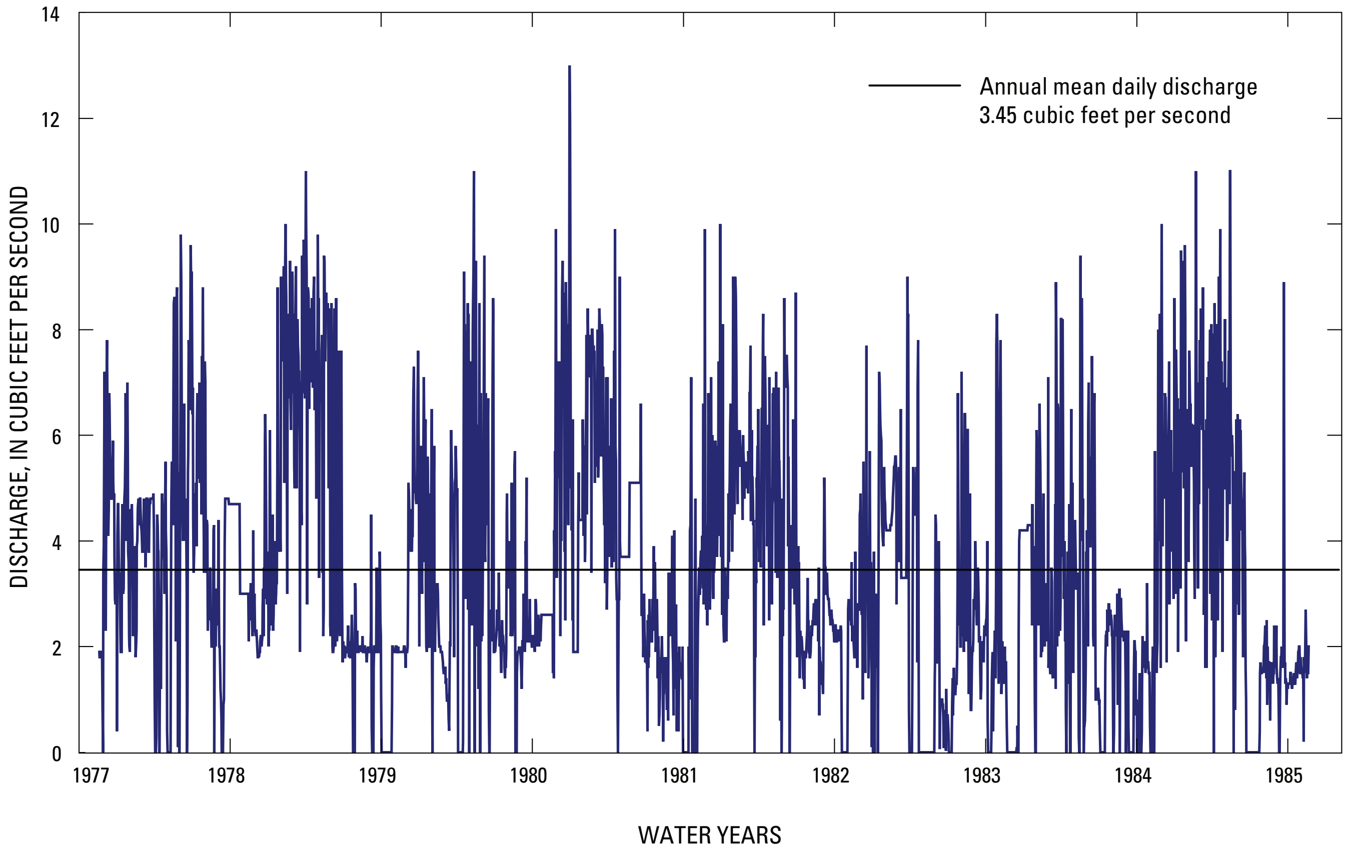

Figure B8. Daily mean discharges for the Muddy River power diversion in the Warm Springs area, near Moapa, Nevada, water years 1978–85. Pumping data was provided to U.S. Geological Survey by Nevada Power Company.

Table B3. Daily mean discharges for the Muddy River Power Diversion near Moapa, Nevada (09415950), water years 1978–85.

Table B3 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Plummer Springs Group

The following sites are included within this section:

364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada (1982–2004)
364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada (1987–2004)
364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada (1987–2004)
364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada (1994–2004)
Converse Consultant Water-Quality Site S1a (1997–2004)
Converse Consultant Water-Quality SIte S1b (1997–2004)
Converse Consultant Water-Quality Site S34 (1997–2004)
Converse Consultant Water-Quality Site S42 (1997–2004)
Converse Consultant Water-Quality Site S43 (1997–2004)
Converse Consultant Water-Quality Site-S44 (1997–2004)
Converse Consultant Water-Quality Site-S44a (1997–2004)
Converse Consultant Water-Quality Site S56 (1997–2004)

364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada

The partial-record stream-gaging station at Warm Springs East was established by the U.S. Geological Survey (USGS) on August 2, 1982, and is located about 70 ft downstream of the confluence with Plummer East tributary and about 180 ft upstream of Warm Springs Road (fig. B9). Flow in Warm Springs East is the combined discharge from all springs and seeps on that part of the Moapa Valley National Wildlife Refuge, formerly known as the Desert Oasis Warm Springs Resort. Periodic discharge measurements have been made by the USGS since 1982. Discharge measurements for the period of record are plotted in figure B10 and listed in table B4.

In October 1998, the U.S. Fish and Wildlife Service (FWS) installed a staff plate in the channel and made periodic discharge measurements through May 2002. The FWS discharge measurements are also plotted on figure B10 and are listed in table B5.

Photographs of the staff plate and bench mark, and of the reference mark established by the USGS at the Warm Springs East stream-gaging station on June 10, 2004, are shown in figure B11.

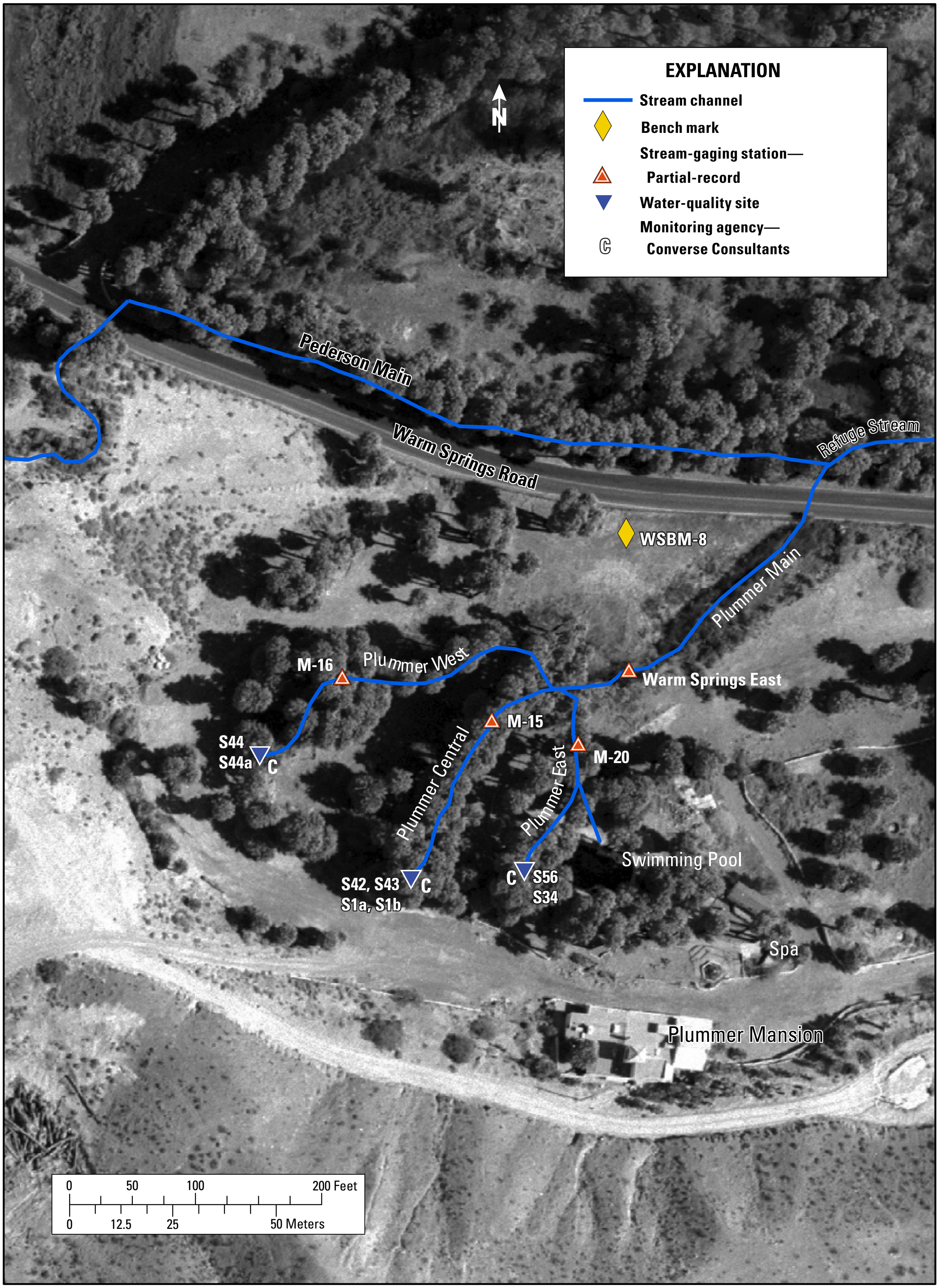

Figure B9. Location of Plummer Springs Group stream-gaging station, monitoring sites, and bench mark WSBM-8 in the Warm Springs area near Moapa, Nevada.

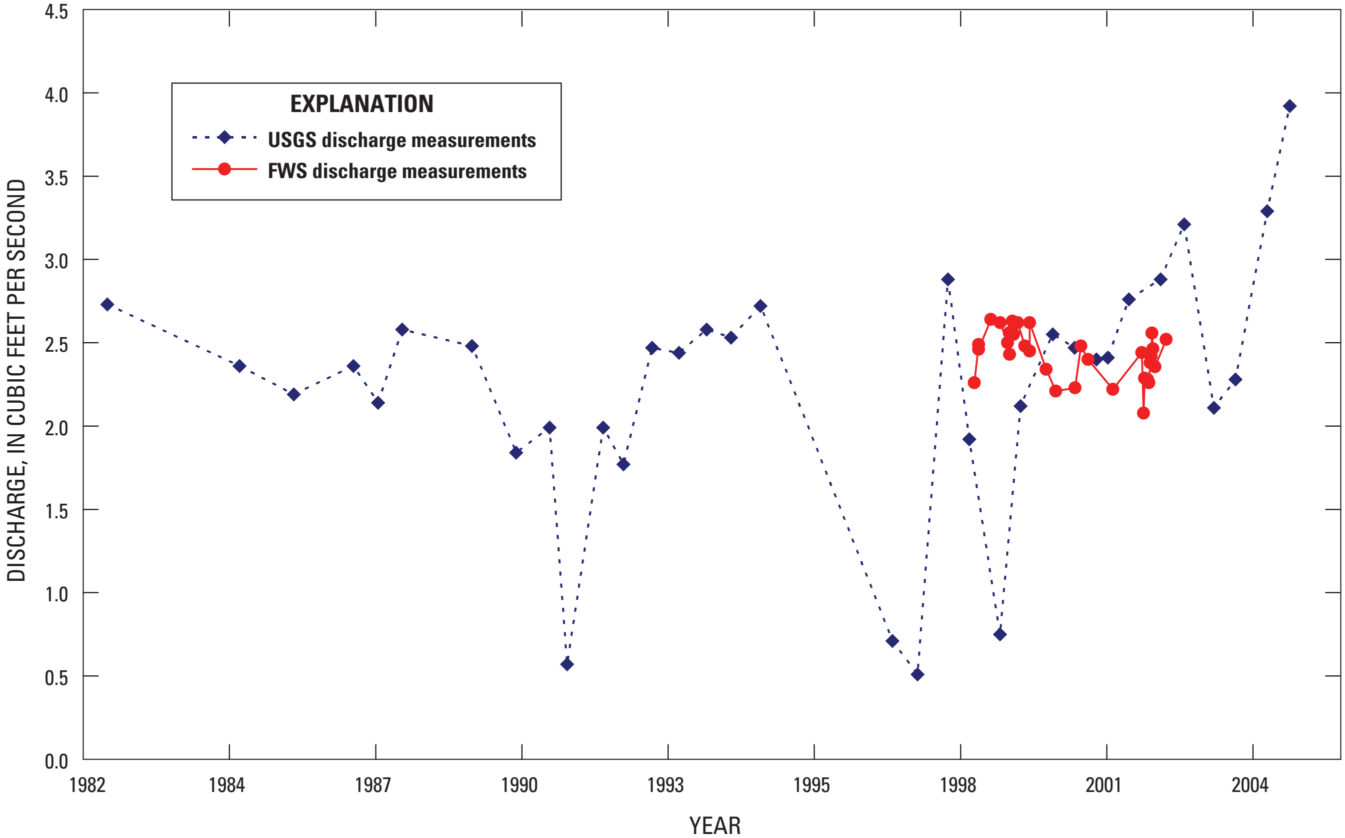

Figure B10. Periodic discharge measurements for partial-record stream-gaging station 364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada, 1982–2004. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) database, accessed 2005 at http://waterdata.usgs.gov and U.S. Fish and Wildlife Service (FWS).

Table B4. Periodic discharge measurements for partial-record stream-gaging station 364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada, 1982–2004.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B4 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B5. Periodic discharge measurements for partial-record stream-gaging station 364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada, 1998–2002.

[Data provided by U.S. Fish and Wildlife Service]

Table B5 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B11. Location of bench mark WSBM-8 and reference mark RM-1 for stream-gaging station 364236114424301 Warm Springs East near Moapa, Nevada. Photographed June 10, 2004 by D. Beck. Elevation bench and reference marks in feet above NAVD 88.

364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada

The partial-record gaging station at Muddy River Springs 15 (M-15) was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 40 ft upstream of the confluence with the Plummer West tributary (fig. B9). Discharge at Muddy River Springs 15 originates upstream from several springs just west of a large swimming pool that was installed by the former Desert Oasis Warm Springs Resort. The area is now part of the Moapa Valley National Wildlife Refuge managed by the U.S. Fish and Wildlife Service (FWS). The FWS removed many of the former resort's recreational facilities and currently is restoring the springs. Periodic discharge measurements have been made by the USGS since 1987. Discharge measurements for the period of record are plotted in figure B12 and listed in table B6.

Photographs of the staff plate and reference mark established for the Muddy River Springs 15 monitoring site on June 10, 2004, are included in figure B13.

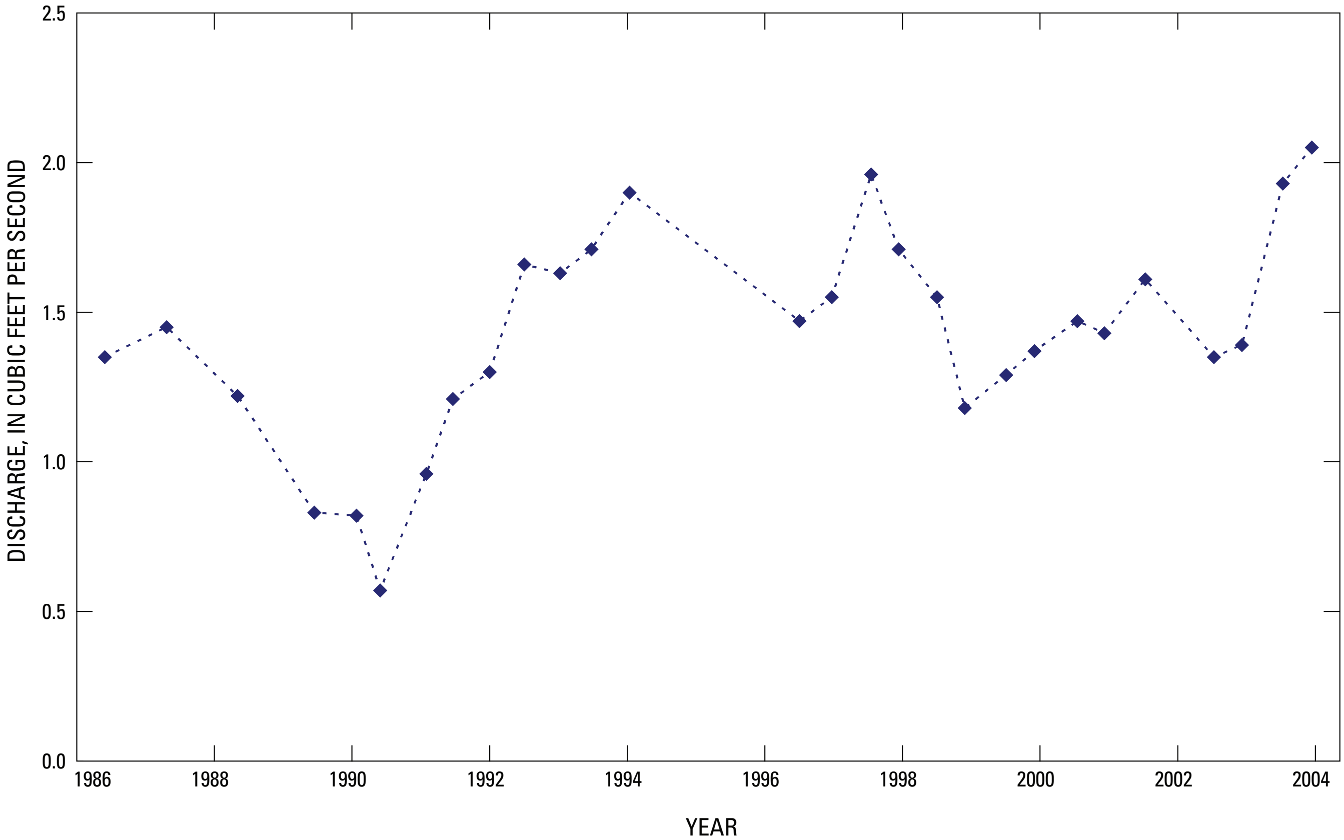

Figure B12. Periodic discharge measurements for partial-record stream-gaging station 364238114424401, Muddy River Springs 15 (M-15) near Moapa, Nevada, 1987–2004. Data from U.S. Geological Survey National Water Information System (NWIS) database, accessed 2005 at http://waterdata.usgs.gov.

Table B6. Periodic discharge measurements for partial-record stream-gaging station 364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada, 1987–2004.

Table B6 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Pond upstream of M-15

Figure B13. Location of staff plate and reference mark (RM-1) at station 364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada, and view of upstream pond. Photographed June 10, 2004 by D. Beck.

364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada

The partial-record gaging station at Muddy River Springs 16 (M-16) was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 225 ft upstream of the confluence with the Plummer Central tributary (fig. B9). Discharge at Muddy River Springs 16 originates from a spring-fed pond just upstream of the gage. The area around the spring had previously been developed for trailers and recreational vehicles by the former Desert Oasis Warm Springs Resort. The area is now part of the Moapa Valley National Wildlife Refuge. U.S. Fish and Wildlife Service (FWS) has removed many of the resort's facilities and is currently restoring the springs. Periodic discharge measurements have been made by the USGS since 1987. Discharge measurements for the period of record are plotted in figure B14 and listed in table B7.

In March 1998, the FWS installed a 90-degree v-notch weir and staff plate in the channel. From 1998 to January 2002, FWS made periodic water-level measurements at the weir as well as two measurements of discharge. Discharges for the water-level measurements were computed using a standard weir rating (Rantz, 1982) and are plotted in figure B14. The computed and manual discharge measurements are listed in table B8.

Photographs of the FWS weir and staff plate and of the USGS reference mark established on June 10, 2004, are included in figure B15. On May 26, 2005, the weir, staff plate, and reference mark were observed to have been destroyed as a result of restoration work at the refuge.

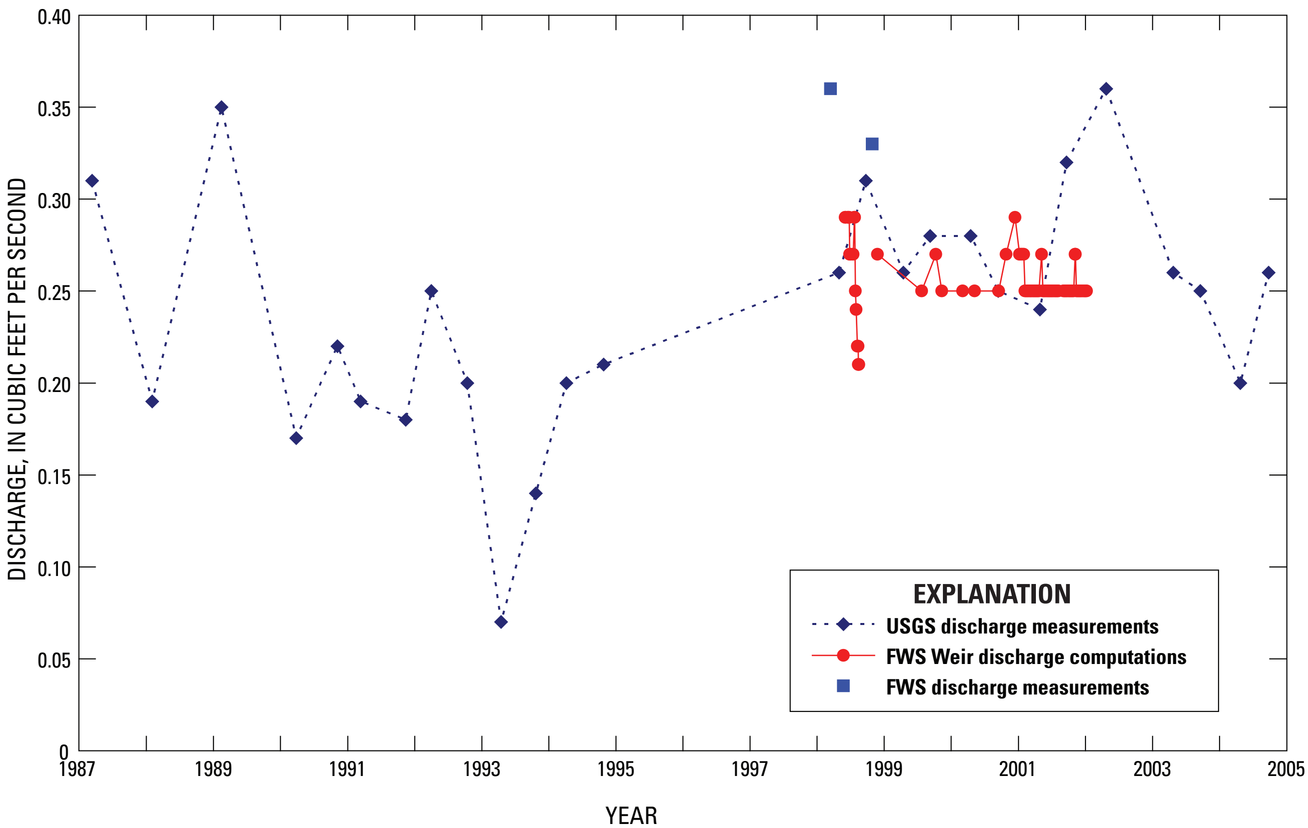

Figure B14. Periodic discharge measurements for partial-record stream-gaging station 364238114424201 Muddy River Springs (M-16) near Moapa, Nevada. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) database, accessed 2005, at http: //waterdata.usgs.gov, and U.S. Fish and Wildlife Service (FWS).

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Table B7. Periodic discharge measurements for partial-record stream-gaging station 364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada, 1987–2004.

Table B7 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B8. Periodic discharge measurements and weir discharge computations for partial-record stream-gaging station 364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada, 1998–2002.

[Data from U.S. Fish and Wildlife Service]

Table B8 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

RM-1
(1,758.08 ft)

Figure B15. Location of U.S. Fish and Wildlife Service weir and staff plate, and reference mark (RM-1) at partial-record stream-gaging station 364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada. Photographed June 10, 2004 by D. Beck. Elevation of RM-1 in feet above NAVD 88.

364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada

The partial-record gaging station at Muddy River Springs 20 (M-20) was established by the U.S. Geological Survey (USGS) on October 25, 1994, and is about 50 ft upstream of the confluence of Plummer East with the Plummer Main tributary (fig. B9). Flow at Muddy River Springs 20 originates upstream of several springs that had been used to fill a large swimming pool previously operated by the former Desert Oasis Warm Springs Resort. The area is now part of the Moapa Valley National Wildlife Refuge. The U.S. Fish and Wildlife Service (FWS) has removed many of the resort's recreational facilities and currently is restoring the springs. Periodic discharge measurements have been made by the USGS since 1994. Discharge measurements for the period of record are plotted in figure B16 and listed in table B9.

Photograph of the staff plate established for the Muddy River Springs 20 monitoring station on June 10, 2004, is included in figure B17. On May 26, 2005, the large swimming pool upstream of the gage was observed to have been removed as part of the restoration program at the refuge.

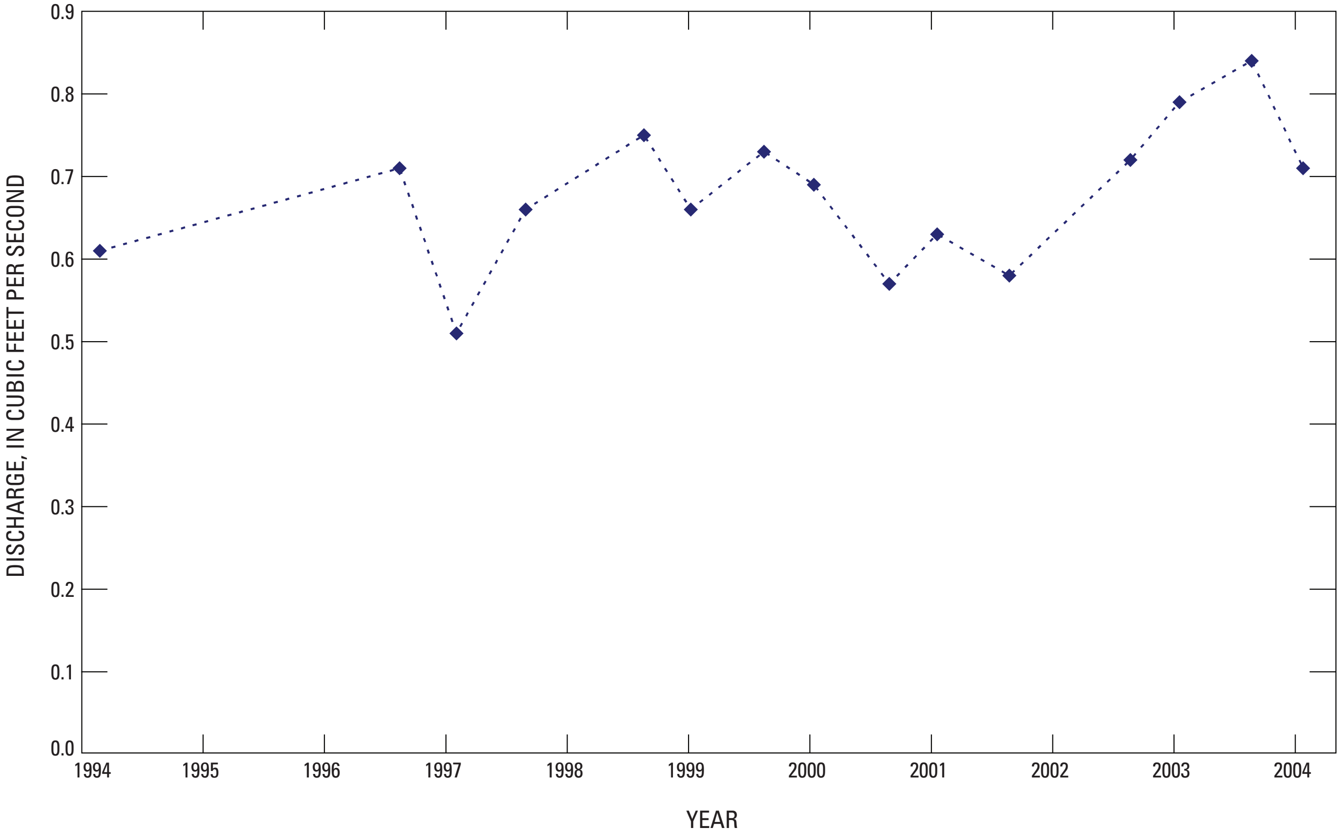

Figure B16. Periodic discharge measurements for partial-record stream-gaging station 364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada, 1994–2004. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov

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Table B9. Periodic discharge measurement for partial-record stream-gaging station 364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada, 1994–2004.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B9 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Swimming pool upstream of M-20

Figure B17. Location of the staff plate at partial-record stream-gaging station 364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada, and view of the spring-fed swimming pool upstream of the gage. Photographed June 10, 2004 by D. Beck.

SE ROA 48993

Miscellaneous Water-Quality Sites in the Plummer Springs Group near Moapa, Nevada

Converse Consultants, on contract with Nevada Power Company, have been measuring water temperature and specific conductance at selected spring sites in the Warm Springs area since 1997. Eight springs were measured within the Plummer Springs Group on the Moapa Valley National Wildlife Refuge and were designated, by Converse Consultants (2004) as sites S1a, S1b, S34, S42, S43, S44, S44a, and S56. Sites S44 and S44a were tributary to Plummer West; sites S1a, S1b, S42, and S43 were tributary to Plummer Central; and sites S34 and S56 were tributary to Plummer East (fig. B9). Quarterly measurements have been made by Converse Consultants since April 1997. Water-temperature and specific-conductance measurements for the period of record are plotted in figures B18 through B25 and listed in tables B10 through B17.

By December 2004, restoration work on the springs within the refuge had destroyed all the sampling sites listed above. As a result, Converse Consultants are now measuring water temperature and specific conductance at the U.S. Geological Survey partial-record stations at Muddy River Springs 15, 16, and 20 (fig. B9).

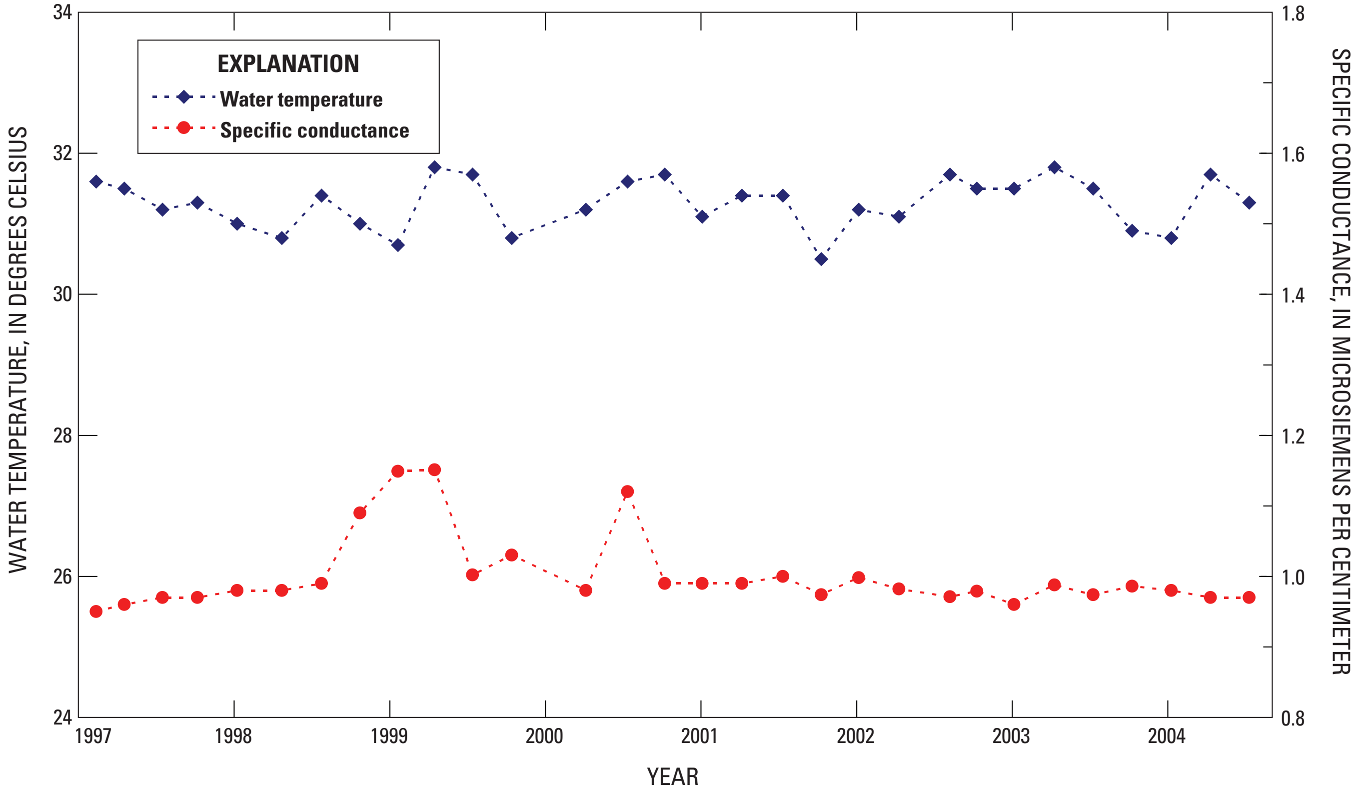

Figure B18. Water-temperature and specific-conductance measurements by Converse Consultants at site S1a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

SE ROA 48995

JA_15181

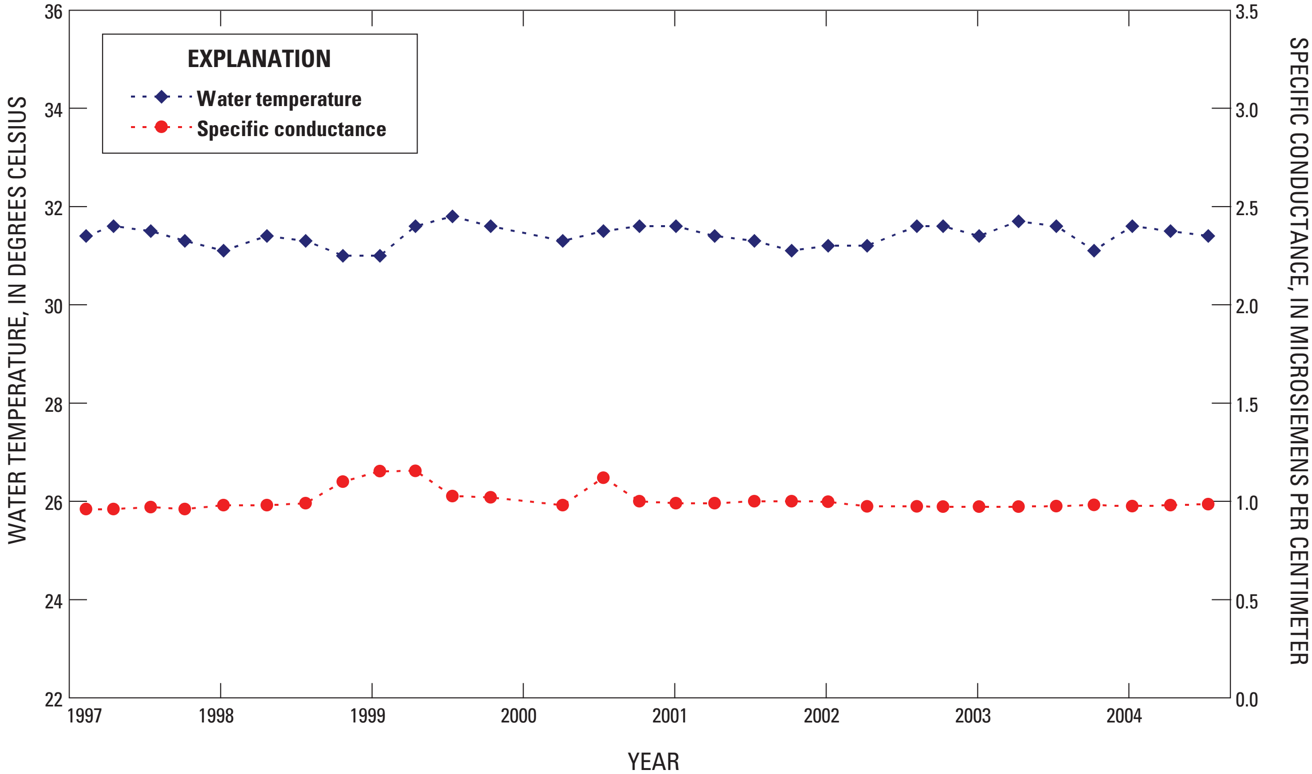

Figure B19. Water-temperature and specific-conductance measurements by Converse Consultants at site S1b in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

SE ROA 48996

JA_15182

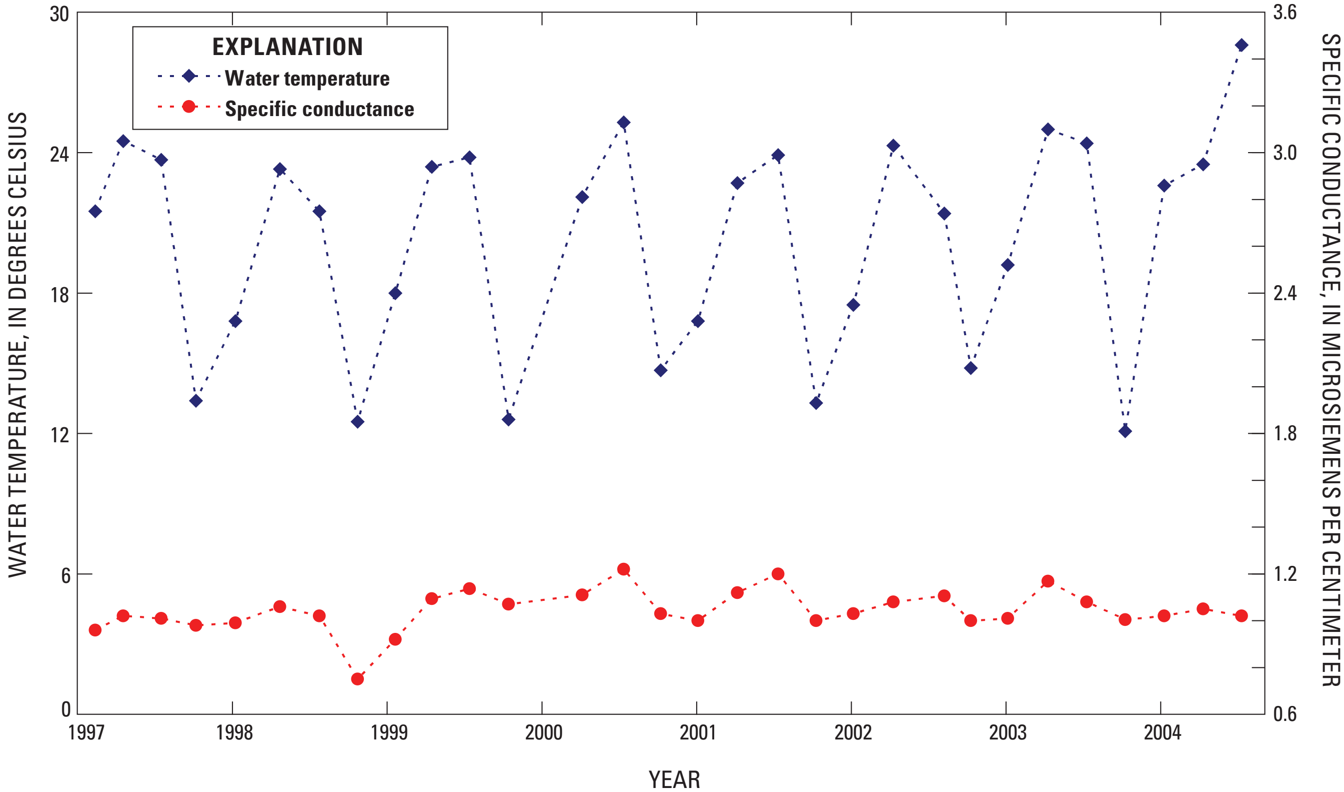

Figure B20. Water-temperature and specific-conductance measurements by Converse Consultants at site S34 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

SE ROA 48997

JA_15183

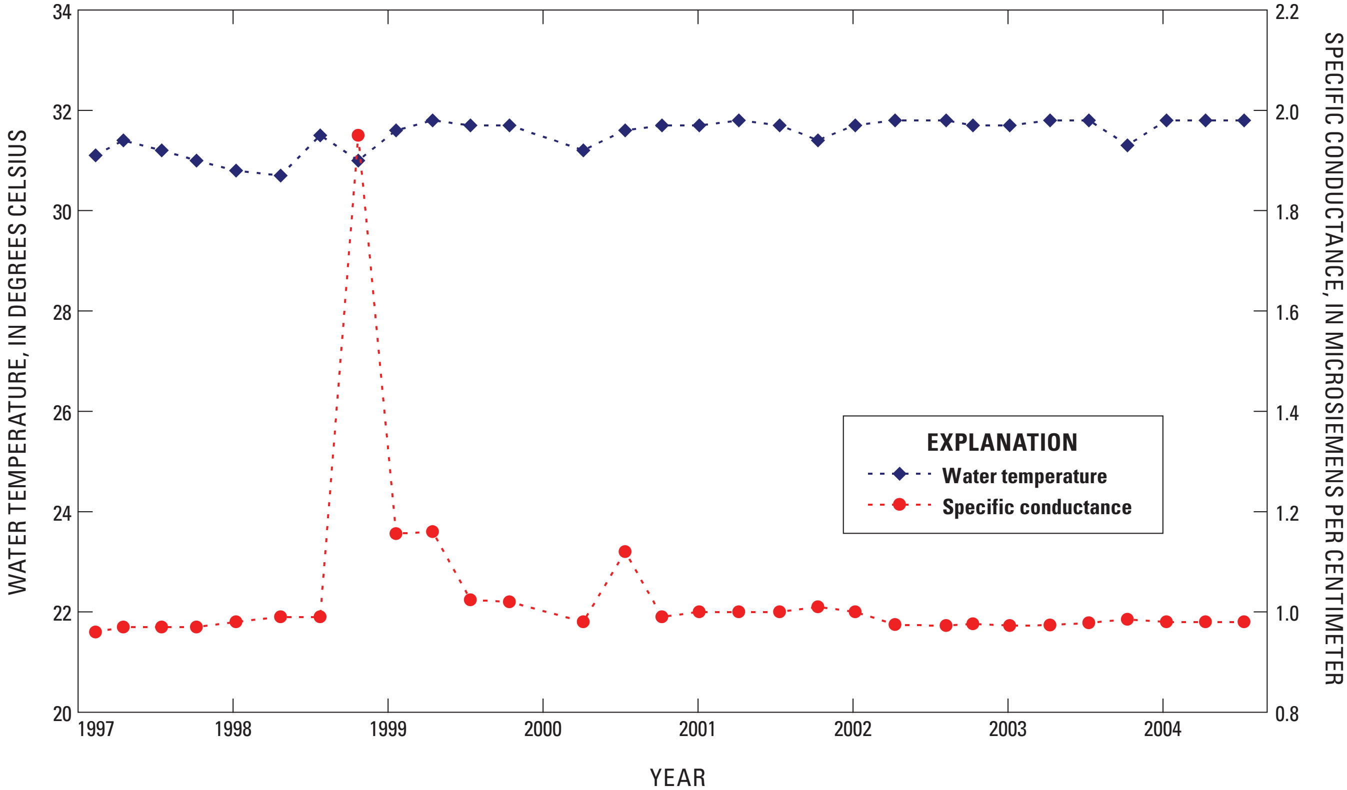

Figure B21. Water-temperature and specific-conductance measurements by Converse Consultants at site S42 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

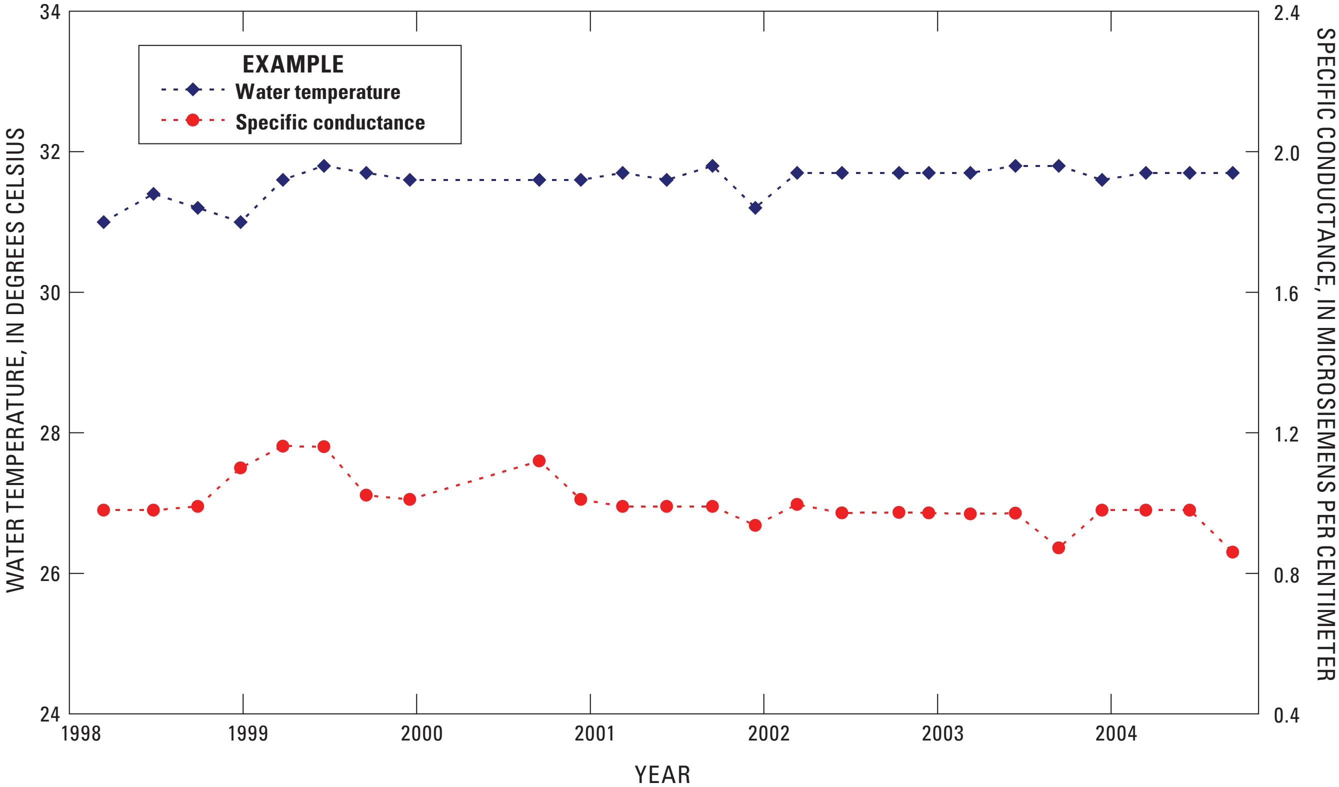

Figure B22. Water-temperature and specific-conductance measurements by Converse Consultants at site S43 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

SE ROA 48999

JA_15185

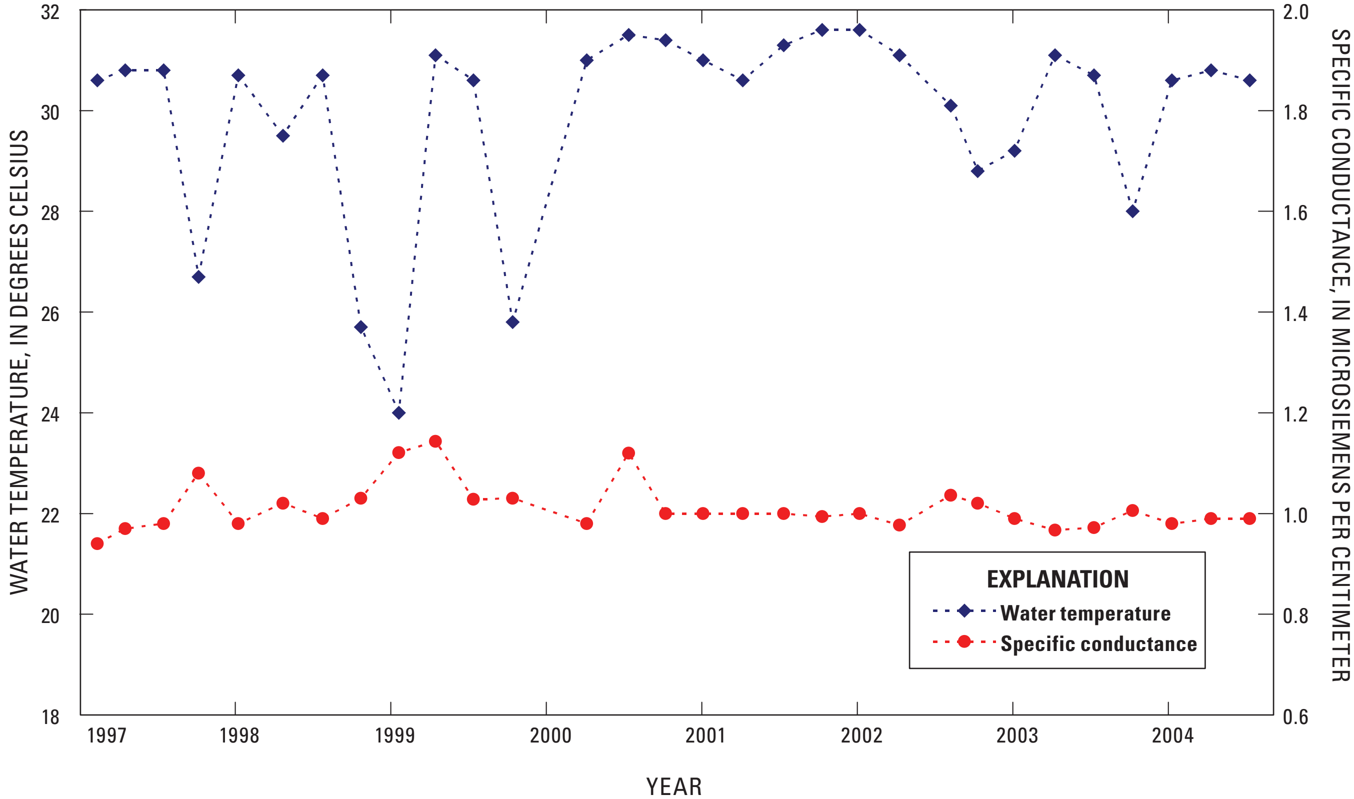

Figure B23. Water-temperature and specific-conductance measurements by Converse Consultants at site S44 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

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JA_15186

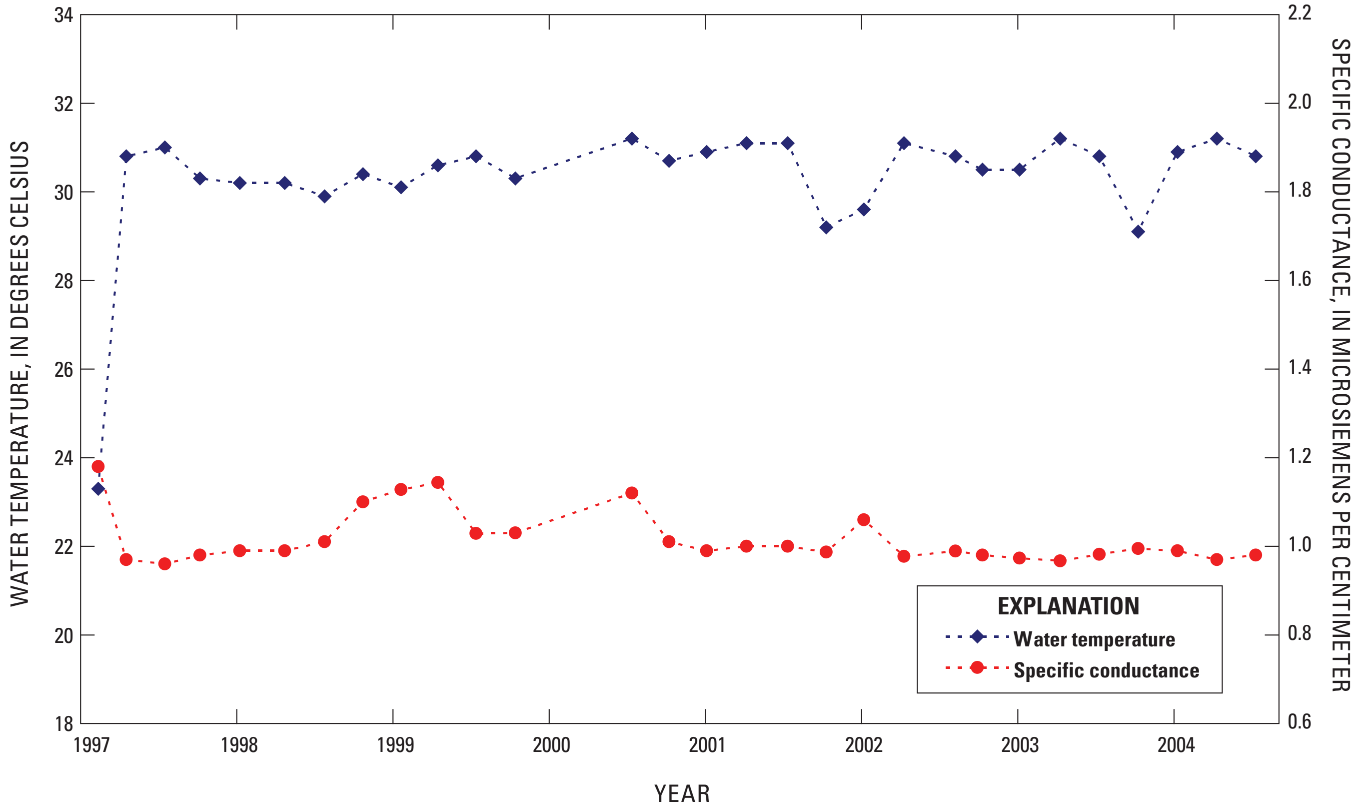

Figure B24. Water-temperature and specific-conductance measurements by Converse Consultants at site S44a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

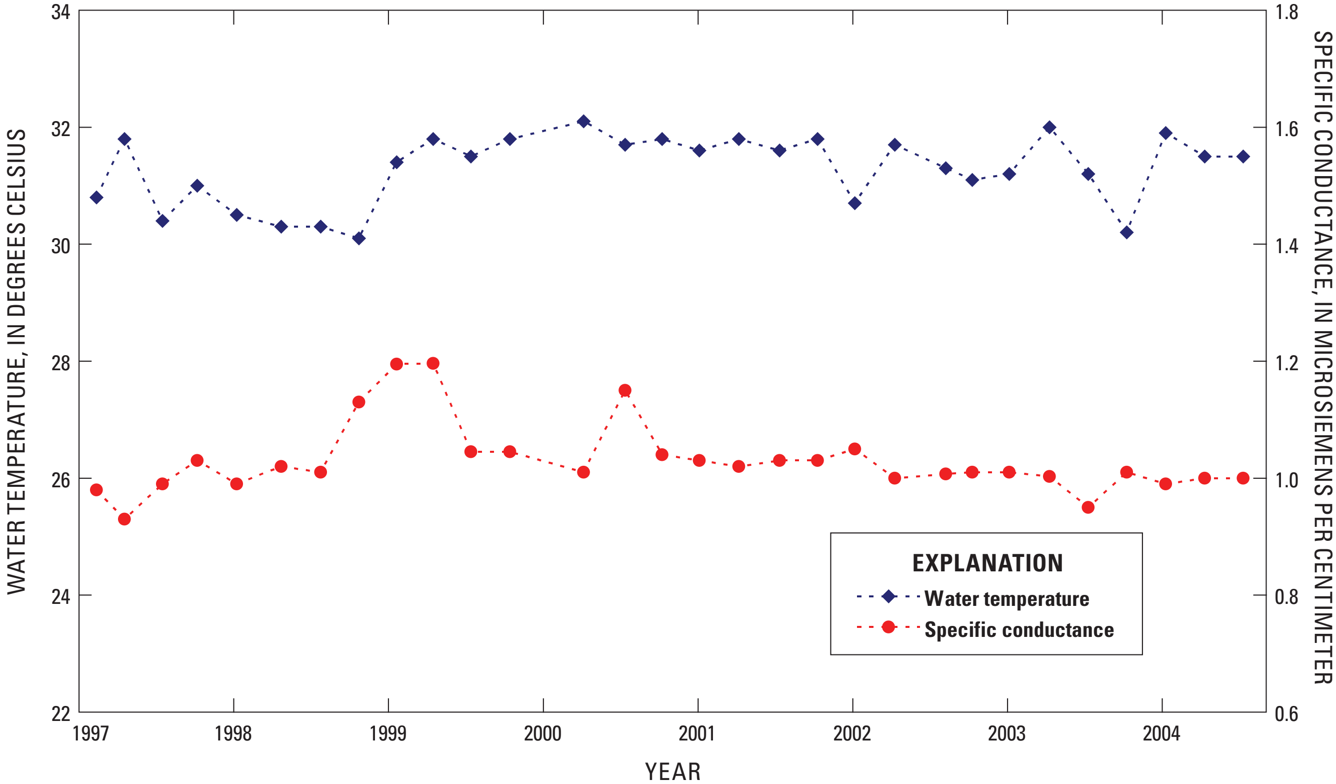

Figure B25. Water-temperature and specific-conductance measurements by Converse Consultants at site S56 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B10. Water-temperature and specific-conductance measurements by Converse Consultants at site S1a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B10 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B11. Water-temperature and specific-conductance measurements by Converse Consultants at site S1b in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B11 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B12. Water-temperature and specific-conductance measurements by Converse Consultants at site S34 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B12 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B13. Water-temperature and specific-conductance measurements by Converse Consultants at site S42 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B13 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B14. Water-temperature and specific-conductance measurements by Converse Consultants at site S43 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B14 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B15. Water-temperature and specific-conductance measurements by Converse Consultants at site S44 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B15 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B16. Water-temperature and specific-conductance measurements by Converse Consultants at site S44a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B16 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B17. Water-temperature and specific-conductance measurements by Converse Consultants at site S56 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B17 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Pederson Springs Group

The following sites are included within this section:

09415908 Pederson East Spring near Moapa, Nevada (2002–04)
09415910 Pederson Spring near Moapa, Nevada (1987–2004)
364235114425201 Muddy River Springs 11 (M-11) near Moapa, Nevada (1987–2004)
364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada (1987–2004)
364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada (1986–2004)
364235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada (1998–2004)
09415920 Warm Springs West near Moapa, Nevada (1967–2005)

09415908 Pederson East Spring near Moapa, Nevada

A continuous-record stream-gaging station was established by the U.S. Geological Survey (USGS) on Pederson East Spring on May 9, 2002. The hydraulic control is a 90-degree v-notch weir that was installed by the U.S. Fish and Wildlife Service in collaboration with the Southern Nevada Water Authority and the U.S. Bureau of Reclamation. Pederson East Spring is about 100 ft north of the Moapa Valley National Wildlife Refuge service road (fig. B26) and is part of a cluster of springs that drain to the northeast. Flow from Pederson East Spring joins with discharge from Pederson Spring about 200 ft downstream from the gage.

Daily mean discharges for the period of record are plotted on figure B27 and listed in table B18. Photographs of the gage and weir, and selected reference marks established for this gage on June 9, 2004, are shown in figure B28.

Water samples were collected at this site on January 12, and May 18, 2004, by the Desert Research Institute (DRI) and analyzed for major ions and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B19.

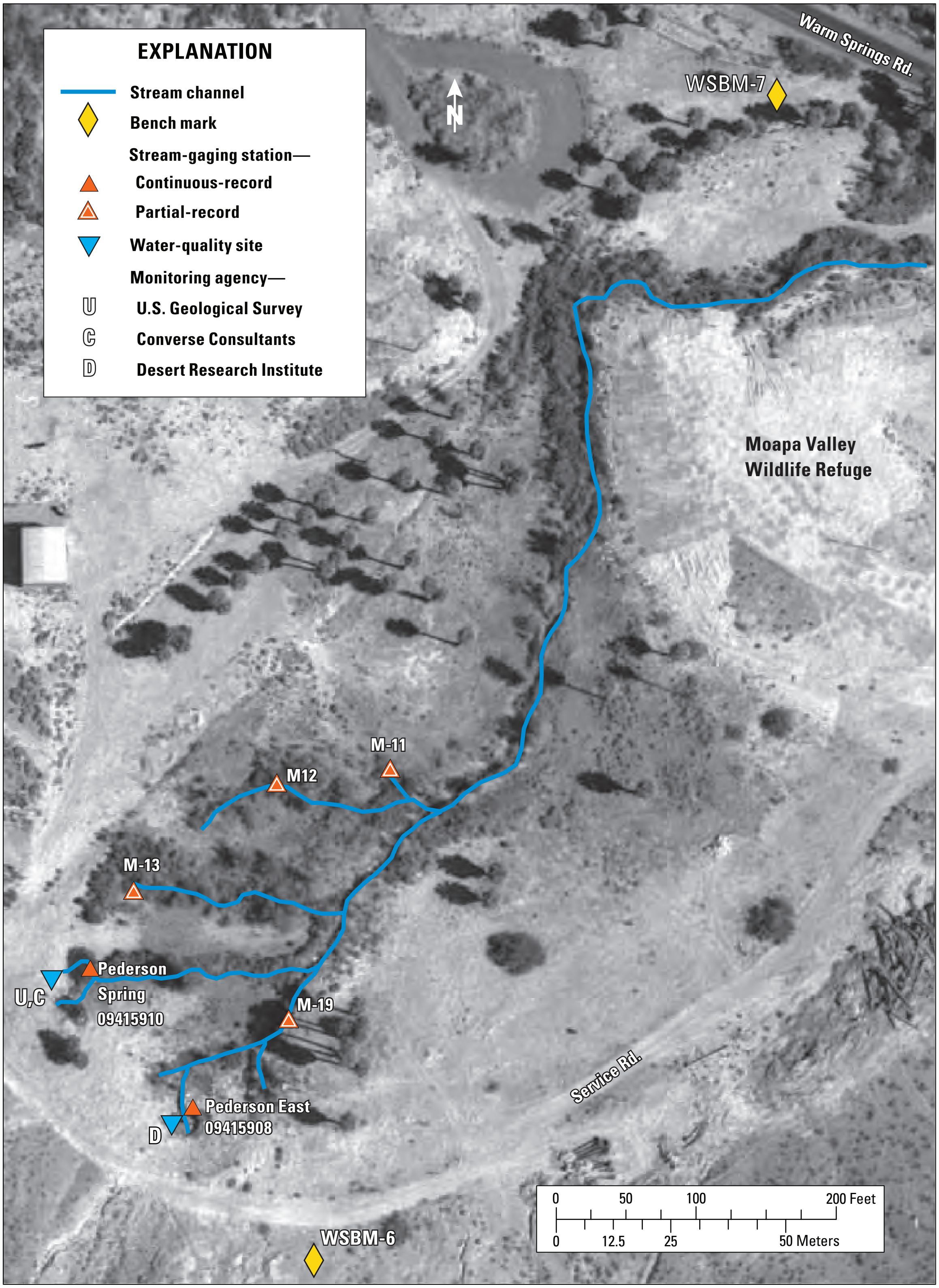

Figure B26. Location of Pederson Springs Group monitoring sites and bench marks WSBM-6 and WSBM-7 in the Warm Springs area near Moapa, Nevada.

SE ROA 49014

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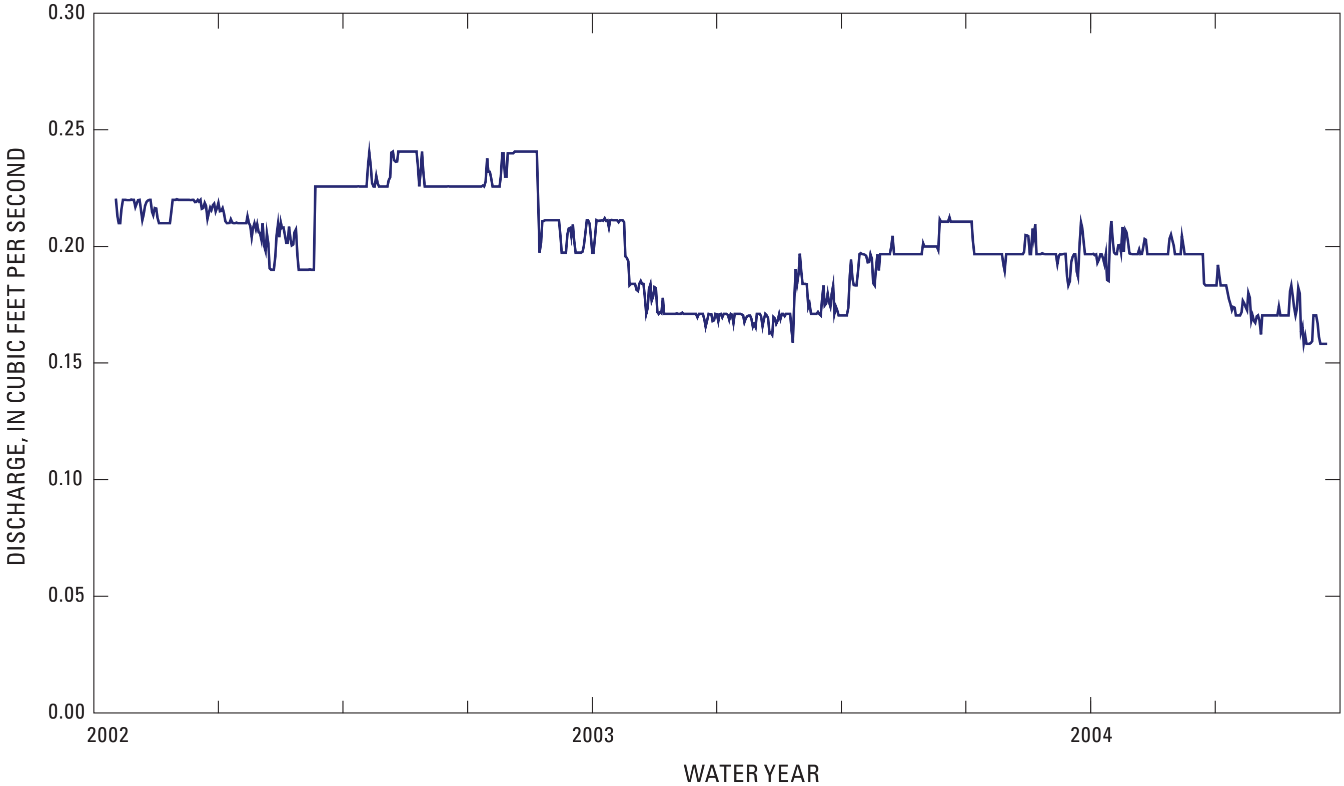


Figure B27. Daily mean discharges for continuous-record stream-gaging station 09415908 Pederson East Spring near Moapa, Nevada, water years 2002–04.

Table B18. Daily mean discharges for continuous-record stream-gaging station 09415908 Pederson East Spring near Moapa, Nevada, water years 2002–04.

Table B18 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B28. Location of staff plate and selected reference marks (RM) for station 09415908 Pederson East Spring in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

Table B19. Water-quality data collected by Desert Research Institute at continous-record stream-gaging station 09415908 Pederson East Spring near Moapa, Nevada, January 12 and May 18, 2004.

Table B19 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

09415910 Pederson Spring near Moapa, Nevada

A continuous-record stream-gaging station with 45 degree v-notch aluminum weir was established by the U.S. Geological Survey (USGS) on Pederson Spring on October 1, 1986. Pederson Spring is about 50 ft northeast of the Moapa Valley National Wildlife Refuge service road (fig. B26) and is part of a cluster of springs that drains to the northeast. Flow from Pederson Spring joins with discharge from Pederson East Spring about 250 ft downstream from the gage. Reclamation of the spring and an adjacent area by the U.S. Fish and Wildlife Service began in 2002; a new weir, with 45 degree v-notch, was installed on April 27, 2004 (fig. B29). The new weir was installed because water was leaking around the old weir and the gage was not measuring the flows accurately.

Daily mean discharges for the period of record are plotted on figure B30 and listed in table B20. Photographs of the gage and weir and of selected reference marks established for this gage on June 9, 2004, are shown in figure B31.

Water-quality data are available for this site from Converse Consultants and the USGS. Beginning April 22, 1997, Converse Consultants began quarterly water temperature and specific conductance measurements. Data collected from 1997 through December 2004 are plotted on figure B32 and listed in table B21.

Water samples were collected by the USGS on July 30, 2003, as part of the National Water-Quality Assessment Program. An extensive suite of analyses were made, and the results are listed in table B22.

A. **View of first weir being installed in 1986.**

B. **View of new weir installed in 2004.**

Figure B29. Looking downstream at continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada.

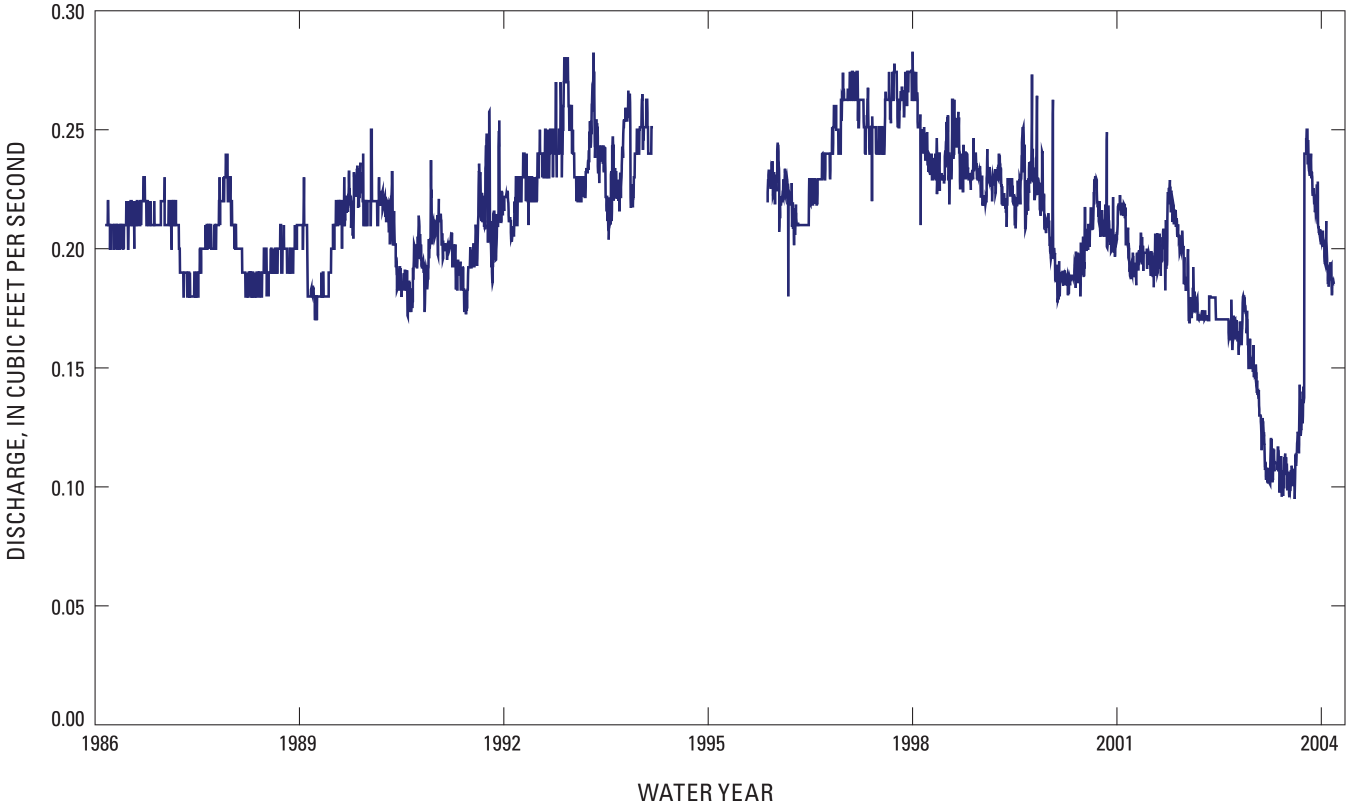


Figure B30. Daily mean discharges for continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada, water years 1987–2004.

Table B20. Daily mean discharges for continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada, water years 1987–2004.

Table B20 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

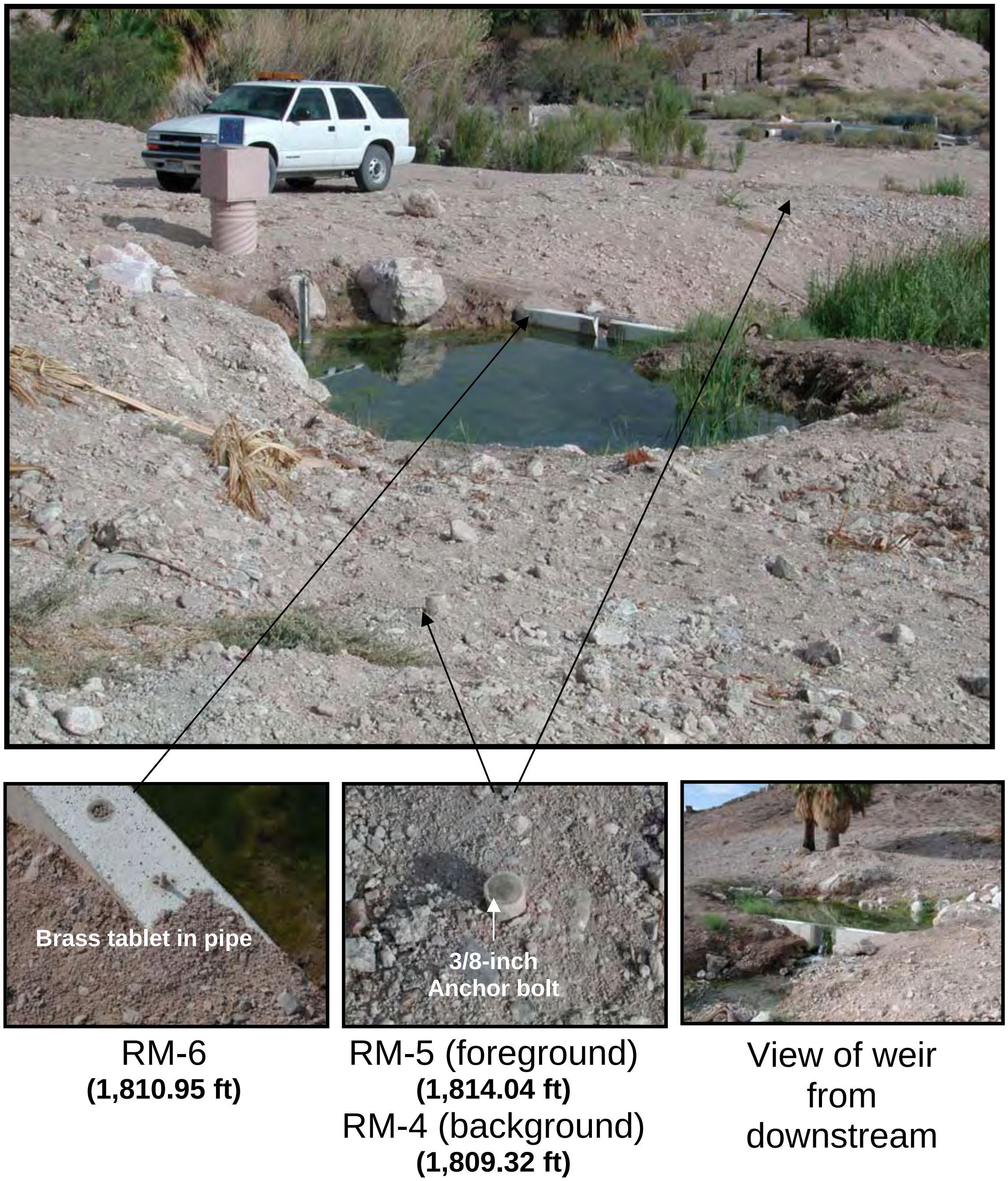


Figure B31. Location of selected reference marks (RM) at continuous-record stream-gaging station 09415910 Pederson Spring in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

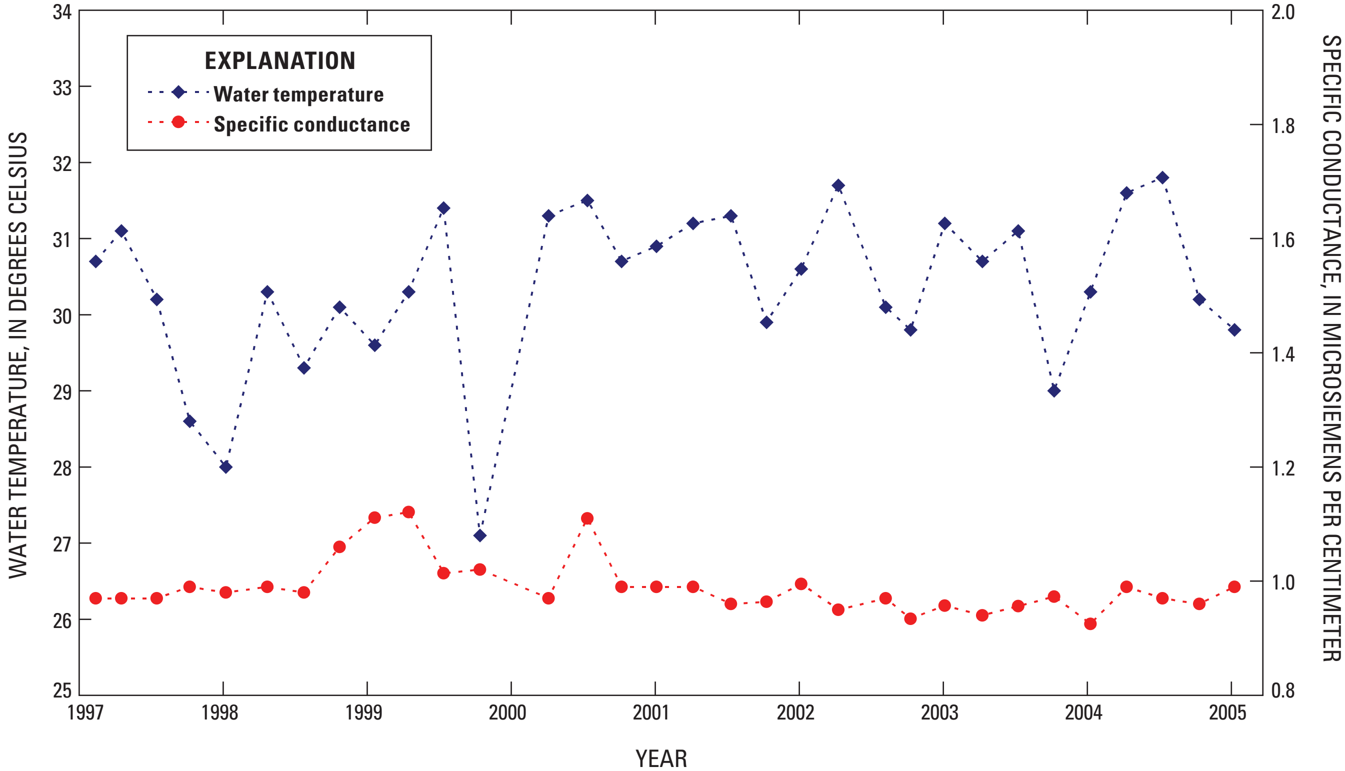


Figure B32. Water-temperature and specific-conductance measurements by Converse Consultants for station 09415910 Pederson Spring near Moapa, Nevada, 1997–2005.

Table B21. Water-temperature and specific-conductance measurements by Converse Consultants at station 09415910 Pederson Spring near Moapa, Nevada, 1997–2005.

Table B21 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B22. Water-quality data collected for continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada, July 30, 2003.

Table B22 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

364235114425201 Muddy River Springs 11 (M-11) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 11 (M-11) was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 50 ft upstream of the main channel that drains the combined flow of Pederson and Pederson East spring tributaries (fig. B26). Discharge at Muddy River Springs 11 originates about 20 ft upstream and is part of a cluster of springs known as the Pederson Spring Group that drains to the northeast.

Periodic discharge measurements have been made by the USGS since March 1987. Discharge measurements for the period of record are plotted in figure B33 and listed in table B23. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 11 monitoring site on June 9, 2004, are included in figure B34.

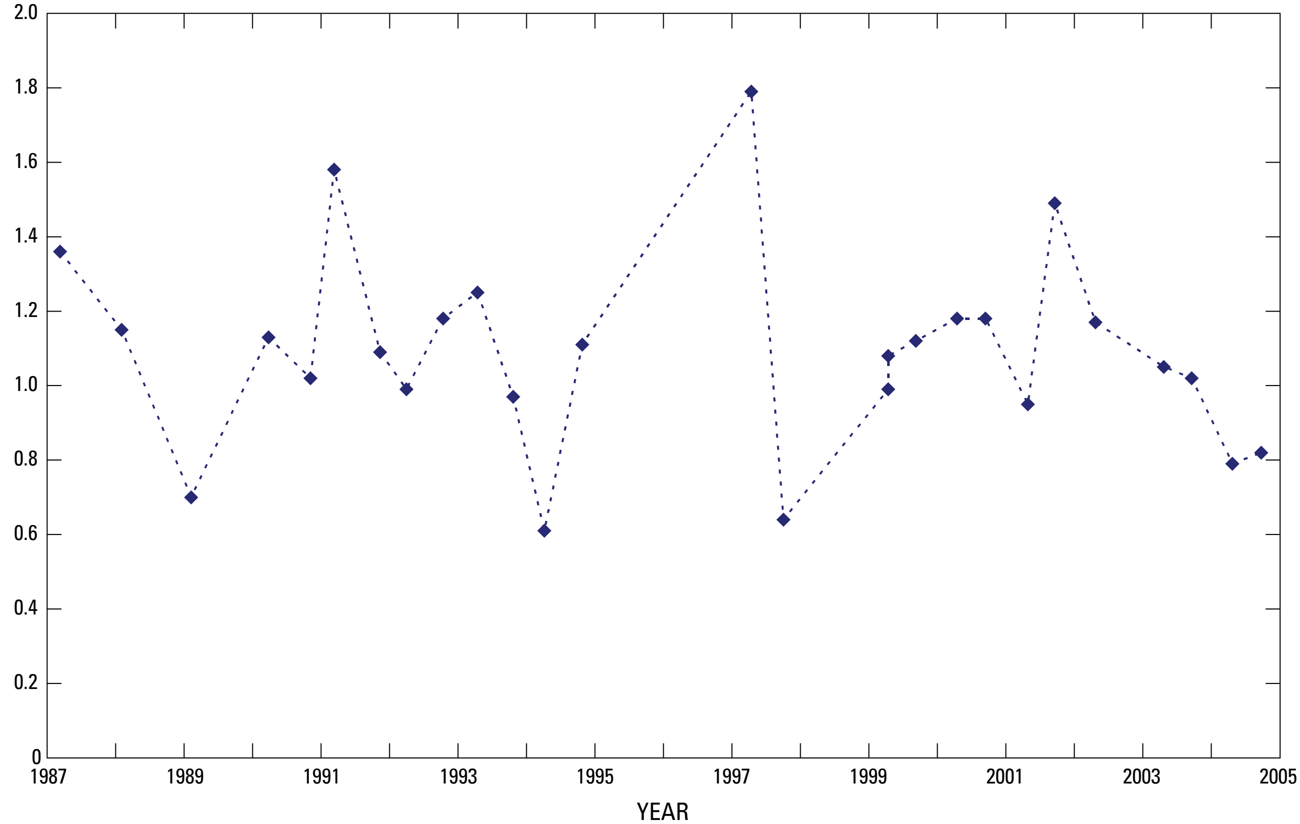


Figure B33. Periodic discharge measurements for partial-record stream-gaging station 364235114425201 Muddy River Springs 11 (M-11) near Moapa, Nevada, 1987–2004.

Table B23. Periodic discharge measurements for partial-record stream-gaging station 364235114425201 Muddy River Sprngs 11 (M-11) near Moapa, Nevada, 1987–2004.

Table B23 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

M-11
RM-1
(1,795.09 ft)

Figure B34. Location of staff plate and reference mark (RM-1) for partial-record stream-gaging station Muddy River Springs 11 (M-11) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet NAVD 88.

364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 12 was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 150 ft upstream of the confluence with the main channel that drains the combined flows from Pederson and Pederson East Spring tributaries (fig. B26). Flow at Muddy River Springs 12 originates approximately 10 ft upstream and is part of a cluster of springs known as the Pederson Spring Group that drains to the northeast.

Periodic discharge measurements have been made by the USGS since March 1987. Discharge measurements for the period of record are plotted in figure B35 and listed in table B24. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 12 monitoring site on June 9, 2004, are included in figure B36.

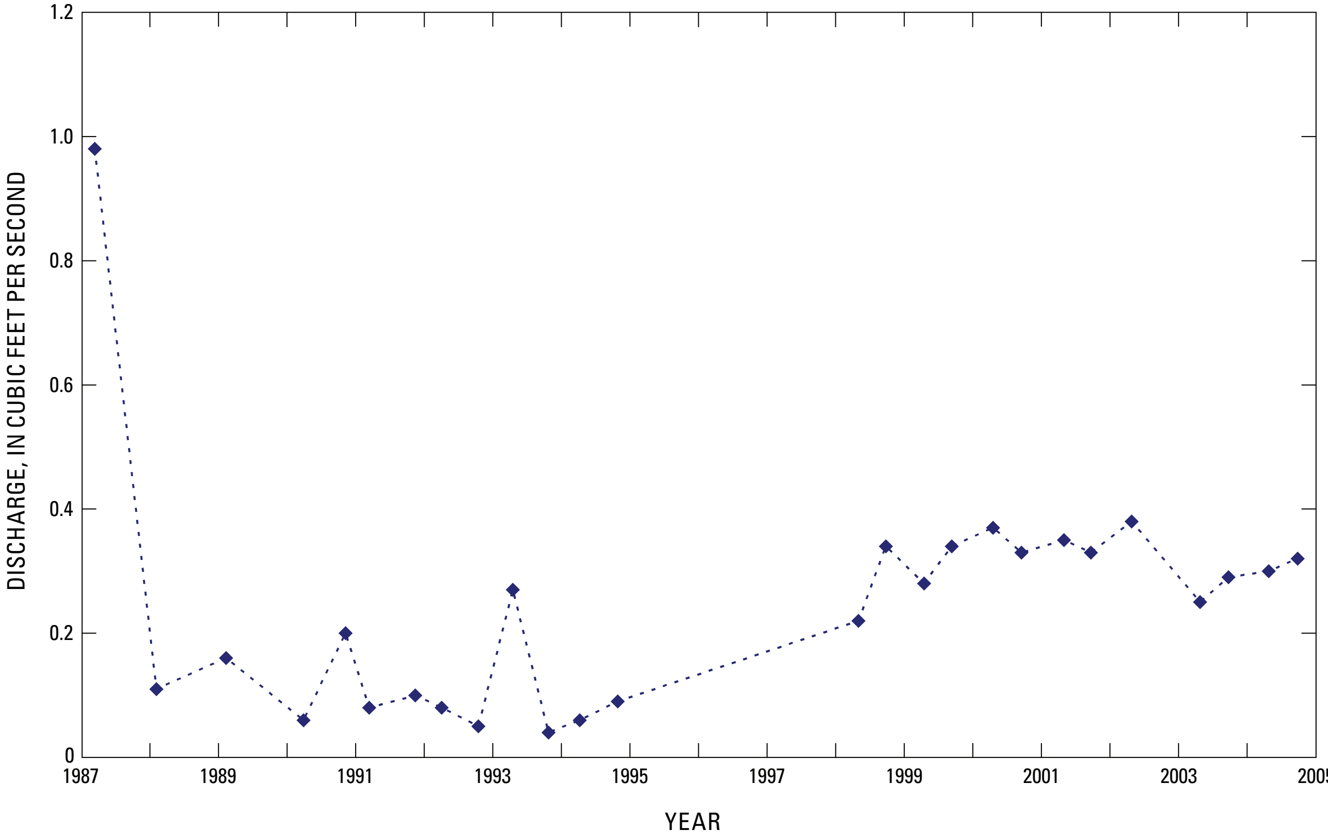


Figure B35. Periodic discharge measurements for partial-record stream-gaging station 364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada, 1987–2004.

Table B24. Periodic discharge measurements for partial-record stream-gaging station 364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada, 1987–2004.

Table B24 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

M-12
RM-2
(1,801.49 ft)

Figure B36. Location of staff plate and reference mark (RM-2) for partial-record stream-gaging station Muddy River Springs 12 (M-12) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 13 was established by the U.S. Geological Survey (USGS) on January 28, 1986, and is about 150 ft upstream of the confluence with the main channel that drains the combined flows from Pederson and Pederson East Spring tributaries (fig. B26). Flow at Muddy River Springs 13 originates approximately 25 ft upstream and is part of a cluster of springs known as the Pederson Spring Group that drains to the northeast.

Periodic discharge measurements have been made by the USGS since January 1986. Discharge measurements for the period of record are plotted in figure B37 and listed in table B25. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 13 monitoring site on June 9, 2004, are included in figure B38.

Water samples were collected at this site on January 12 and May 18, 2004, by Desert Research Institute (DRI) and analyzed for major ions, physical and chemical parameters (dissolved oxygen, pH, and water temperature), and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B26.

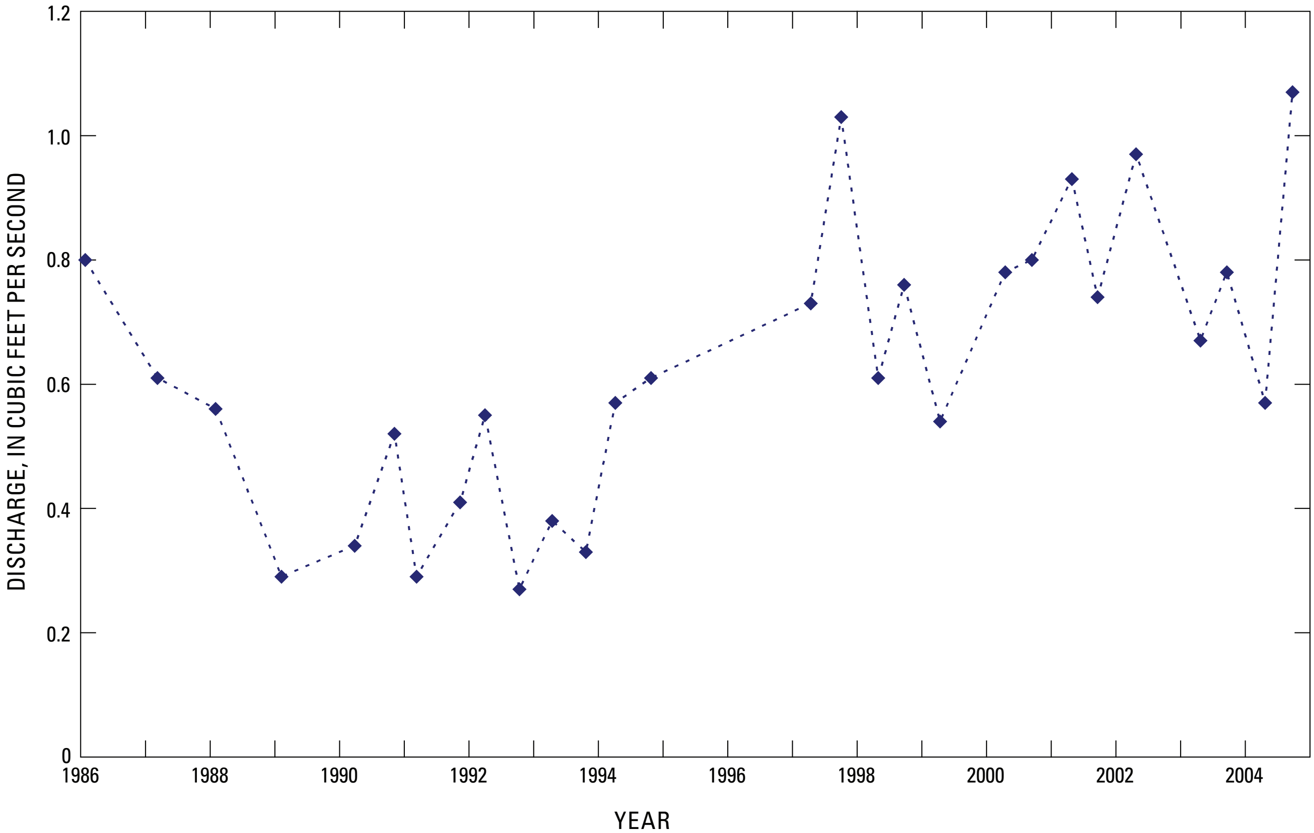


Figure B37. Periodic discharge measurements for stream-gaging station 364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada, 1986–2004.

Table B25. Periodic discharge measurements for partial-record stream-gaging station 364261144254O1 Muddy River Springs 13 (M-13) near Moapa, Nevada, 1986–2004.

Table B25 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B38. Location of staff plate and reference mark (RM-1) for partial-record stream-gaging station Muddy River Springs 13 (M-13) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

Table B26. Water-quality data collected by Desert Research Institute at station 364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada, January 12 and May 18, 2004.

Table B26 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

364235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 19 (M-19) was established by the U.S. Geological Survey (USGS) on April 28, 1990, and is about 100 ft downstream from the Pederson East Spring gage (fig. B26). Flow at Muddy River Springs 19 originates from water discharging at the Pederson East Spring pool and from three other spring pools downstream of the gage. Flow at M-19 drains to the northeast and joins with flow from Pederson Spring approximately 50 ft downstream.

Periodic discharge measurements have been made by the USGS since April 1998. Discharge measurements for the period of record are plotted in figure B39 and listed in table B27. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 19 monitoring site on June 9, 2004, are included in figure B40.

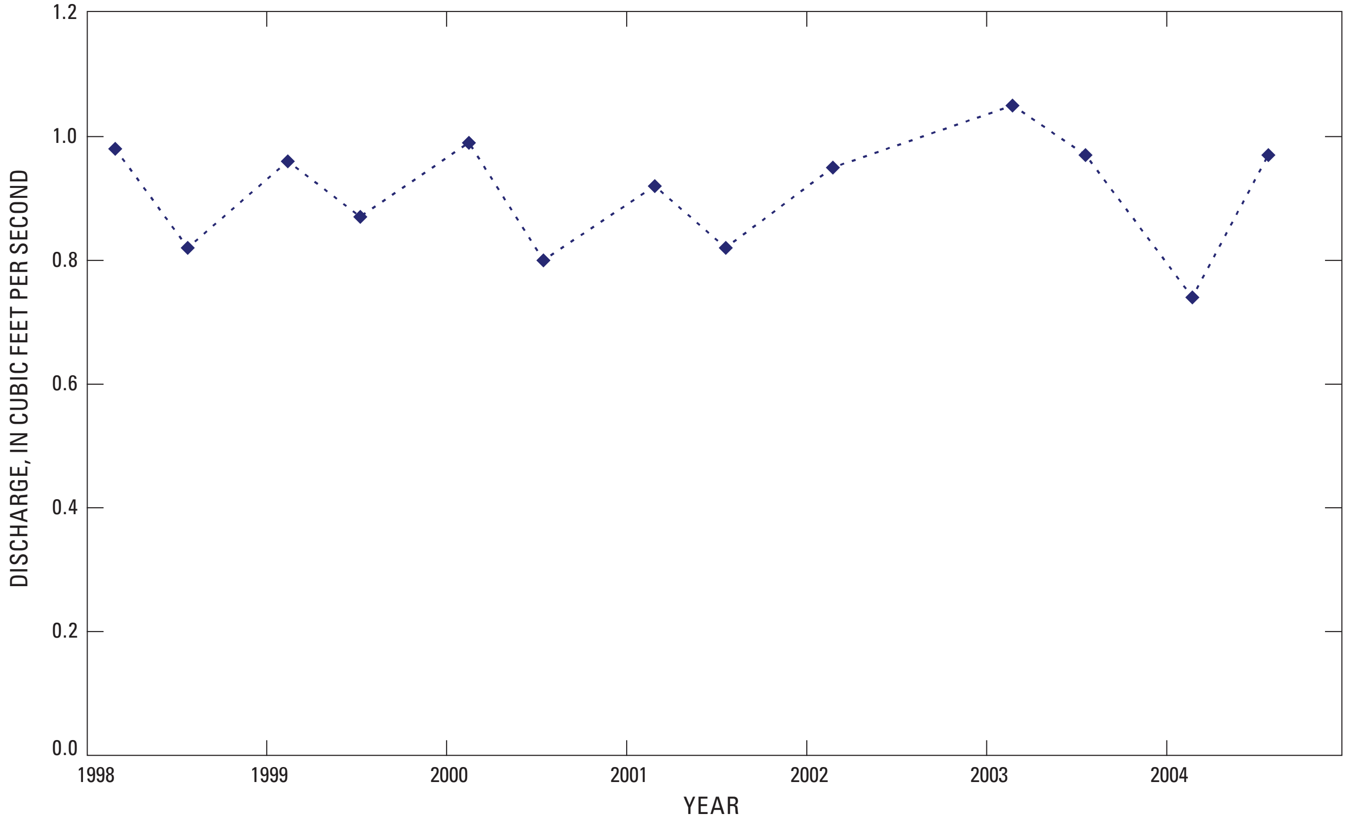
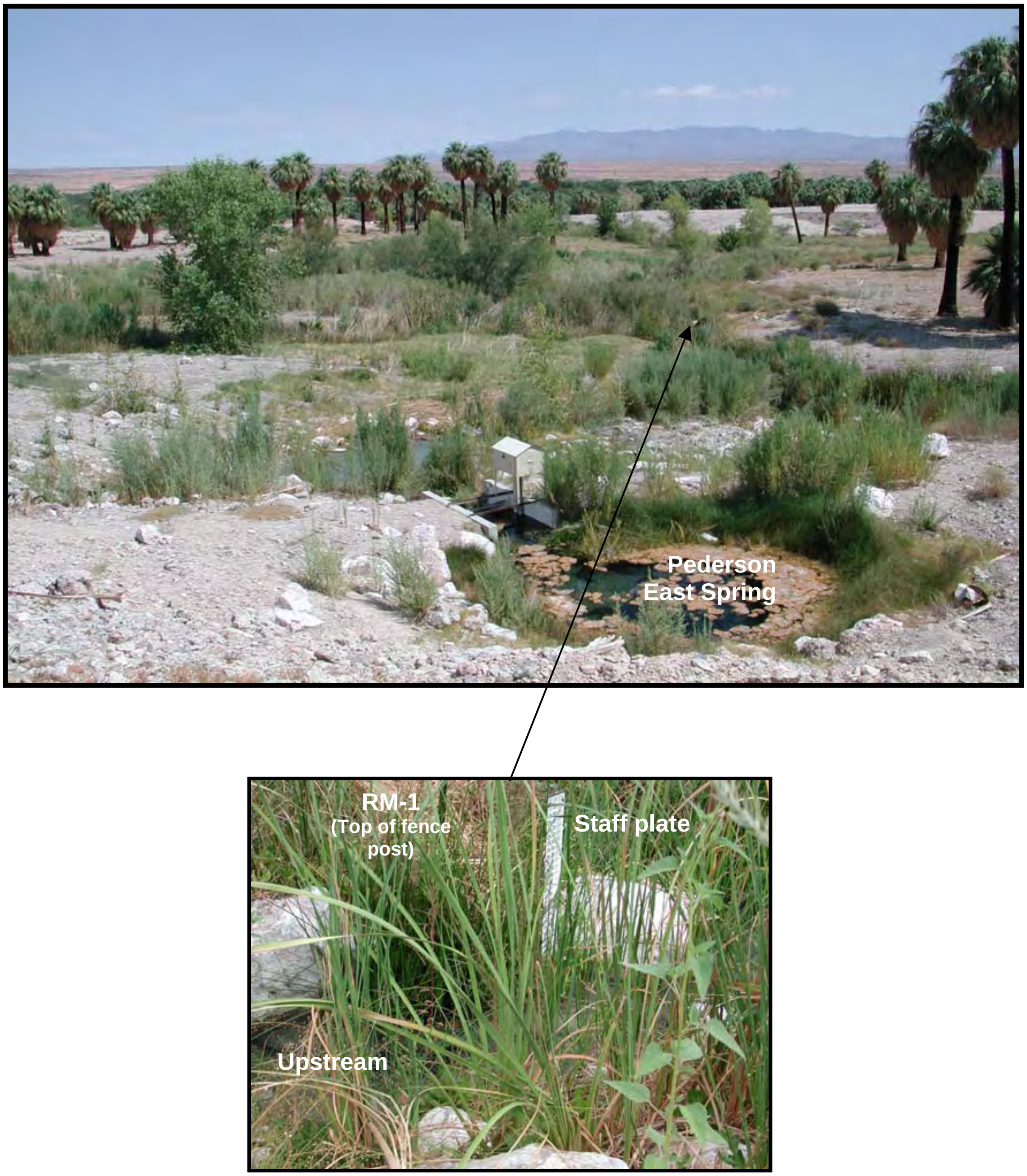


Figure B39. Periodic discharge measurements for partial-record stream-gaging station 3642235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada, 1998–2004.

Table B27. Periodic discharge measurements for partial-record stream-gaging station 364235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada, 1998–2004.

Table B27 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.



M-19
RM-1 (1,800.88 ft)

Figure B40. Location of staff plate and reference mark (RM-1) for partial-record stream-gaging station Muddy River Springs 19 (M-19) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

09415920 Warm Springs West near Moapa, Nevada

A 1.5-foot (ft) Parshall flume was installed at the Warm Springs West stream-gaging station on September 20, 1967, by the Nevada Division of Water Resources (NDWR). Initially called the Pederson flume by NDWR, the exact location is unknown, but the flume is believed to have been installed in the vicinity of the current gage, just upstream of Warm Springs Road (fig. B41). At this site, the flume would have monitored the total flow discharging from all springs associated with the Pederson Spring Groups (fig. B26). Downstream from the flume, flow discharges under Warm Springs Road and then turns sharply to the east after exiting the culvert. About 0.1 mi below the culvert, flow merges with discharge draining the Plummer (Iverson) Spring Group.

Data provided by NDWR show that water levels at the Pederson flume generally were measured monthly from October 1967 to July 1981. A large gap in the record is evident from August 1971 to March 1974. Additional data provided by NDWR showed that a 1-ft Parshall flume, called the U.S. Fish and Wildlife Flume, was installed on May 6, 1981. The exact location of this flume also is unknown, but it is believed that it was near the location of the current gage. Water levels were concurrently measured at the Pederson and the Fish and Wildlife flumes during May, June, and July 1981. Water levels for the Fish and Wildlife Flume were measured daily from June 29, 1981, to September 27, 1981, and measured somewhat monthly from October 1981 to June 1986. Measurements were not available for July 1986 to July 1993 when a new 1-ft Parshall flume was installed. Monthly measurements resumed and continued though February 2005.

As only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 1.5-ft and 1-ft Parshall flumes (Leupold and Stevens, 1987). Plots of the computed discharges from October 1967 to February 2005 are shown in figure B42. Listings of the water-level measurements and computed discharges are included in table B28 for October 1967 to July 1981; table B29 for May 1981 to June 1986; and table B30 for July 1993 to February 2005. Computed discharges from March 1974, after the large gap in record, until July 1981 are significantly lower than all other computed discharges. Although not noted in the records received from NDWR, the drop in discharge probably was the result of flow bypassing the flume.

A continuous-stage recorder was installed by the U.S. Geological Survey (USGS) on August 22, 1985, and maintained through September 30, 1994. The gage was reactivated in June 1996 and is routinely maintained as part of the current monitoring network. Daily mean discharges computed for the period of record have been included on the plot in figure B42 and listed in table B31. Photographs of the current flume and bench mark, and a selected reference mark established for this gage on June 3, 2004, are shown in figure B43.

Quarterly measurements of water temperature and specific conductance made at this gage from April 1997 to March 2005 were provided from Converse Consultants. These data are plotted on figure B44 and listed in table B32.

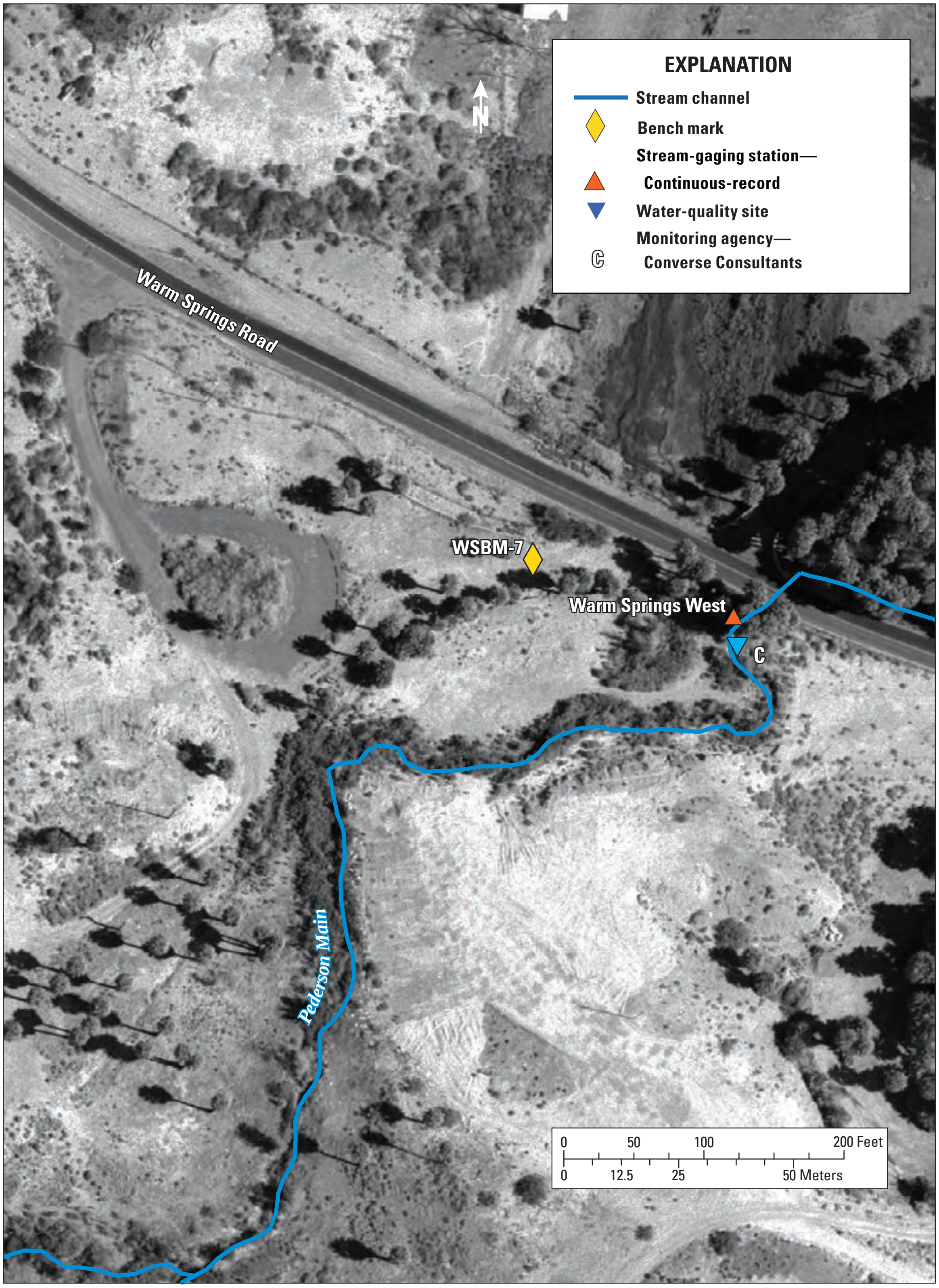


Figure B41. Location of continuous-record stream-gaging station 09415920 Warm Springs West and bench mark WSBM-7 in the Warm Springs area near Moapa, Nevada.

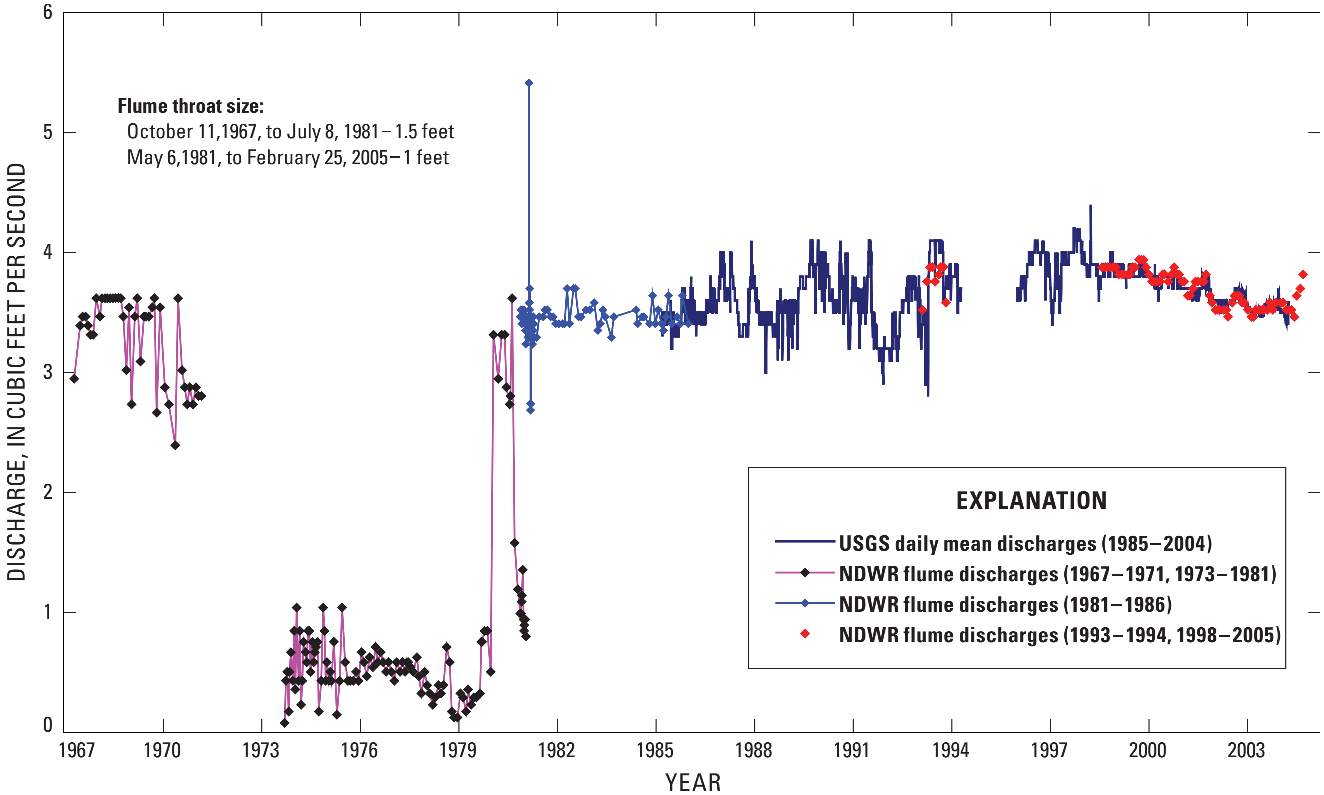


Figure B42. Instantaneous and daily mean discharges for continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada, 1967–2005. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov. NDWR, Nevada Division of Water Resources.

Table B28. Water levels and computed instantaneous discharges for Pederson Flume near Moapa, Nevada, 1967–81.

[Data from Nevada Division of Water Resources.]

Table B28 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B29. Water levels and computed instantaneous discharges for U.S. Fish and Wildlife Service flume near Moapa, Nevada, 1981–86.

[Data from Nevada Division of Water Resources.]

Table B29 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B30. Water levels and computed instantaneous discharges for U.S. Fish and Wildlife Service flume near Moapa, Nevada, 1993–2005.

[Water levels provided by Nevada Division of Water Resources.]

Table B30 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B31. Daily mean discharges for continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada, water years 1985–2004.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B31 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

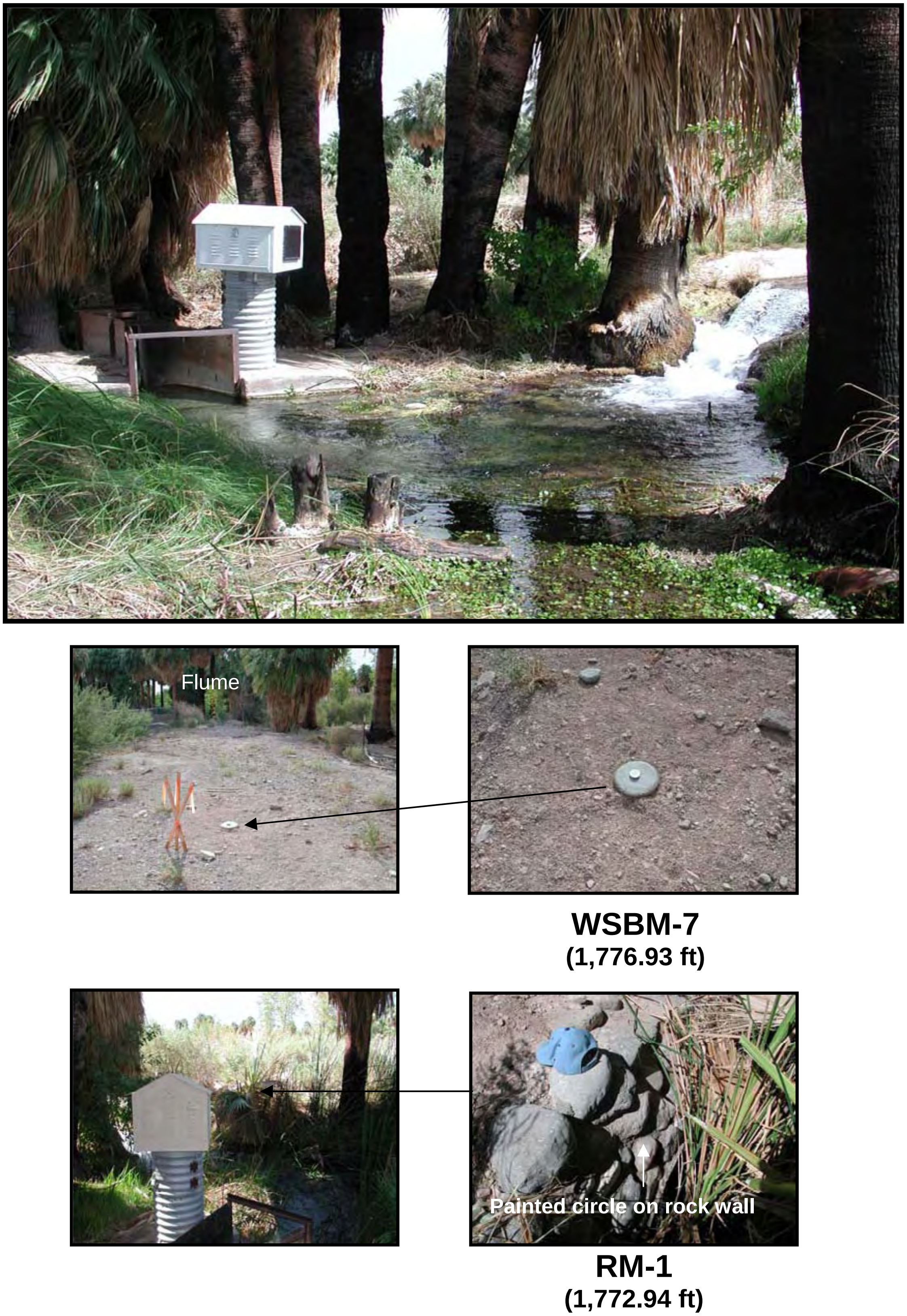


Figure B43. Location of bench mark WSBM-7 and reference mark RM-1 for continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada. The top picture shows the stream-gaging station photographed in 2001. Elevation of bench and reference marks in feet above NAVD 88.

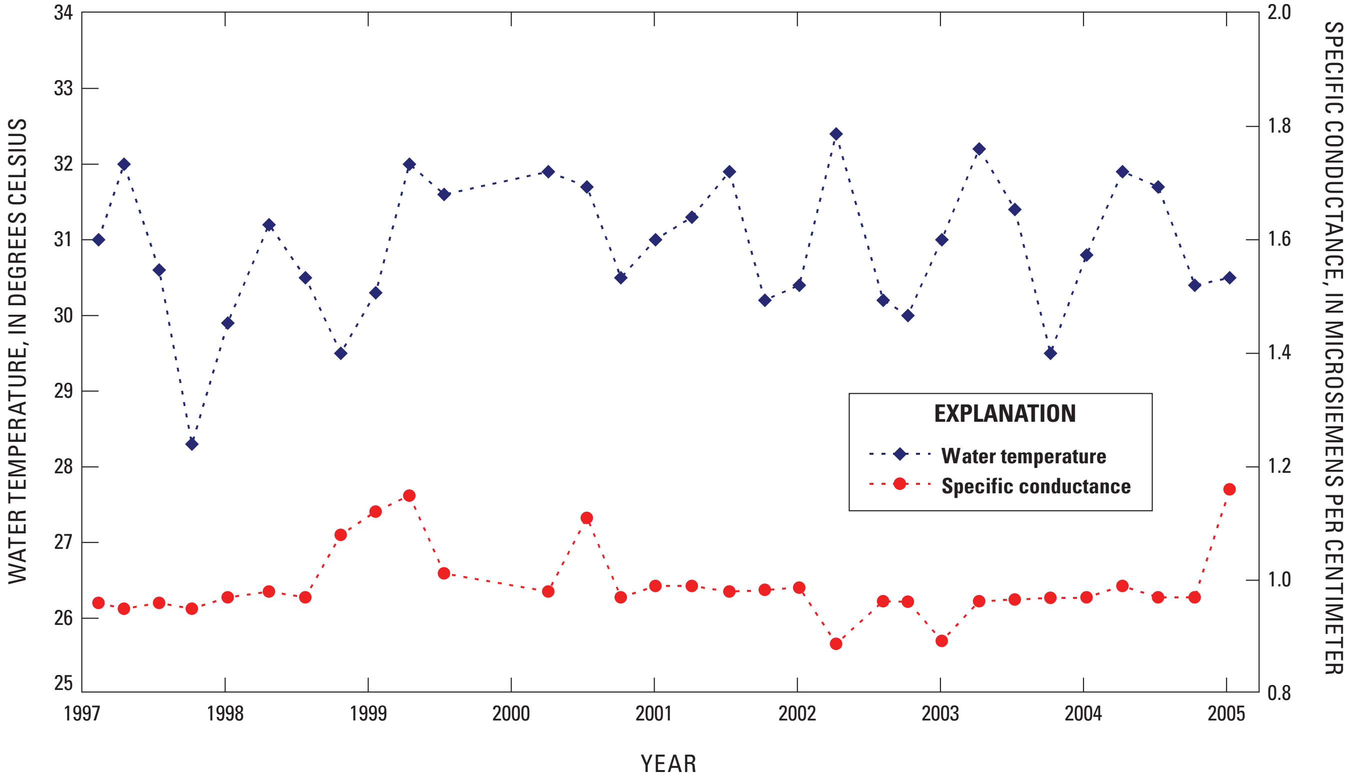


Figure B44. Water temperature and specific conductance measurements for continuous-record stream-gaging station 09415920 Warm. Springs West near Moapa, Nevada, 1997–2005. Data provided by Converse Consultants.

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Table B32. Water-temperature and specific-conductance measurements by Converse Consultants at continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada, 1997–2005.

Table B32 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Muddy Springs

The following site is included within this section:

09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada (1967–2005)

09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada

A 1-foot (ft) Parshall flume was installed on Muddy (Big) Springs on August 25, 1967, by the Nevada Division of Water Resources (NDWR). The flume was located approximately 0.1 mi downstream from the former Francis Taylor mansion (fig. B45) located on the L.D.S. Recreation Area. Although there are several springs in the area, most flow emanates from a large spring-fed pond on the northwest side of the mansion. Discharge from the spring-fed pond is directed around both sides of the mansion and converges just north of the large swimming pool. From there, flow generally drains to the south and joins with Muddy River about 0.5 mi downstream. Springflow is frequently diverted to fill the large swimming pool.

Data provided by NDWR show that water levels in the 1-ft flume were measured monthly from August 1967 to August 1971. Measurements were not available between September 1971 and February 1974 at which time a larger (3-ft) Parshall flume was installed. Monthly measurements resumed and continued until November 1987, although during July and August 1981, daily readings were recorded. Between December 1987 to July 1993 only six measurements were made. On July 16, 1993, a new 3-ft Parshall flume was installed and monthly measurements resumed. Because only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 1-ft and 3-ft Parshall flumes (Leupold and Stevens, 1987). Discharges for October 1967 to February 2005 are shown in figure B46. A complete listing of the water-level measurements and computed discharges is included in table B33.

A continuous-stage recorder was installed on the flume by the U.S. Geological Survey on August 22, 1985, and maintained until September 30, 1994. The gage was reactivated in June 1996 and is routinely maintained as part of the current monitoring network. Daily mean discharges computed for the period of record are also plotted on figure B46 and listed in table B34. Photographs of the current flume, bench mark, and selected reference marks established for this gage on June 3, 2004, are shown in figure B47.

Water samples were collected at this site on May 18, 2004, by Desert Research Institute (DRI) and analyzed for major ions, water temperature, and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B35.

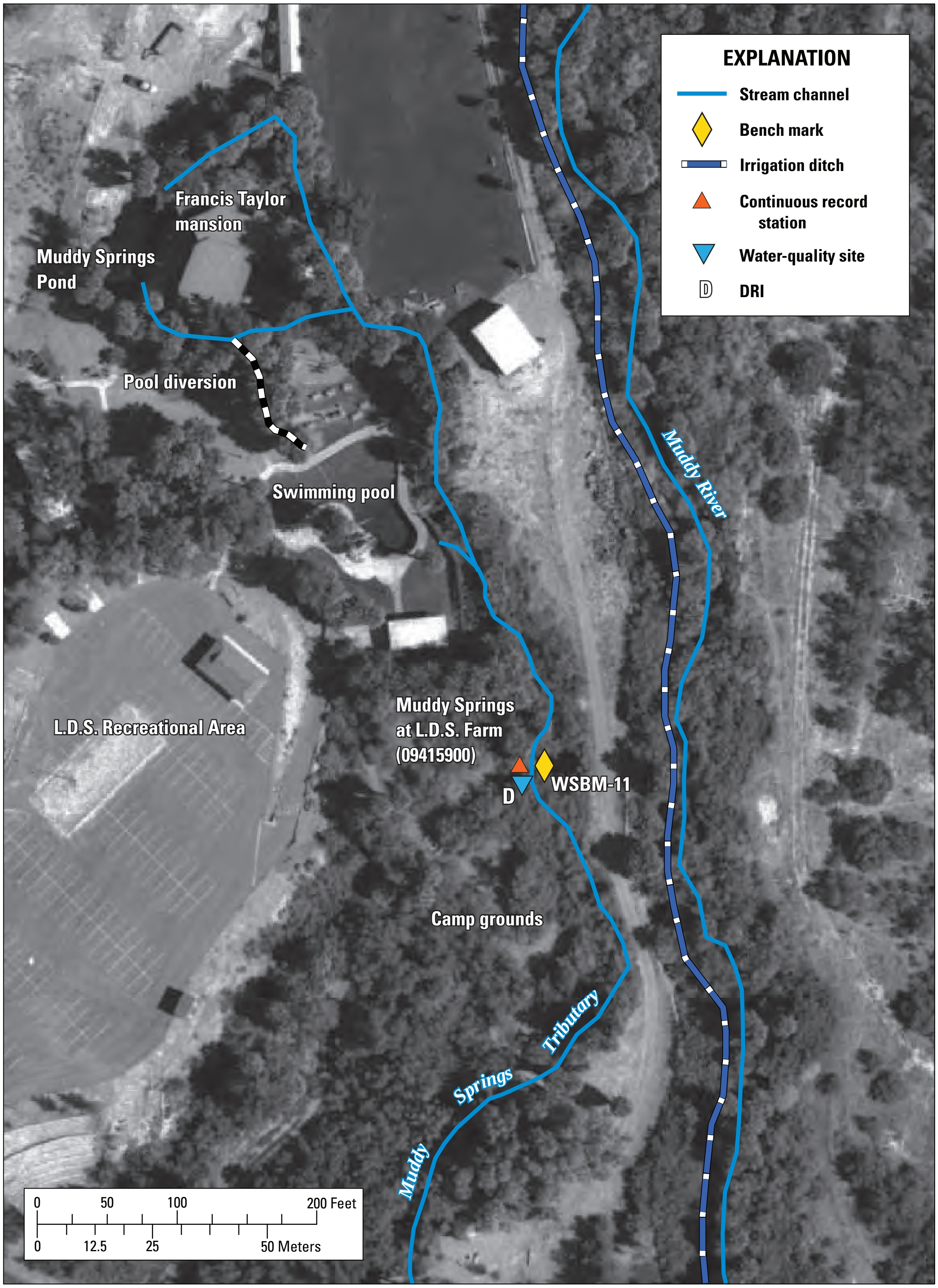

Figure B45. Location of Muddy Springs at Latter Day Saints (L.D.S.) Farm continuous-record stream-gaging station, L.D.S. Recreational Area, Desert Research Institute monitoring site, and bench mark WSBM-11 in the Warm Springs area near Moapa, Nevada.

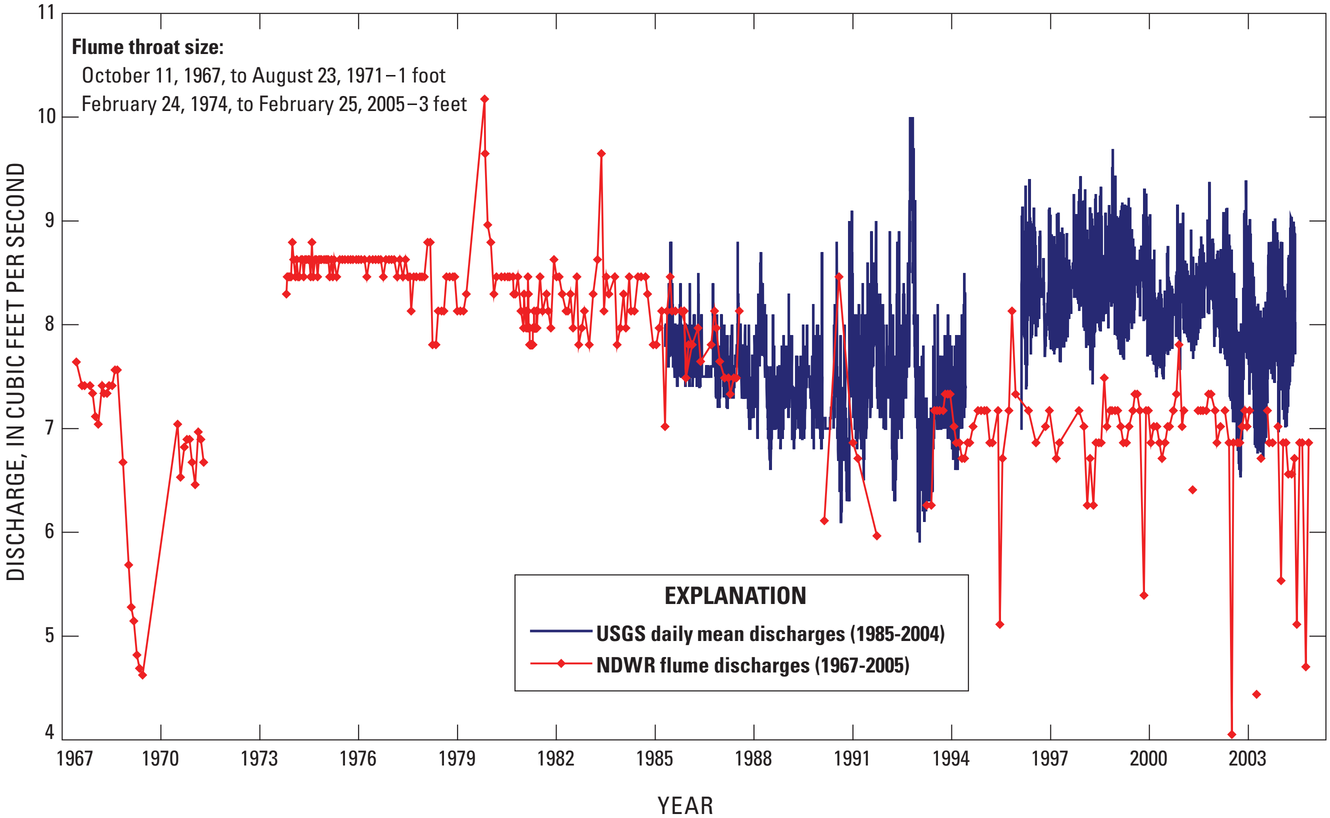

Figure B46. Instantaneous and daily mean discharge for continuous-record stream-gaging station 09415900 Muddy Springs at Latter Day Saints (L.D.S.) Farm near Moapa, Nevada, 1967–2005. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov. NWDR, Nevada Division of Water Resources.

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Table B33. Water levels and computed instantaneous discharges for continuous-record stream-gaging 097415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada, 1967–2005.

Table B33 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B34. Daily mean discharges for continuous-record stream-gaging station 09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada, water years 1985–2004.

Table B34 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B47. Location of bench mark WSBM-11 and reference marks RM-3 and RM-5 at stream-gaging station 09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada. Photographed June 3, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Table B35. Water-quality data collected by Desert Research Institute for continuous-record stream-gaging at station 09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada, May 18, 2004.

Table B35 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Apcar (Pipeline Jones) Springs

The following sites are included within this section:

Garden Ditch Flume (1978–92)
North Tributary Water-Quality Site (1997–2005)
South Tributary Water-Quality Site (1997–2005)
Apcar Pumphouse Water-Quality Site (1997–2004)

Apcar (Pipeline Jones) Springs near Moapa, Nevada

Apcar Springs is about 0.1 mi west of Warm Springs Road in the south-central part of the Warm Springs area (fig. 2). Currently, two channels, the North Tributary and South Tributary, discharge water from the Apcar Spring area. The North Tributary drains to the northeast through a culvert under Warm Springs Road (fig. B48). Downstream of Warm Springs Road, flow continues in a dirt channel to the north for about 0.1 mi and then turns to the northeast. About 0.2 mi farther, the channel turns to the southeast and continues until it is just south of the confluence of Muddy Springs tributary and Muddy River (fig. 2). Most of the ditch between Warm Springs Road and the confluence is thickly overgrown. Near the confluence, flow from the ditch is directed into an old concrete irrigation trough that distributes water to the southeast fields, ultimately terminating into Refuge Stream about 0.4 mi downstream (fig. 2). The South Tributary generally drains to the east, eventually becoming Apcar Stream, which terminates into Refuge Stream about 0.55 mi downstream from the Warm Springs Road crossing (fig. 2). In 1960, a pump house (fig. B48) was constructed at the springs by the then Moapa Valley Water Company to supply water for residential and commercial areas within the southern towns of Moapa Valley.

A 9-inch (in.) Parshall flume was installed on Garden Ditch on January 4, 1978, by the Nevada Division of Water Resources (NDWR). This flume is reported to have been located on the North Tributary just upstream of the culvert at Warm Springs Road (fig. B48) (Testolin and others, 1993). The flume is no longer there; however, remnant pieces of concrete litter the area. Data provided by NDWR show that water-level measurements for the 9-in flume generally were made monthly from January 1978 until June 1981 and daily from July through September 1981. Monthly measurements resumed in October 1981 and ended in November 1987. No measurements were made from December 1987 until June 1990. From June 1990 to June 1992, only six measurements were made. No measurements are available after June 26, 1992. Because only water-level measurements were provided by NDWR, discharge rates were computed using a standard equation for the 9-in Parshall flume (Leupold and Stevens, 1987). Computed discharges from January 1978 to June 1992 are shown in figure B49. Water-level measurements and computed discharges are given in table B36.

In April 1997, Converse Consultants, on contract with Nevada Power Company, began quarterly field measurements of water temperature and specific conductance on the North and South Tributaries (fig. B48). Measurements for the North and South Tributary sites through March 2005 were provided by Converse Consultants and are plotted in figures B50 and B51 and listed in tables B37 and B38, respectively.

In December 1997, the Moapa Valley Water District (MVWD) began collecting water samples from a spigot at the Apcar Springs old pump house (fig. B48). Water samples generally are collected annually by MVWD and analyzed by Southwest Analytical, Inc., for major ions, trace metals, and selected chemical parameters (pH, specific conductance, total dissolved solids, and alkalinity). Although a new pump house was constructed during the summer of 2004 (fig. B48), all water-quality data provided by MVWD were from the original pump house (Susan Rose, Moapa Valley Water District, oral commun., 2005). The results of the analyses of the samples collected from December 1997 to August 2004 are given in table B39.

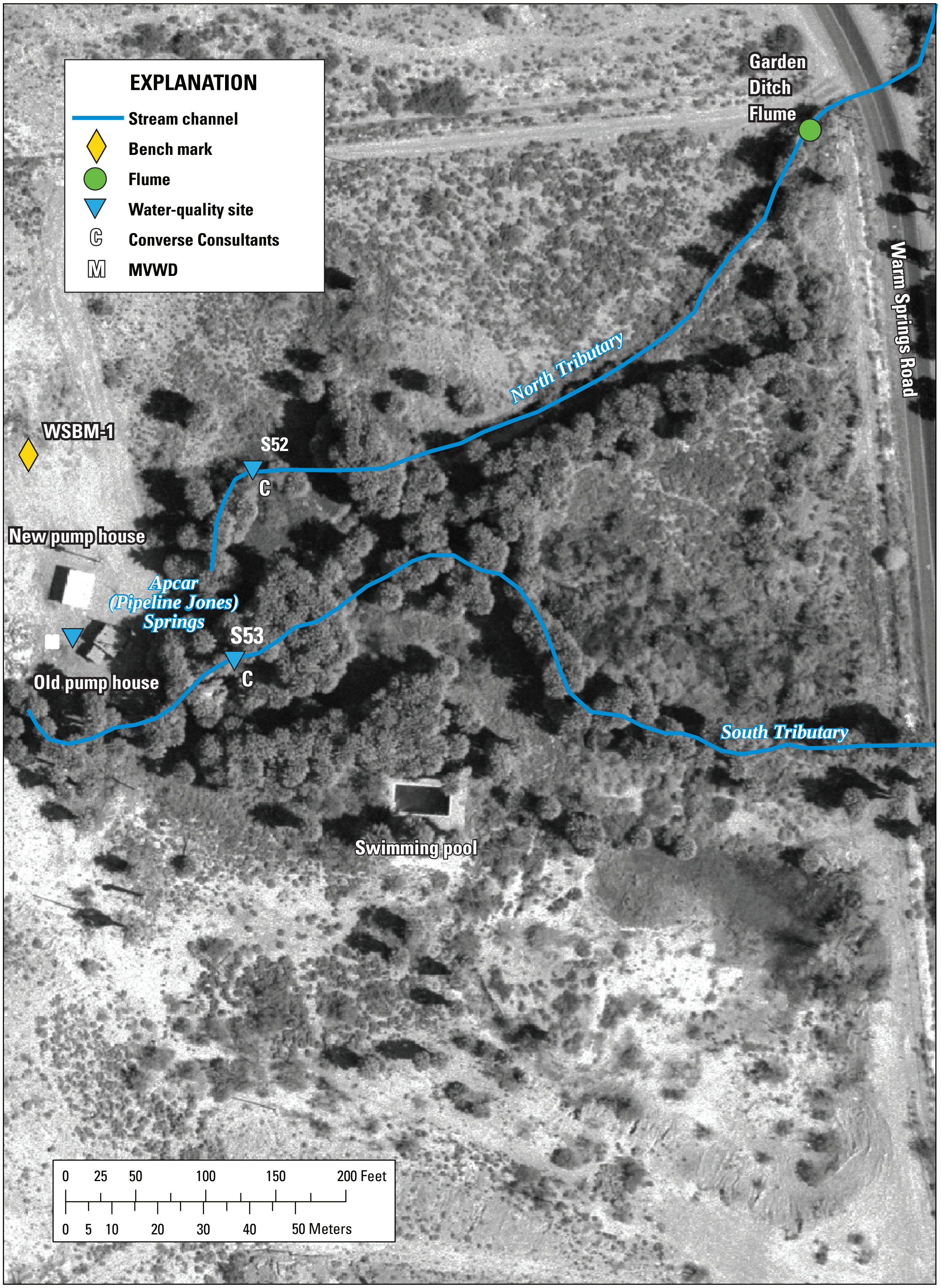

Figure B48. Location of Apcar (Pipeline Jones) Springs, pump houses, monitoring sites, and bench mark WSBM-1 in the Warm Springs area near Moapa, Nevada.

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Garden Ditch Flume at Apcar (Pipeline Jones) Springs near Moapa, Nevada

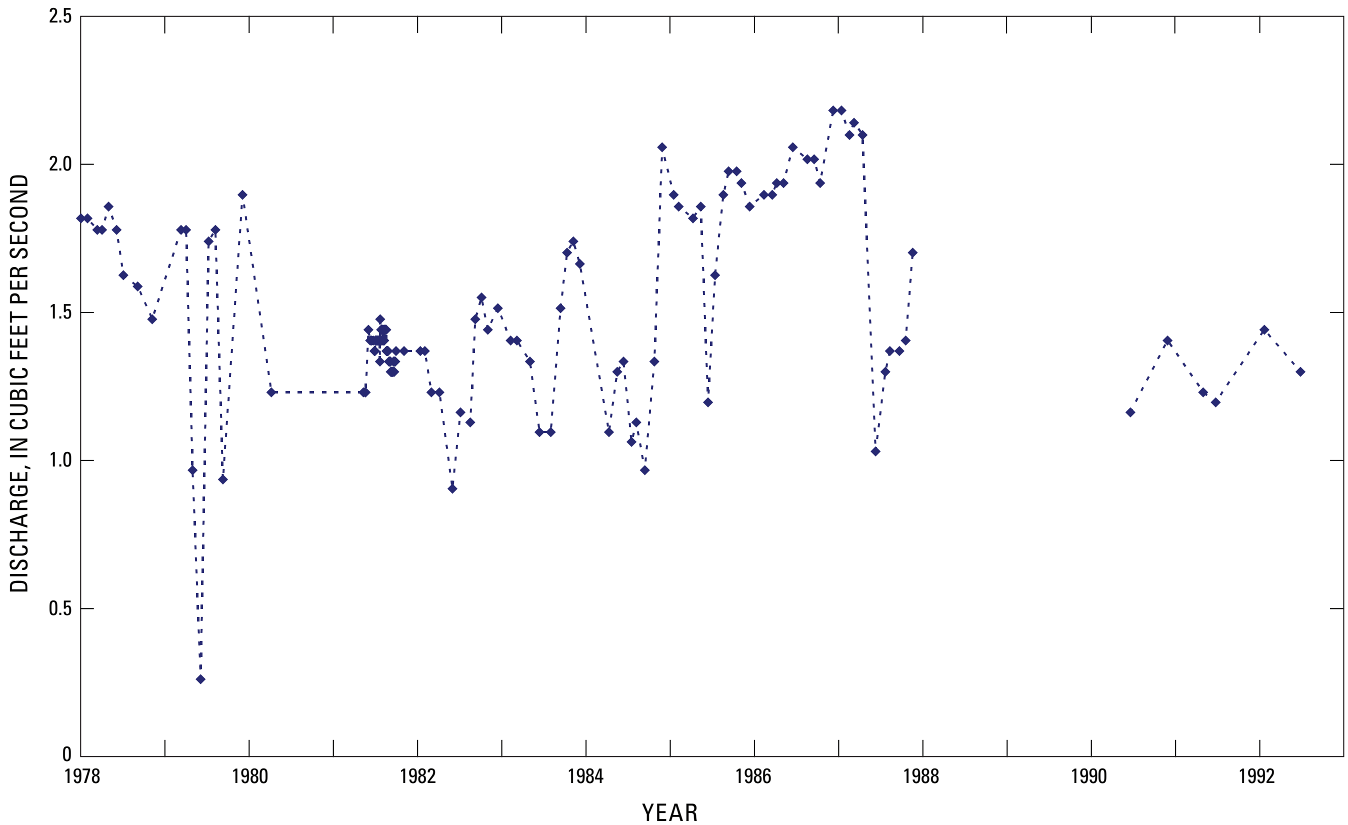

Figure B49. Instantaneous discharges computed from water-level measurements provided by Nevada Division of Water Resources for Garden Ditch Flume on North Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1978–92. Data provided by Nevada Division of Water Resources.

Table B36. Instantaneous discharges computed from water-level measurements for Garden Ditch Flume on North Tributary at Apcar (Pipelne Jones) Springs near Moapa, nevada, 1978–92.

[Data provided by Nevada Division of Water Resources.]

Table B36 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Water-Quality Sites at Apcar (Pipeline Jones) Springs near Moapa, Nevada

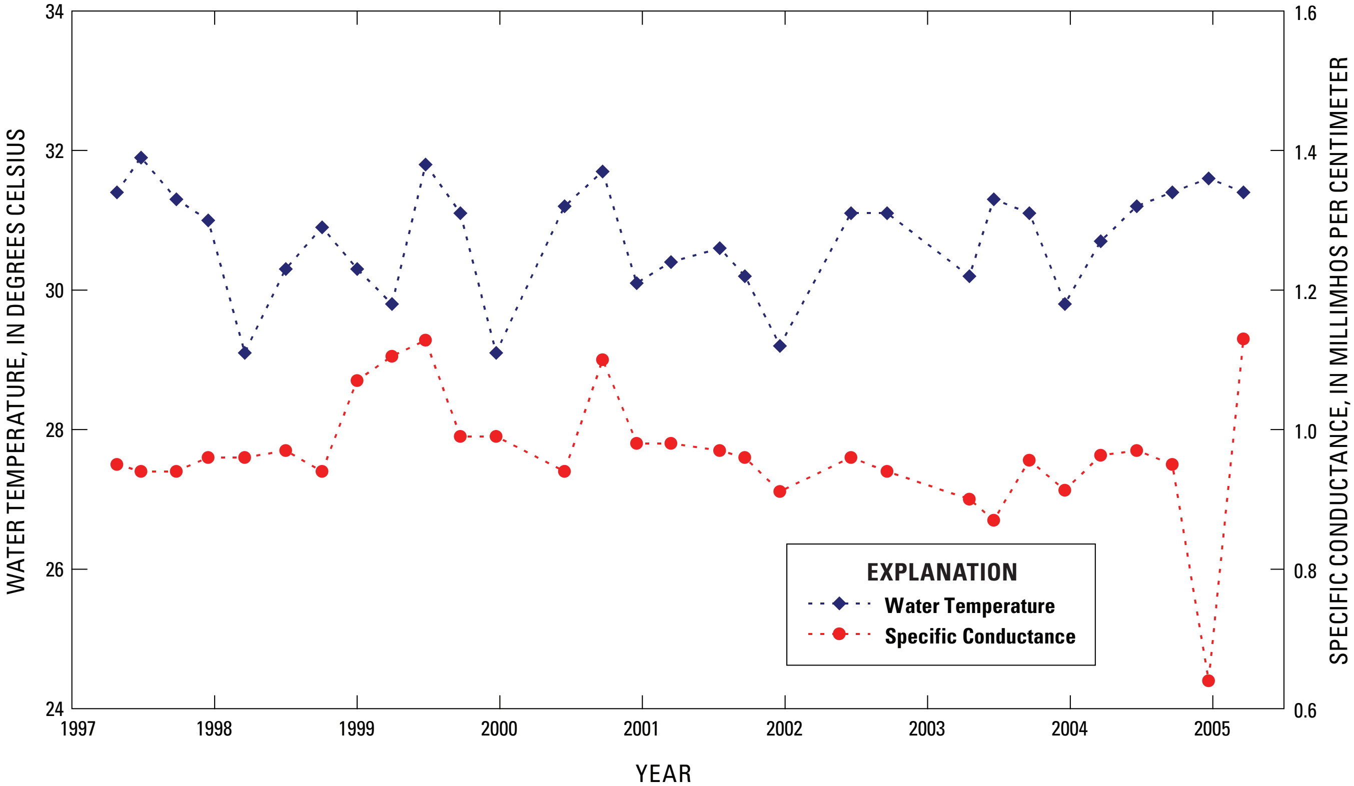

Figure B50. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S52 on North Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–32005.

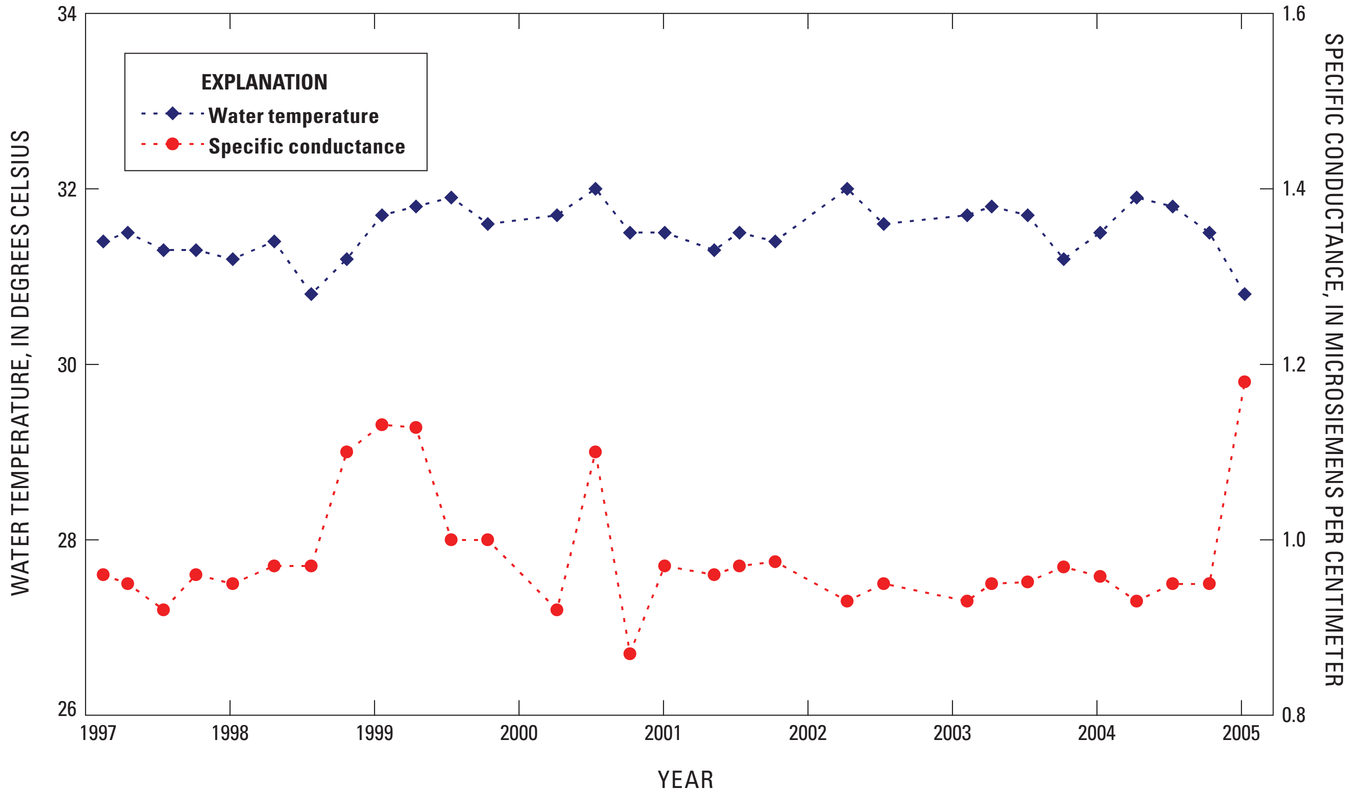

Figure B51. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S53 on South Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–2005..

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JA_15254

Table B37. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S52 on North Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–2005.

Table B37 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B38. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S53 on South Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–2005.

Table B38 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B39. Water-quality data for pump house at Apcar (Pipeline Jones) Springs, near Moapa, Nevada, 1997–2004.

Table B39 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Baldwin Springs

The following sites are included within this section:

Baldwin Cuts Flume (1967–85)
09415875 Baldwin Springs Flume near Moapa, Nevada (1967–2005)
Baldwin Springs Flume Water-Quality Site (1997–2005)
Baldwin Springs Pump House Water-Quality Sites (1997–2004)

Baldwin Springs near Moapa, Nevada

Baldwin Springs is about 0.2 mi north of Warm Springs Road and about 0.5 mi west of the L.D.S. Recreation Area (fig. 2). Discharge from the springs generally trends to the northeast, and contributes most of the flow of the South Fork Muddy River (fig. B52). In 1974, a pump house was constructed in the spring area by the Moapa Valley Water District (MVWD) to supply additional water to southern areas of the valley. Water not diverted at the springs is discharged directly into the channel about 20 ft north of the pump house (fig. B52).

A 9-inch (in.) Parshall flume, called Baldwin Cuts Flume, was installed at Baldwin Springs on October 11, 1967, by the Nevada Division of Water Resources (NDWR). The exact location of the flume is unknown, but it is believed to have been installed just downstream from the pump house. Data provided by NDWR show that water-level measurements for the 9-in. flume generally were made monthly October 1967 to August 1971, February 1974 to June 1981, and October 1981 to August 1985. During July, August, and September 1981, daily measurements were recorded. Because only water-level measurements were provided by NDWR, discharge rates were computed using a standard equation for the 9-in. Parshall flume (Leupold and Stevens, 1987). Computed discharges for October 1967 to August 1985 are shown in figure B53. A complete listing of the water-level measurements and computed discharges is given in table B40.

About the same time that the Baldwin Cuts flume was installed, a 1-foot (ft) Parshall flume, the Baldwin Springs Flume, was installed by NDWR on the South Fork Muddy River about 0.25 mi downstream from the pump house and about 75 ft north of Kimball Road (fig. B54). Data provided by NDWR show that monthly readings generally were made from October 1967 to August 1971. Similar to Baldwin Cuts flume, no measurements were made from September 1971 to January 1974. On February 22, 1974, a larger 2-ft Parshall flume was installed and monthly measurements were made until July 1984. On July 15, 1993, a new 2-ft Parshall flume was installed and monthly measurements were made through February 2005. Because only water-level measurements were provided by NDWR, discharge rates for this site were computed using standard equations for the 1-ft and 2-ft Parshall flumes (Leupold and Stevens, 1987). Computed discharges from October 1967 to February 2005 are given in figure B53, which also includes the measurements computed for the Baldwin Cuts Flume. A complete listing of the water-level measurements and computed discharges is given in table B41.

In April 1997, Converse Consultants, on contract with Nevada Power Company, began making quarterly field measurements of water temperature and specific conductance at the Baldwin Springs Flume. Measurements were compiled through March 2005 and are plotted in figure B55 and listed in table B42.

On June 2, 2004, the U.S. Geological Survey established bench mark WSBM-12 (table 2) and several reference marks (table 3) at Baldwin Springs Flume to determine water-surface elevations. Photographs of the flume, bench mark, and selected reference marks are included in figure B56.

In December 1997, the Moapa Valley Water District (MVWD) began collecting water samples from a spigot at the Baldwin Springs pump house (fig. B52). Water samples generally were collected annually by MVWD and analyzed by Southwest Analytical, Inc. for major ions, trace metals, and selected chemical and physical parameters (pH, specific conductance, total dissolved solids, and alkalinity). The results of the analyses of samples collected from December 1997 to August 2004 were provided by the MVWD are given in table B43.

On January 12 and May 18, 2004, water samples were collected at the pump house by Desert Research Institute and analyzed for major ions, selected chemical and physical parameters (pH, specific conductance, and dissolved solids), and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B44.

Baldwin Cuts Flume near Moapa, Nevada

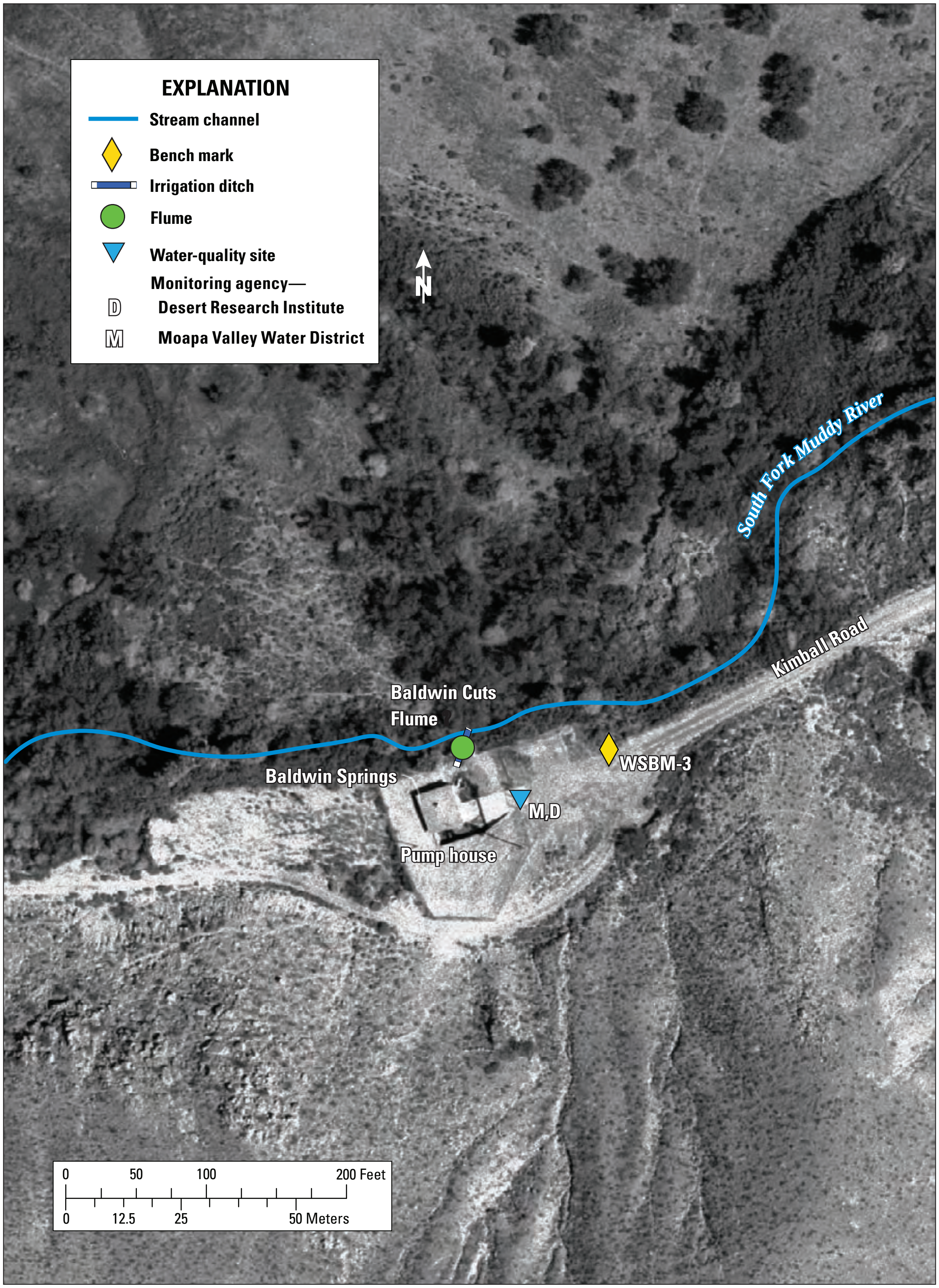

Figure B52. Location of Baldwin Springs, pump house, monitoring sites, and bench mark WSBM-3 in the Warm Springs area near Moapa, Nevada.

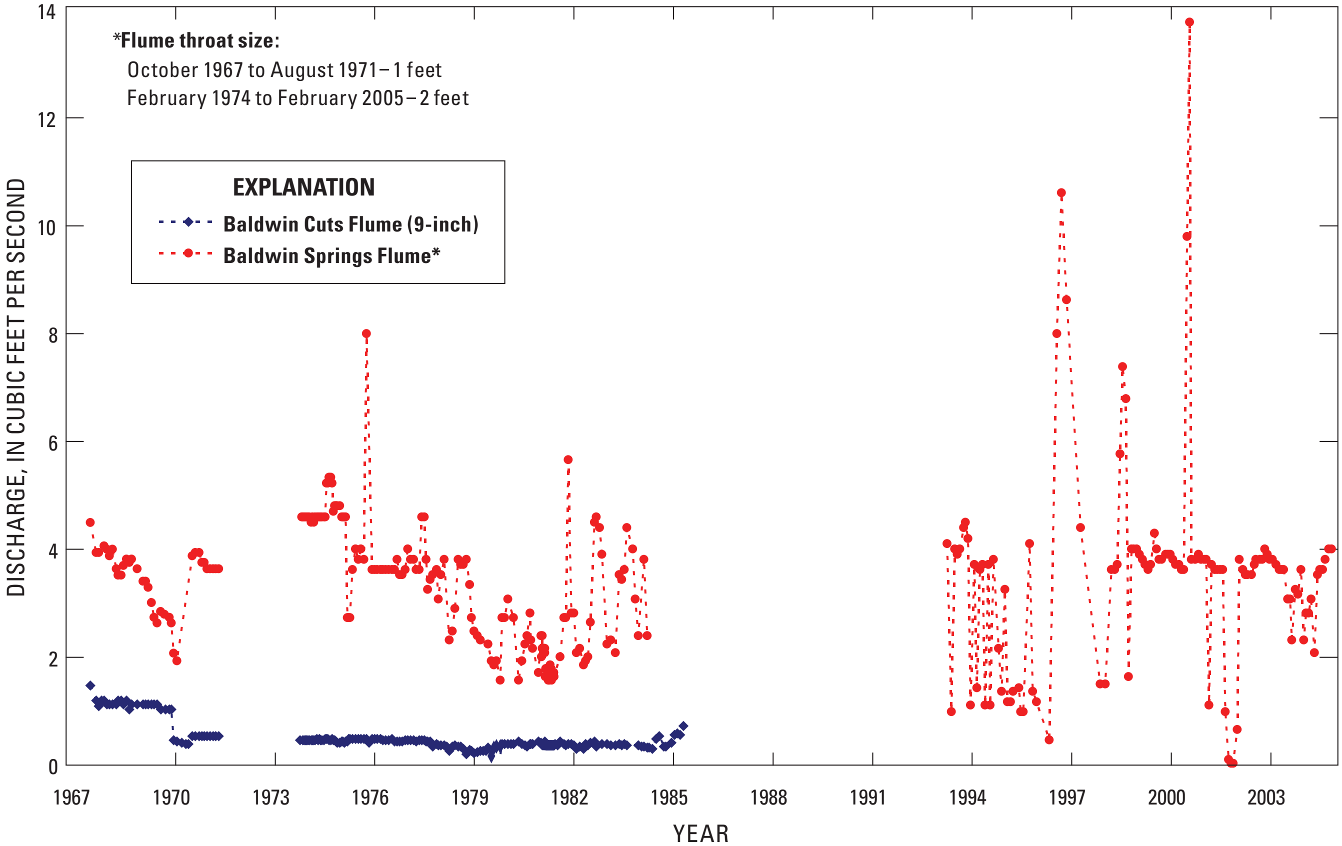

Figure B53. Instantaneous discharges computed from water-level measurements provided by Nevada Division of Water Resources for Baldwin Cuts and Baldwin Springs Flumes near Moapa, Nevada, 1967–2005.

SE ROA 49075

JA_15261

Table B40. Instantaneous discharges computed from water-level measurements for Baldwin Cuts Flume near Moapa, Nevada, 1967–85.

Table B40 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

09415875 Baldwin Springs Flume near Moapa, Nevada

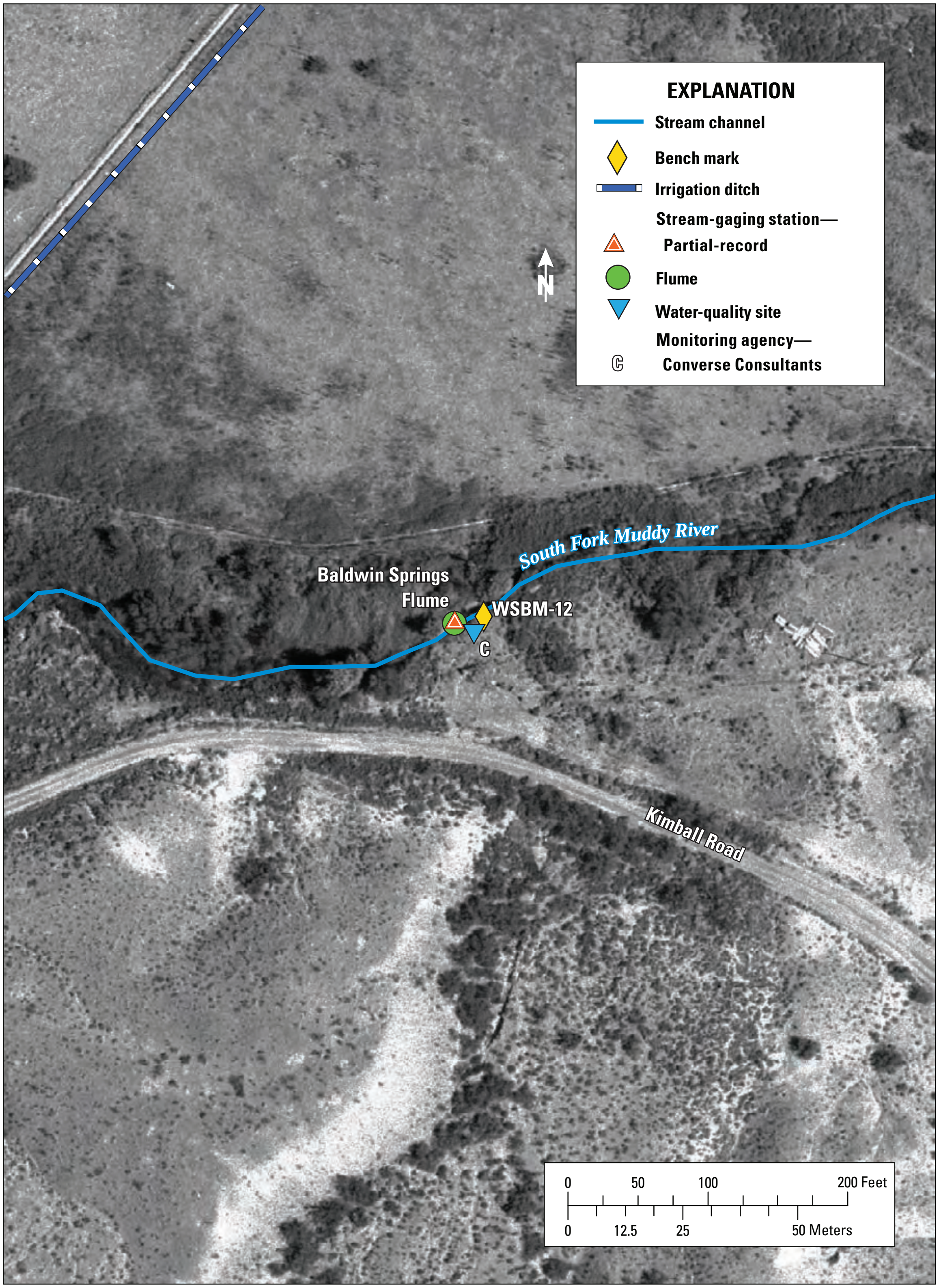

Figure B54. Location of Baldwin Springs Flume and bench mark WSBM-12 in the Warm Springs area near Moapa, Nevada.

SE ROA 49077

Table B41. Water levels and computed instantaneous discharges for partial-record stream-gaging station 09415875 Baldwin Springs Flume near Moapa, Nevada, 1967–2005.

Table B41 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

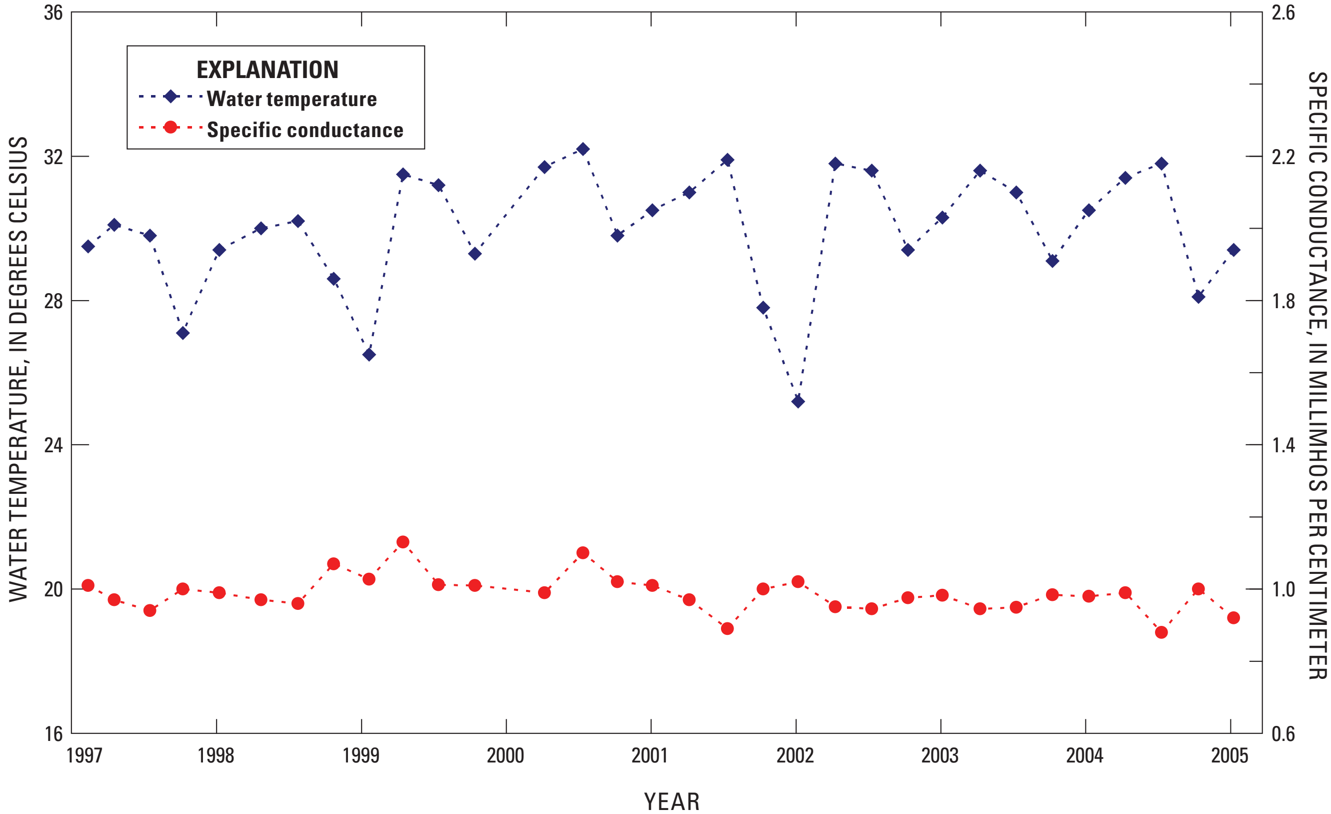

Figure B55. Water-temperature and specific-conductance measurements provided by Converse Consultants for Baldwin Springs Flume near Moapa, Nevada, 1997–2005.

Table B42. Water-temperature and specific-conductance measurements provided by Converse Consultants for Baldwin Springs Flume near Moapa, Nevada, 1997–2005.

Table B42 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

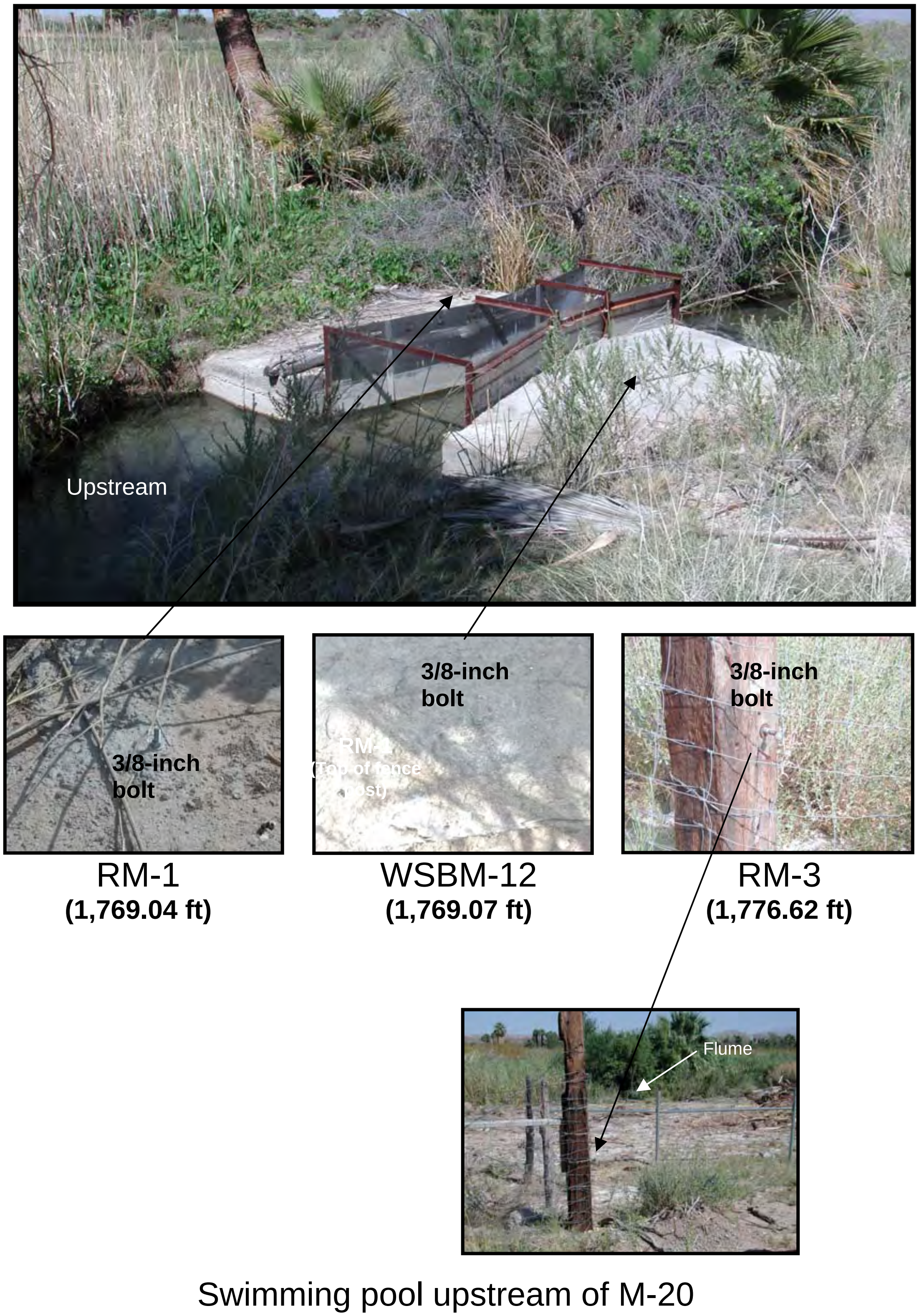

Figure B56. Location of bench mark WSBM-12 and reference marks RM-1 and RM-3 for Baldwin Springs Flume in the Warm Springs area near Moapa, Nevada. Photographed June 2, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Water-Quality Sites at Baldwin Spring Pump House near Moapa, Nevada

Table B43. Water-quality data provided by the Moapa Valley Water District for pump house at Baldwin Springs near Moapa, Nevada, 1997–2004.

Table B43 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B44. Water-quality data provided by the Desert Research Institute for pump house at Baldwin Springs near Moapa, Nevada, January 12 and May 18, 2004.

Table B44 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Cardy Lamb Springs

The following sites are included within this section:

Baldwin House Spring #1 (South) Flume (1967–80)
Baldwin House Spring #2 (North) Flume (1967–80)
364327114430801 Muddy River Springs 10 (1986–2004)
Water-Quality Site (S-15) at Cardy Lamb Pond (1997–2005)

Cardy Lamb Springs near Moapa, Nevada

Cardy Lamb Springs is about 0.1 mi east of Warm Springs Road and about 0.8 mi west-northwest of the L.D.S. Recreation Area (fig. 2). Discharge from this area generally trends to the southeast, but past agricultural and recreational developments in the area have modified or filled any pre-existing natural drainage channels. An intricate network of concrete irrigation ditches installed during the 1950s and 1960s distributed most of the flow from the springs onto agricultural fields to the east (fig. 2). Sometime during 1980, a swimming pond and a bathhouse were constructed in the area in an attempt to develop a recreational facility (fig. B57). The pond was constructed over one of the spring discharge areas and a drainage pipe was installed at the northeast wall to allow the pond to drain into the irrigation drainage network (fig. B57). Although the recreational area never materialized, the pond is still used today by the current owners to irrigate fields to the east for livestock grazing.

On October 11, 1967, two 6-inch Parshall flumes (Baldwin House Spring #1- South and Baldwin House Spring #2-North) were installed by the Nevada Division of Water Resources (NDWR) as part of a program to monitor spring discharges within the Warm Springs area. The exact location of the two flumes is unknown, but they are believed to have been located between the pond and the irrigation ditch to the east (fig. B57). Data provided by NDWR show that water-level measurements for flumes #1 and #2 generally were made monthly from October 1967 to May 1980 and October 1967 to April 1980, respectively, except during September 1971 to January 1974. Since the last measurement at both sites coincides with the installation date of the pond, the flumes are believed to have been removed at that time. Because only water-level measurements were provided by NDWR, discharge rates were computed using a standard equation for the 6-inch Parshall flumes (Leupold and Stevens, 1987). Plots of the computed discharges for both flumes from October 1967 to May 1980 are shown in figure B58. Complete listings of the water-level measurements and computed discharges for Spring #1 and Spring #2 are given in tables B45 and B46, respectively.

The partial-record station at Muddy River Springs 10 (M-10) was established by the U.S. Geological Survey (USGS) on January 28, 1986 and is located about 250 ft east of the swimming pond (fig. B57). The measurement site is inside an old concrete irrigation ditch about 2 ft downstream from a small concrete culvert. Most of the flow at Muddy River Springs 10 originates from flow within the swimming pond that discharges through the drainage pipe. Water exiting the drainage pipe flows into a small pond approximately 10 ft upstream of the concrete culvert and merges with flows from small springs to the southwest. Periodic discharge measurements have been made by the USGS since January 1986. Discharge measurements for the period of record are plotted in figure B59 and listed in table B47. Photographs of the bench mark, reference points, and selected reference marks established for the Muddy River Springs 10 monitoring site on June 3, 2004, are shown in figure B60.

In April 1997, Converse Consultants, on contract with Nevada Power Company, began quarterly field measurements of water temperature and specific conductance at site S15 (fig. B57) at the south end of the swimming pond. Measurements were compiled through March 2005 and are plotted in figure B61 and listed in table B48.

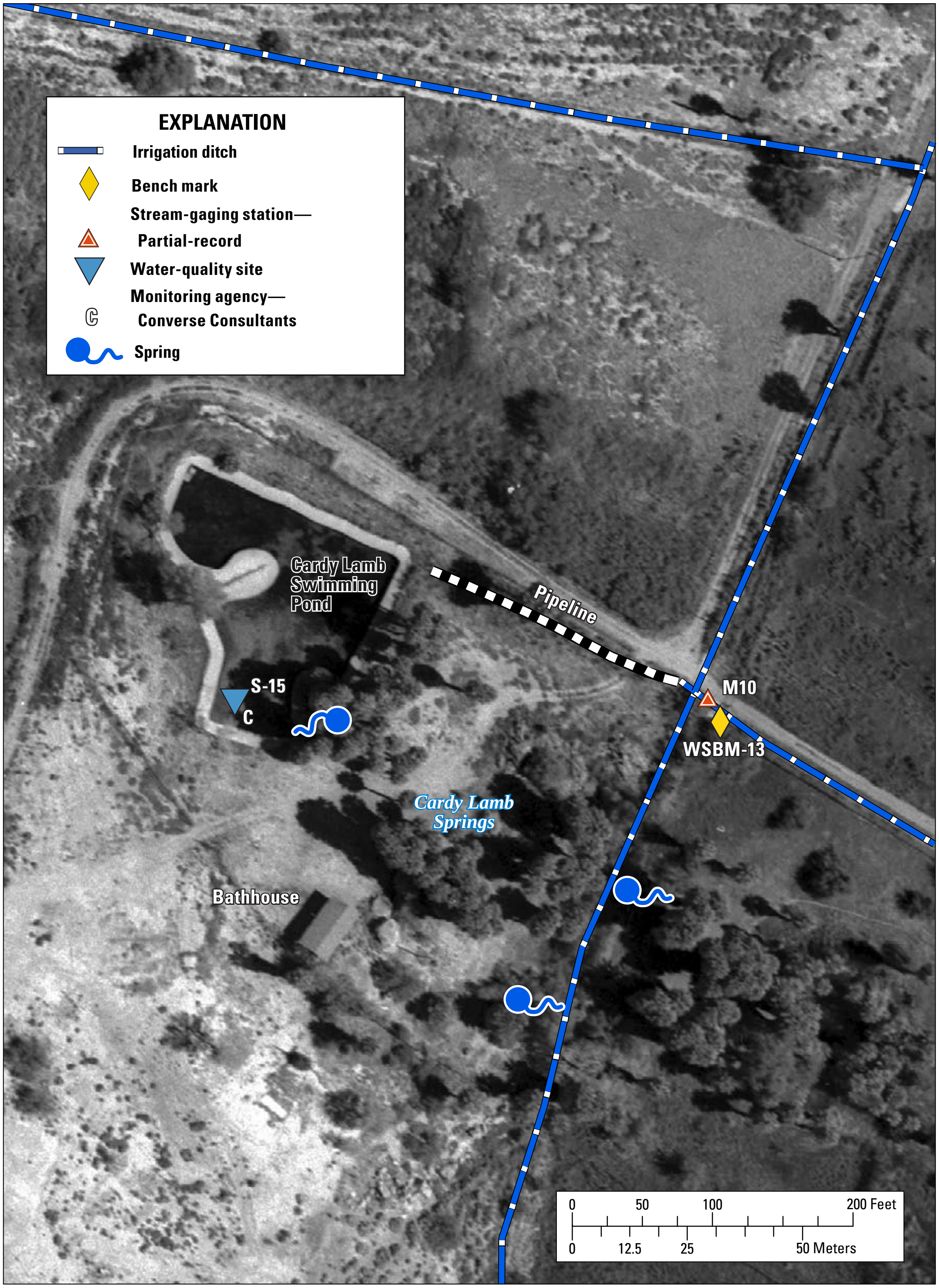

Figure B57. Location of Cardy Lamb Springs swimming pond, bench mark WSBM-13, and monitoring sites in the Warm Springs area near Moapa, Nevada.

SE ROA 49088

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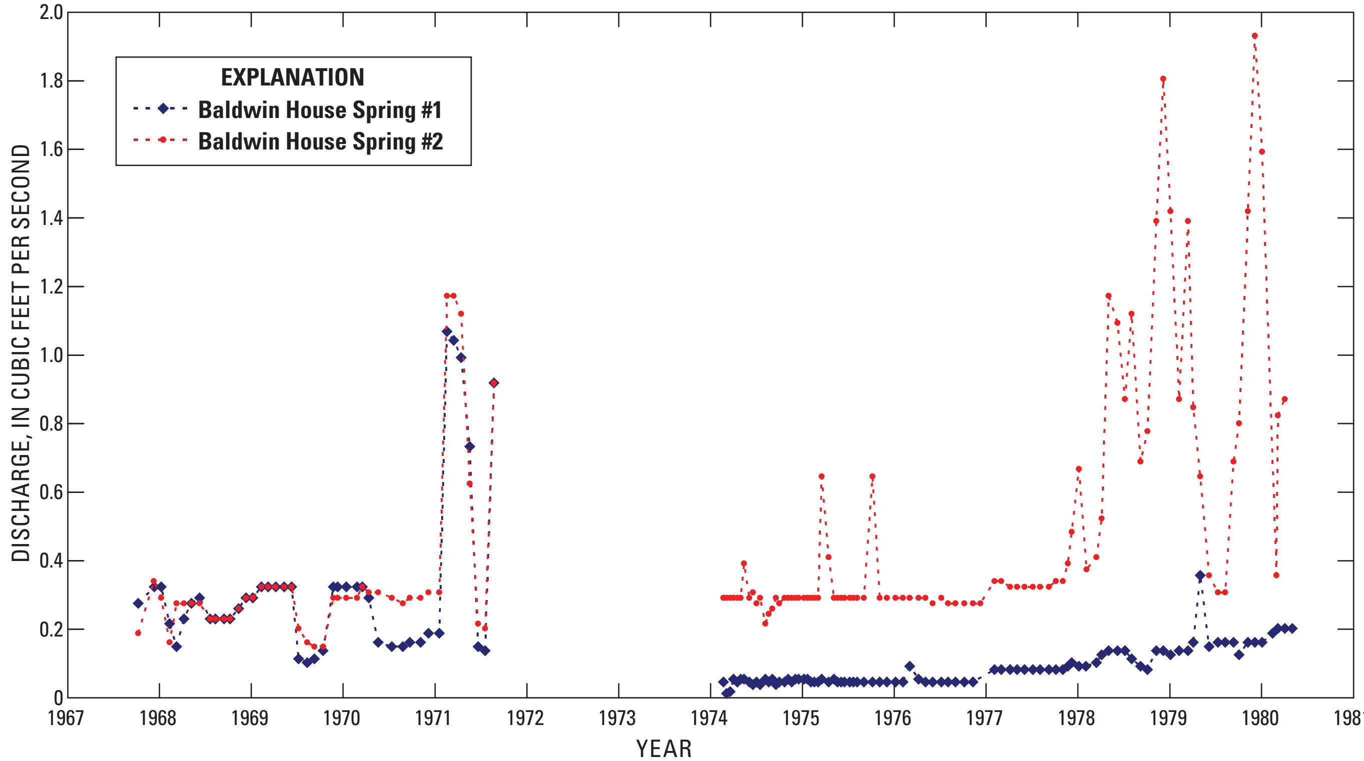

Figure B58. Instantaneous discharges for Baldwin House Springs #1 and #2 flumes at Cardy Lamb Springs near Moapa, Nevada, 1967–80. Data provided by Nevada Division of Water Resources.

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JA_15275

Baldwin House Spring #1 (South) Flume near Moapa, Nevada

Table B45. Water levels and computed instantaneous discharges for Baldwin House Spring #1 (South) Flume at Cardy Lamb Springs near Moapa, Nevada, 1967–80.

Table B45 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Baldwin House Spring #2 (North) Flume near Moapa, Nevada

Table B46. Water levels and computed instantaneous discharges for Baldwin House Spring #2 (Nouth) Flume at Cardy Lamb Springs near Moapa, Nevada, 1967–80.

Table B46 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

364327114430801 Muddy River Springs 10 (M-10) near Moapa, Nevada

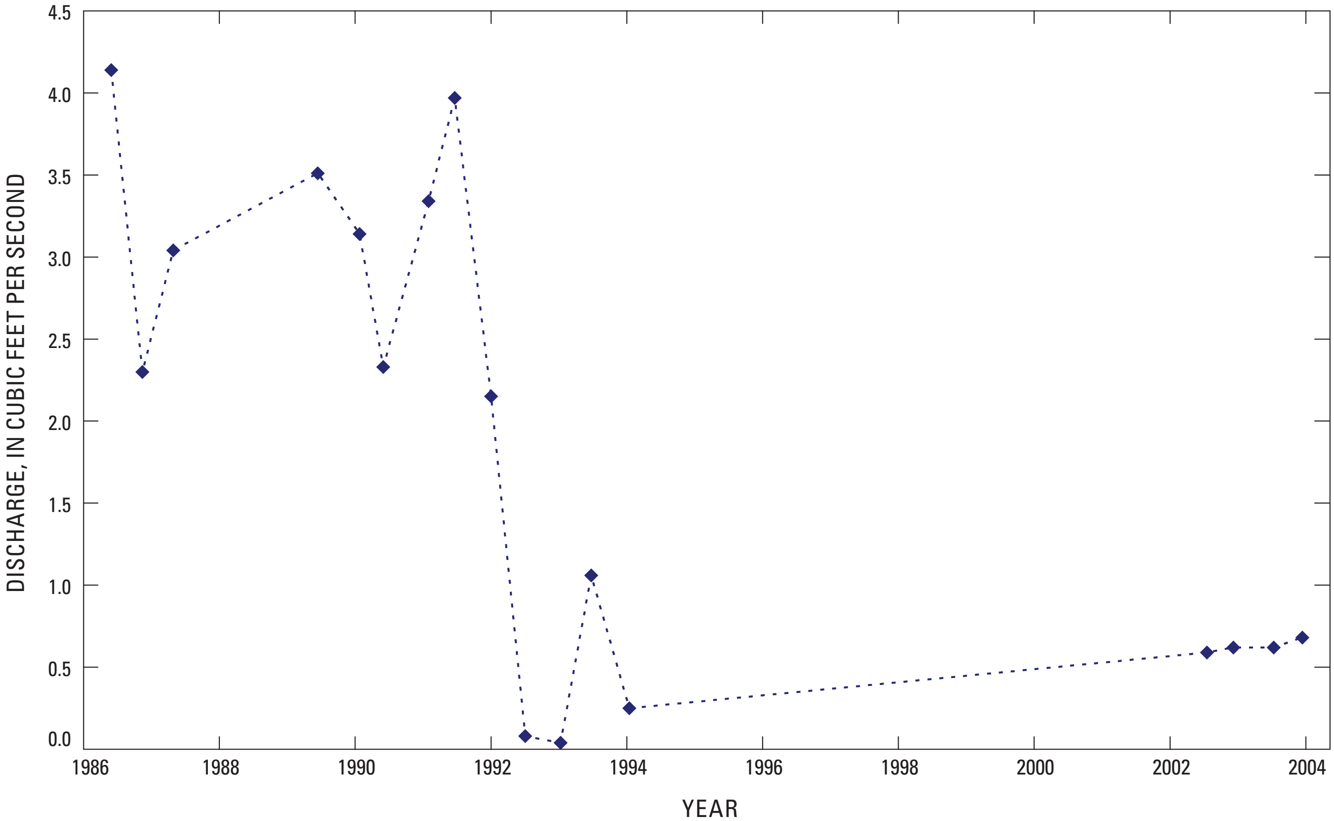

Figure B59. Periodic discharge measurements for partial-record stream-gaging station 364327114430801 Muddy River Springs 10 (M-10) at Cardy Lamb Springs near Moapa, Nevada, 1986–2004.

Table B47. Periodic discharge measurements for partial-record stream-gaging station 364327114430801 Muddy River Springs 10 (M-10) at Cardy Lamb Springs near Moapa, Nevada, 1986–2004.

Table B47 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

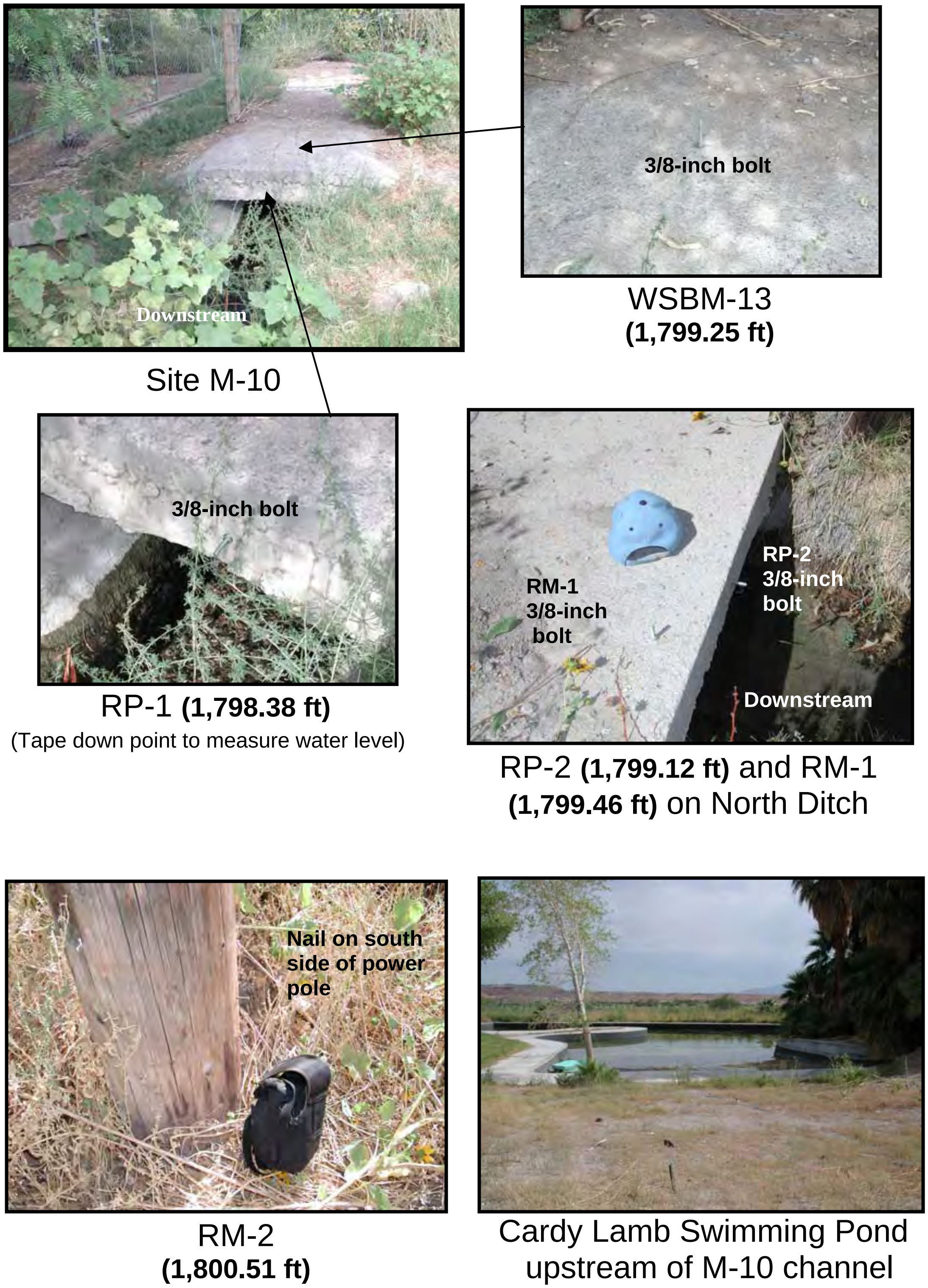

Figure B60. Location of bench mark WSBM-13, reference points RP-1 and RP-2, and reference marks RM-1 and RM-2 for partial-record station Muddy River Springs 10 (M-10) in the Warm Springs area near Moapa, Nevada. Photographed June 3, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Water-Quality Site at Cardy Lamb Pond near Moapa, Nevada

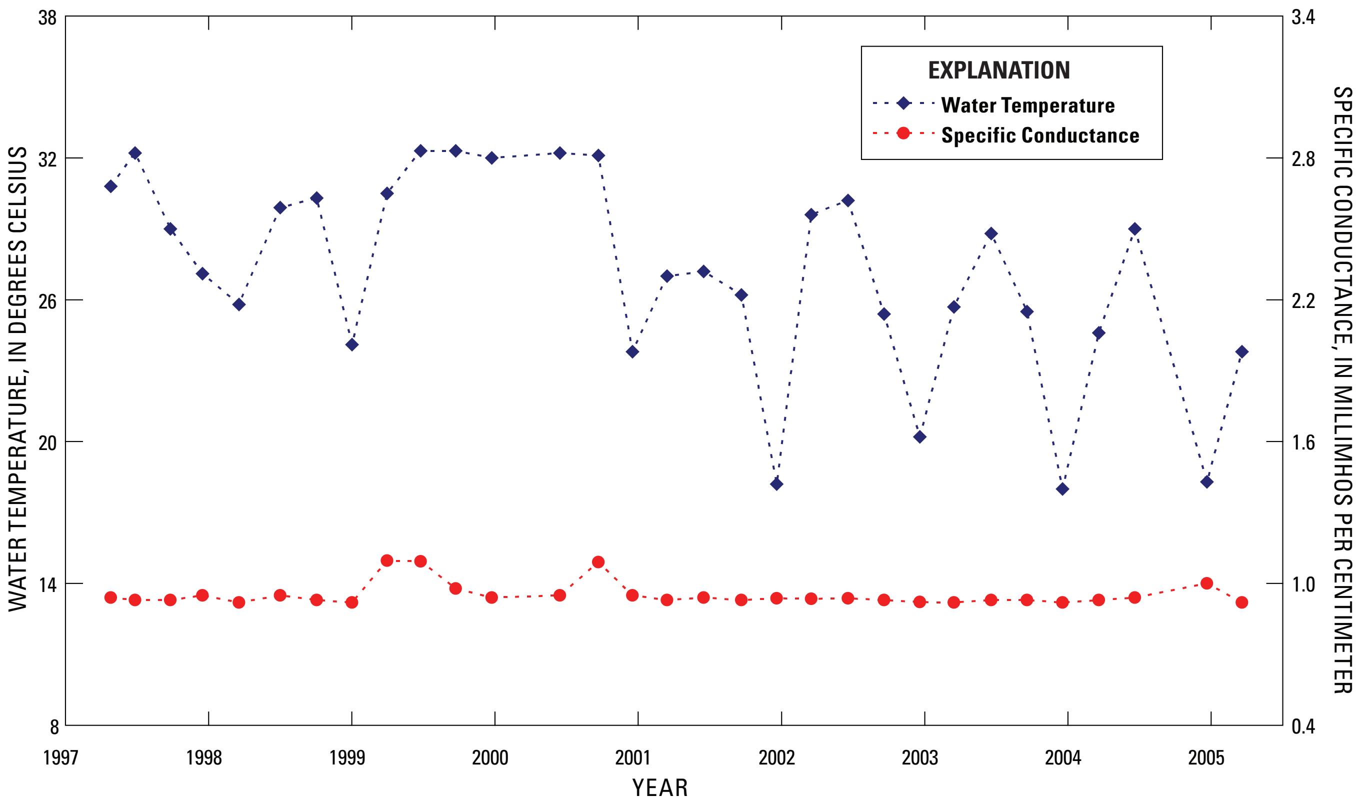

Figure B61. Water-temperature and specific-conductance measurements for site S15 at Cardy Lamb Springs near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

SE ROA 49097

JA_15283

Table B48. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S15 at Cardy Lamb Springs near Moapa, Nevada, 1997–2005.

Table B48 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Miscellaneous Sites

The following sites are included within this section:

09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada (1967–2005)
09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada (1967–2005)
Unnamed Springs at L.D.S. East well near Moapa, Nevada (2004)
Miscellaneous Water-Quality Sites (1997–2005)

09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada

A 9-inch (in.) Parshall flume was installed on Apcar Stream on August 22, 1967, by the Nevada Division of Water Resources (NDWR). This flume is believed to have been located at or near the current flume site, which is about 670 ft north of Warm Springs Road (fig. B62) and about 0.6 mi downstream of Apcar Springs (fig. 2). Although flow at the flume originates from Apcar Springs, additional water enters the stream channel from other springs and seeps downstream of the Warm Springs Road crossing. Below the flume, flow generally drains to the east and is tributary to Refuge Stream about 0.4 mi downstream.

Data provided by NDWR show that water-level measurements for the 9-in flume were made monthly from August 1967 until May 1969. Monthly measurements resumed on February 22, 1974, when a new, 2-ft Parshall flume was installed. Measurements ended on February 7, 1985, and didn't resume until July 1993 when a new 3-ft Parshall flume was installed. Because only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 9-in., 2-ft, and 3-ft Parshall flumes (Leupold and Stevens, 1987). A plot of the computed discharges from October 1967 to February 2005 is shown in figure B63. A complete listing of the water-level measurements and computed discharges is given in table B49.

Two discharge measurements were made at this site on February 7, 2001, as part of a multi-agency synoptic seepage run in the Warm Springs area. The discharges for the two measurements were averaged and the resulting value was plotted on figure B63. Discharge values and related information for the two measurements made during the seepage run are included in Appendix E.

On July 20, 2004, the U.S. Geological Survey installed a staff plate on the flume and established one bench mark and two reference marks at the site as part of this study. Photographs of the flume, bench mark, and reference marks are shown in figure B64. During the installation of the staff plate, backwater conditions were observed at the flume caused by a large palm tree that had fallen across the channel about 40 ft downstream. Until the blockage is removed, computed discharges from water-level measurements will show erroneous higher rates of flow.

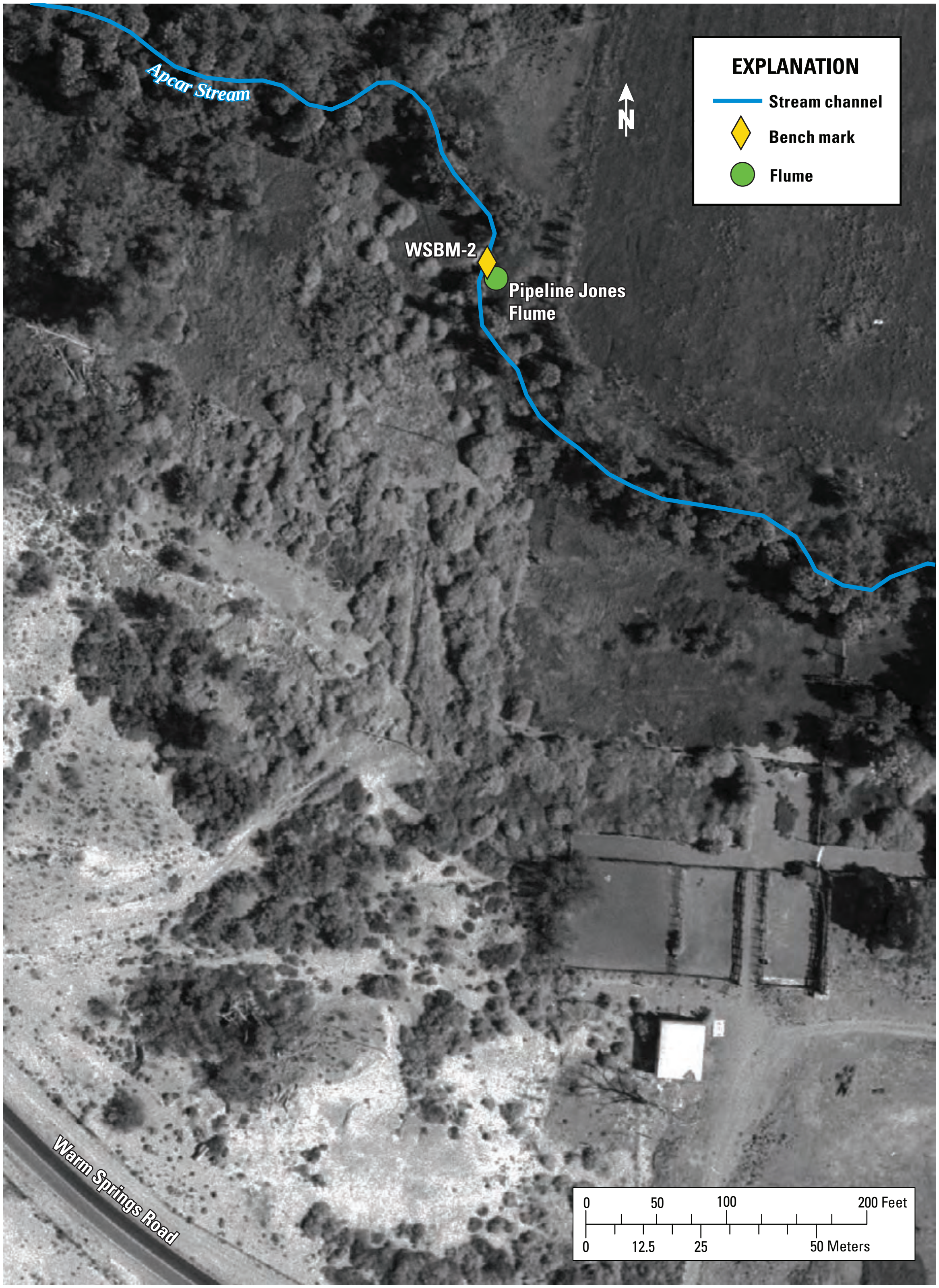

Figure B62. Location of Pipeline Jones Flume and bench Mark WSBM-2 in the Warm Springs area near Moapa, Nevada.

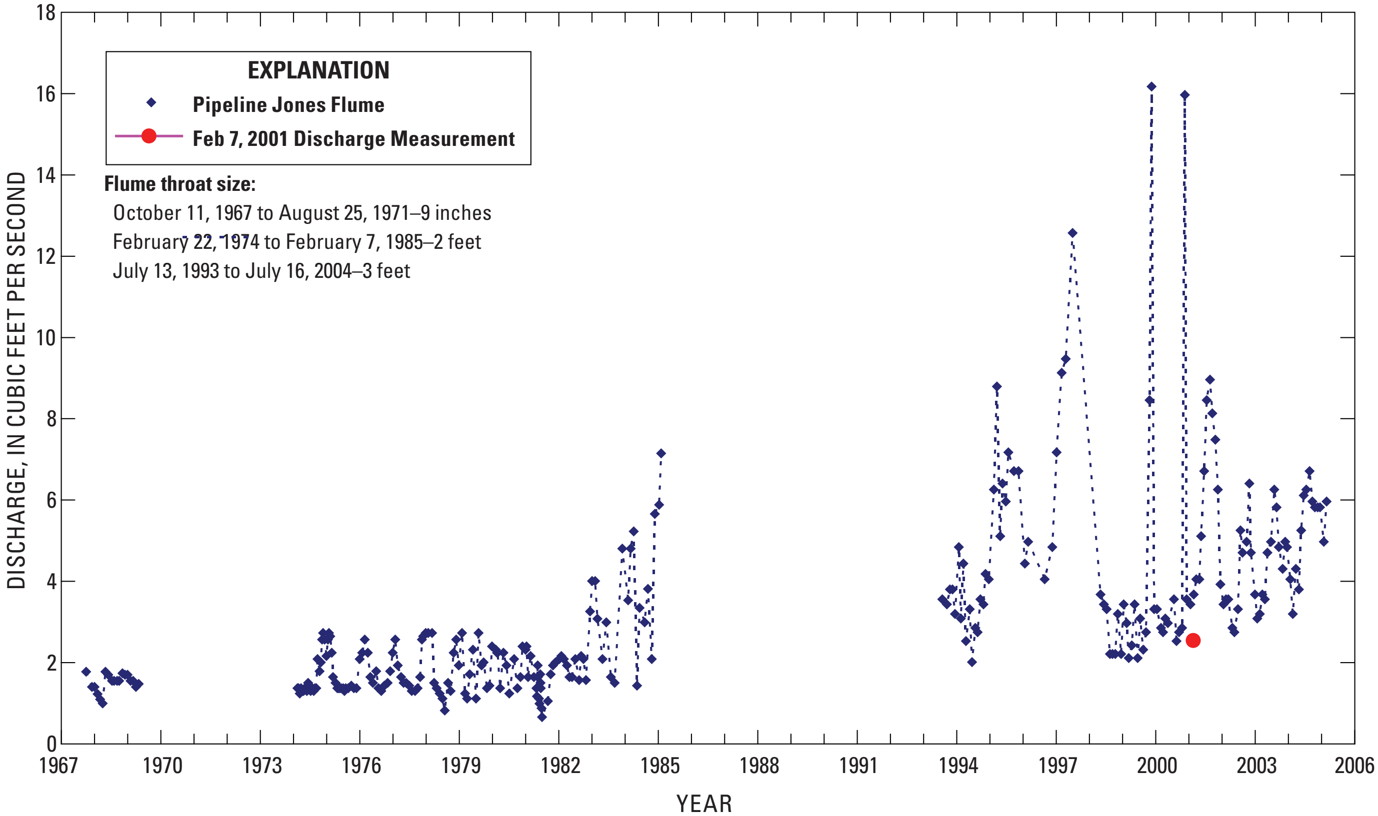

Figure B63. Instantaneous discharges compiled for 1967–2005, and discharge measurement made on February 7, 2001, for partial-record stream-gaging station 09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada.

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Table B49. Water levels and computed instantaneous discharges for partial-record stream-gaging station 09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada, 1967–2005.

[Data from Nevada Division of Water Resources.]

Table B49 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

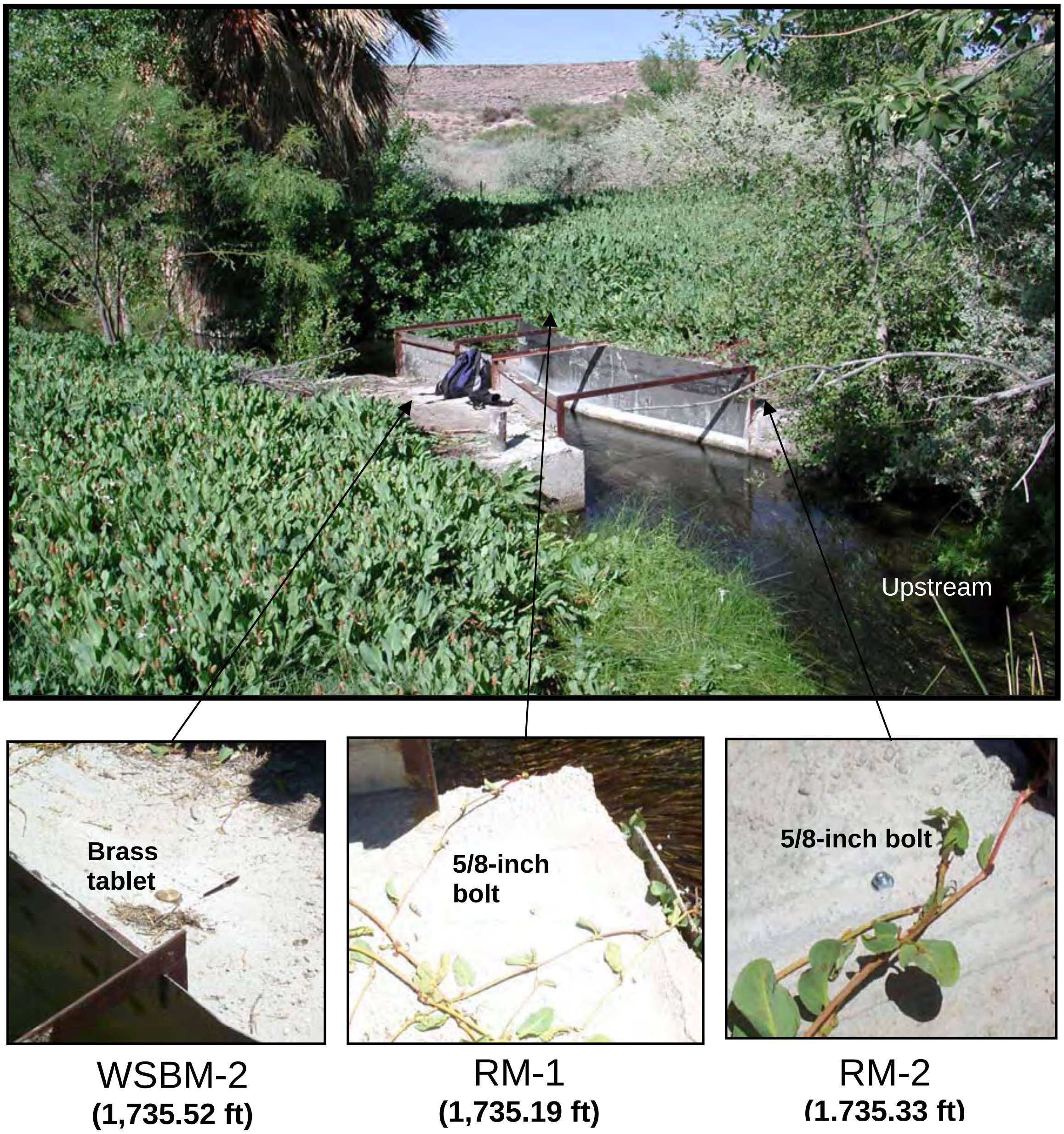

Figure B64. Location of bench mark WSBM-2 and reference marks RM-1 and RM-2 at partial-record stream–gaging station 09415940 Apcar Stream at Pipeline Jones Fume near Moapa, Nevada. Photographed July 20, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada

A 1-foot (ft) Parshall flume was installed on Refuge Stream on October 11, 1967, by the Nevada Division of Water Resources (NDWR). The flume was located approximately 0.8 mi southeast of the L.D.S. Recreational Area and about 250 ft north of Warm Springs Road (fig. B65). Flow at this flume is the combined discharges from the Plummer and Pederson Spring groups. Below the flume, flow generally drains to the northeast and is tributary to the Muddy River about 0.3 mi downstream. Flow from Apcar Stream enters Refuge Stream from the west about 800 ft downstream from the flume.

Data provided by NDWR show that water-level measurements for the 1-ft Parshall flume generally were made monthly from October 1967 until August 1971. Monthly measurements resumed on February 24, 1974, when a new, 3-ft Parshall flume was installed. Measurements ended on November 19, 1987, and didn't resume until July 1993 when a new 3-ft Parshall flume was installed. The site is still visited monthly by NDWR. Because only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 1-ft and 3-ft Parshall flumes (Leupold and Stevens, 1987). A plot of the computed discharges from October 1967 to February 2005 is shown in figure B66. A complete listing of the water-level measurements and computed discharges are given in table B50.

A continuous-stage recorder was installed at the flume by the U.S. Geological Survey on October 1, 2001, and maintained through September 30, 2004. From the time that the gage was installed, submerged flow conditions have been in effect owing to the growth of a large palm tree and other plants in the channel downstream from the flume. Discharge measurements are routinely made at the site and used to define the stage-discharge relation for the flume. Daily mean discharges computed for the period of record have been included for comparison on the plot in figure B66 and listed in table B51. Photographs of the current flume, bench mark, and a selected reference mark established for this gage on June 3, 2004, are shown in figure B67.

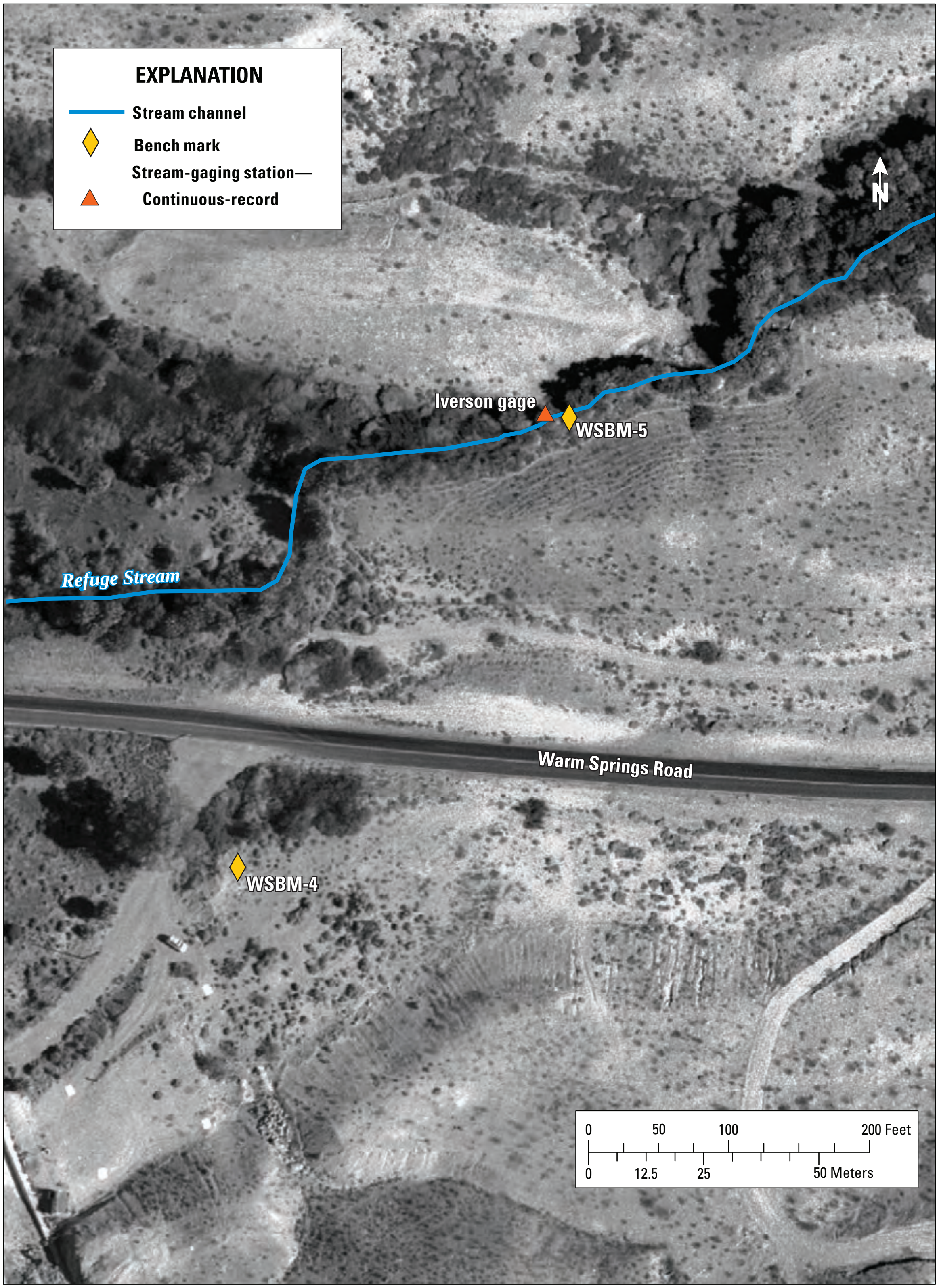

Figure B65. Location of continuous-record stream-gaging station 09415927 and bench marks, WSBM-4 and WSBM-5, Warm Springs Confluence at Iverson Flume near Moapa, Nevada.

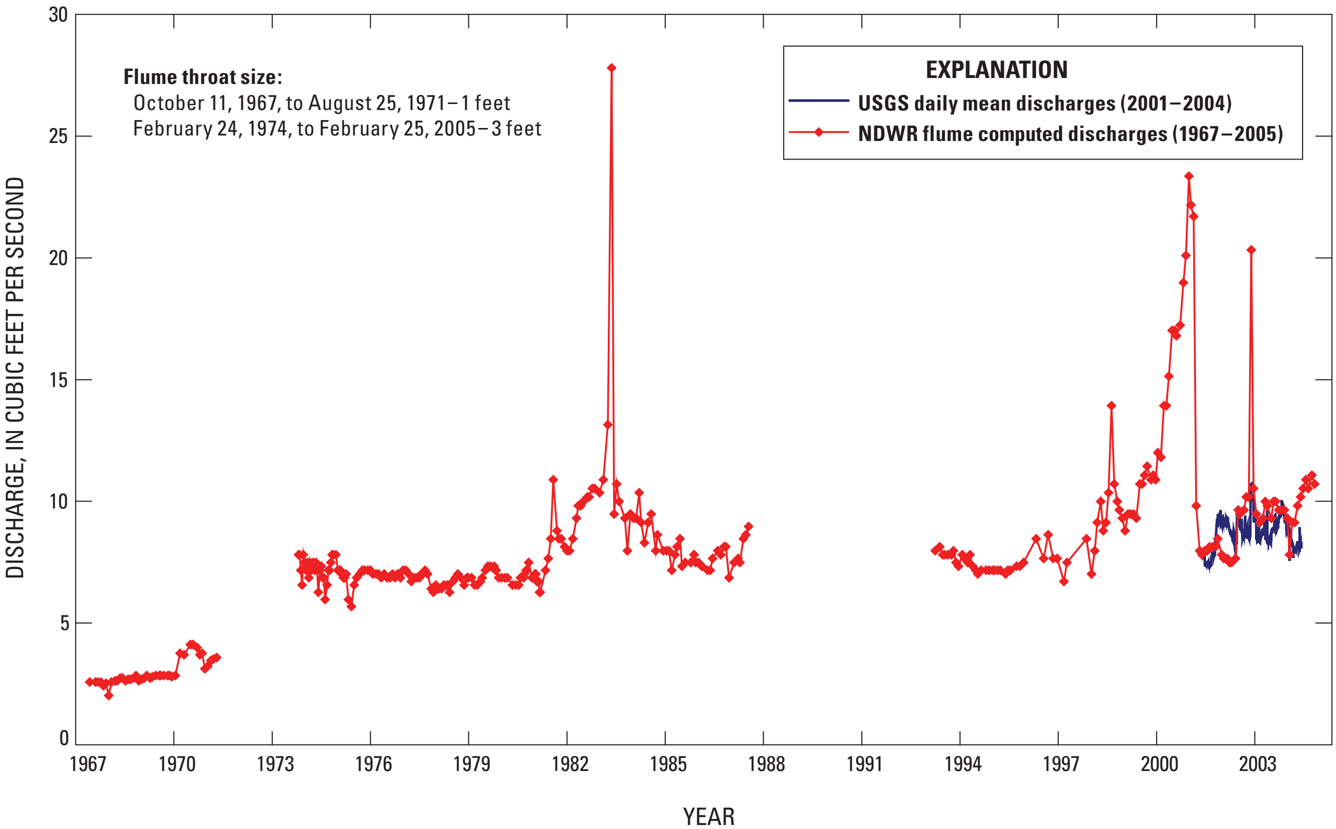

Figure B66. Instantaneous and daily mean discharges for continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada, 1967–2005. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov. Water level measurements used to compute discharges were provided by Nevada Division of Water Resources (NDWR).

Table B50. Water levels and computed instantaneous discharges for continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada, 1967–2005.

[Water-level measurements provided by Nevada Division of Water Resources.]

Table B50 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B51. Daily mean discharges for continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada, water years 2002–04.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B51 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B67. Location of bench mark WSBM-5 and reference mark RM-3 at continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada. Photographed June 3, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Unnamed Springs at L.D.S. East Well near Moapa, Nevada

An unnamed group of springs is located just to the south and east of L.D.S. Well East adjacent to State Highway 168 in the north-central part of the Warm Springs area (figs. 2 and B68). Discharge from the springs may have been perennial in the past; however, discharge is currently intermittent, occurring mainly during the winter when pumpage from the well and evapotranspiration rates are at their lowest. Flow from the area generally is to the southeast, but a network of irrigation ditches distributes flow to the east and south. During field reconnaissance of the Warm Springs area in February 2004, discharge from the springs was observed flowing into the Muddy River at two locations. The first site was about 100 ft upstream of the confluence with Refuge Stream. The second site was about 0.3 mi downstream from the confluence with Refuge Stream.

On August 17, 2004, surface-water elevations at all U.S. Geological Survey monitoring sites within the Warm Springs area were measured. At this time, the unnamed springs were not discharging; therefore, the elevation of a small spring pool about 100 ft to the east of L.D.S. Well East was measured using optical theodolite surveying techniques (Kennedy, 1988). Elevation for the water-surface measurement was determined using a bench mark (WSBM-10) established at the well by the Las Vegas Valley Water District (table 2). The surface-water elevation of the pond on August 17, 2004, is given in table 4. Photographs showing the location of the bench mark and measurement site are included in figure B69.

In April 1997, Converse Consultants, on contract with Nevada Power Company, initiated quarterly field measurements of water temperature and specific conductance at the unnamed spring area (fig. B68). Measurements were compiled through March 2005 and are plotted in figure B70 and listed in table B52.

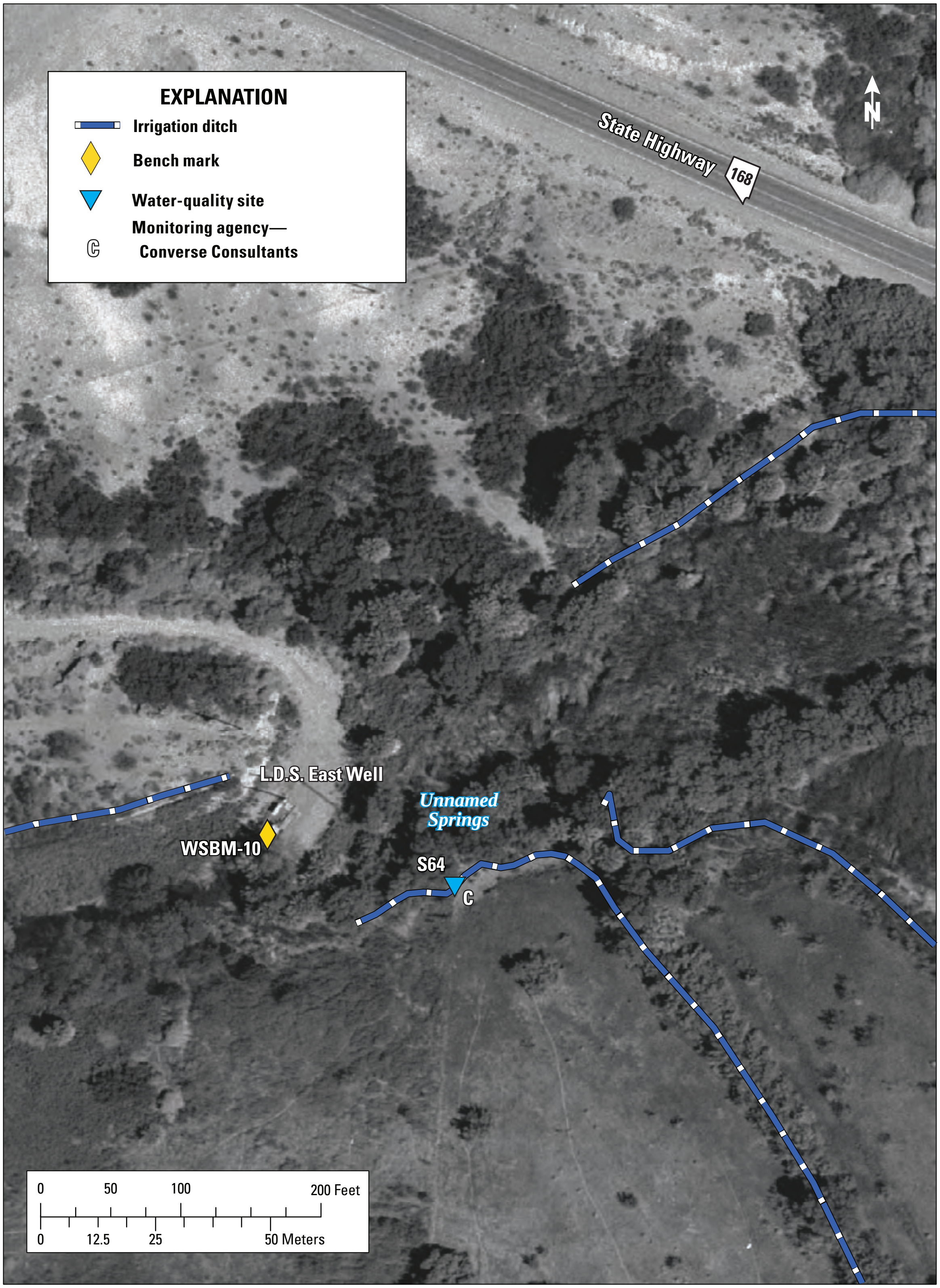

Figure B68. Location of unnamed springs near L.D.S. East well and bench mark WSBM-10 in the Warm Springs area near Moapa, Nevada.

Figure B69. Location of bench mark WSBM-10 at L.D.S. East well and spring-fed pool surveyed on August 17, 2004, at unnamed springs near Moapa, Nevada. Elevation of bench mark in feet above NAVD 88.

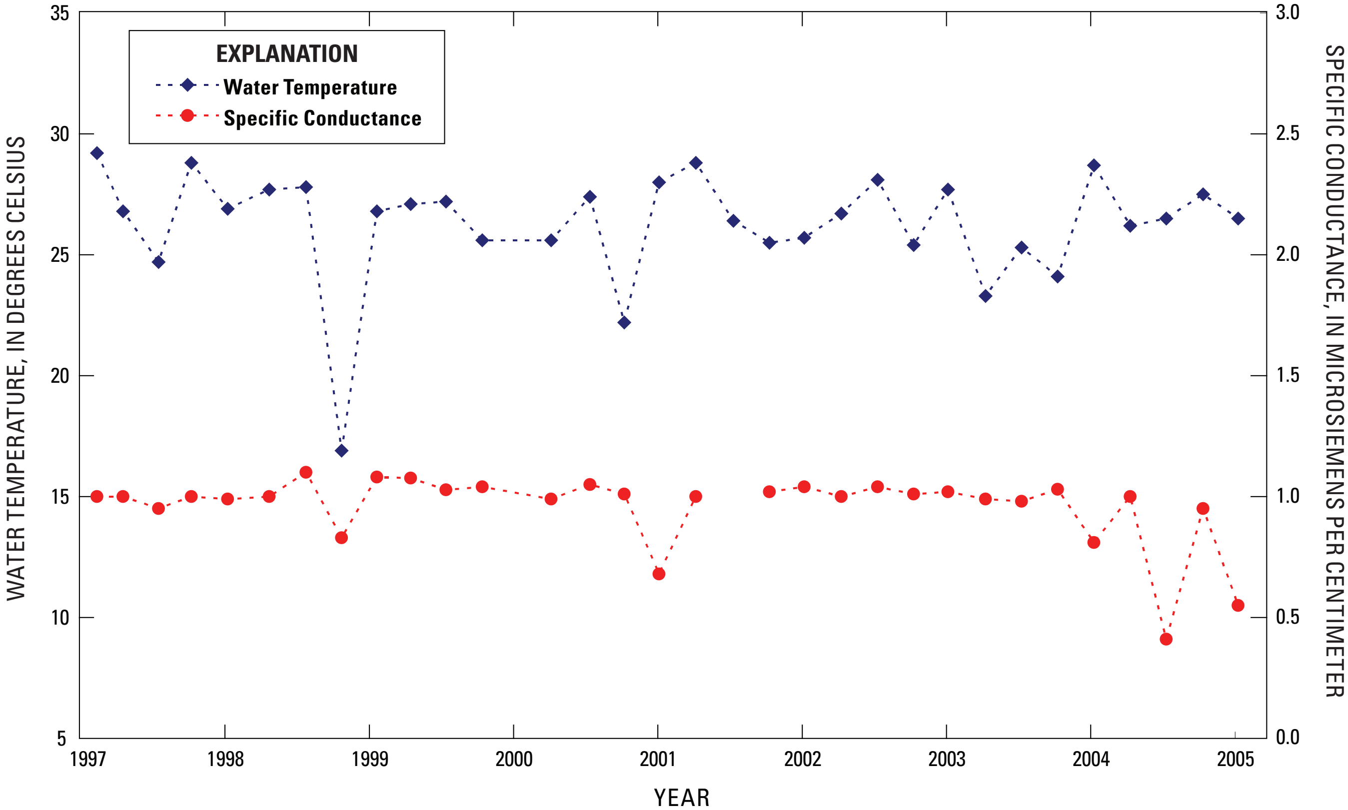

Figure B70. Water-temperature and specific-conductance measurements for spring pond at unnamed springs at L.D.S. East well near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

Table B52. Water-temperature and specific-conductance measurements by Converse Consultants for spring pond at unnamed springs at L.D.S. East well near Moapa, Nevada, 1997–2005.

Table B52 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Miscellaneous Water-Quality Sites in the Warm Springs area near Moapa, Nevada

In April 1997, Converse Consultants, on contract with Nevada Power Company, began quarterly field measurements of water temperature and specific conductance at selected springs within the Warm Springs area. Most of the measurement sites are located at springs that are included as part of the major spring groups, such as Plummer, Pederson, Apcar, Muddy, and Cardy Lamb, and are discussed elsewhere in this report. Other measurement sites that are not part of the major spring groups include S6, S7a, and S65. The locations of these sites are shown in figure B71.

Water temperature and specific conductance data for the period of record for sites S6, S7a, and S65 are plotted in figures B72, B73, and B74 and listed in tables B53, B54, and B55, respectively.

Figure B71. Location of Converse Consultants water-quality sites S6, S7a, and S65 in the Warm Springs area near Moapa, Nevada.

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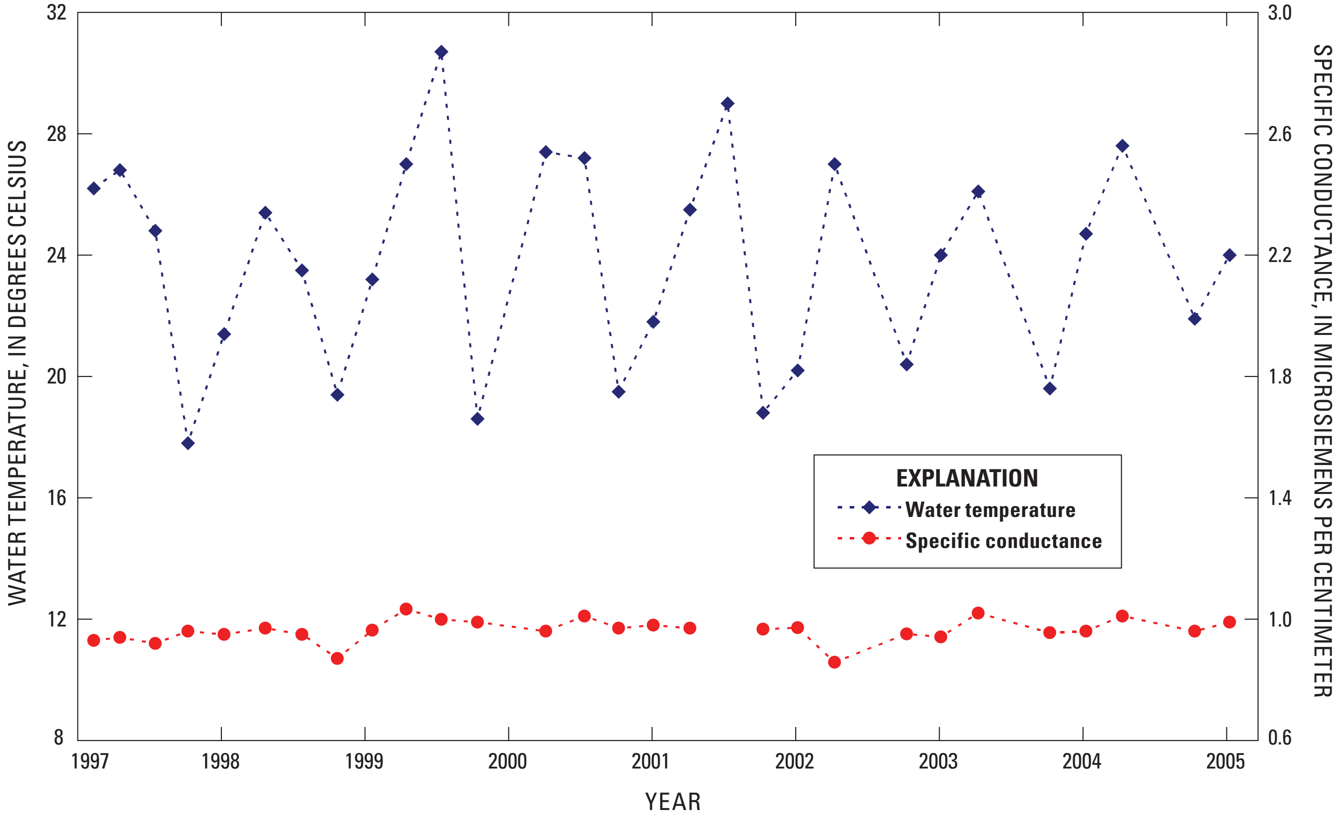

Figure B72. Water-temperature and specific-conductance measurements for site S6 in the Warm Springs area near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

SE ROA 49119

JA_15305

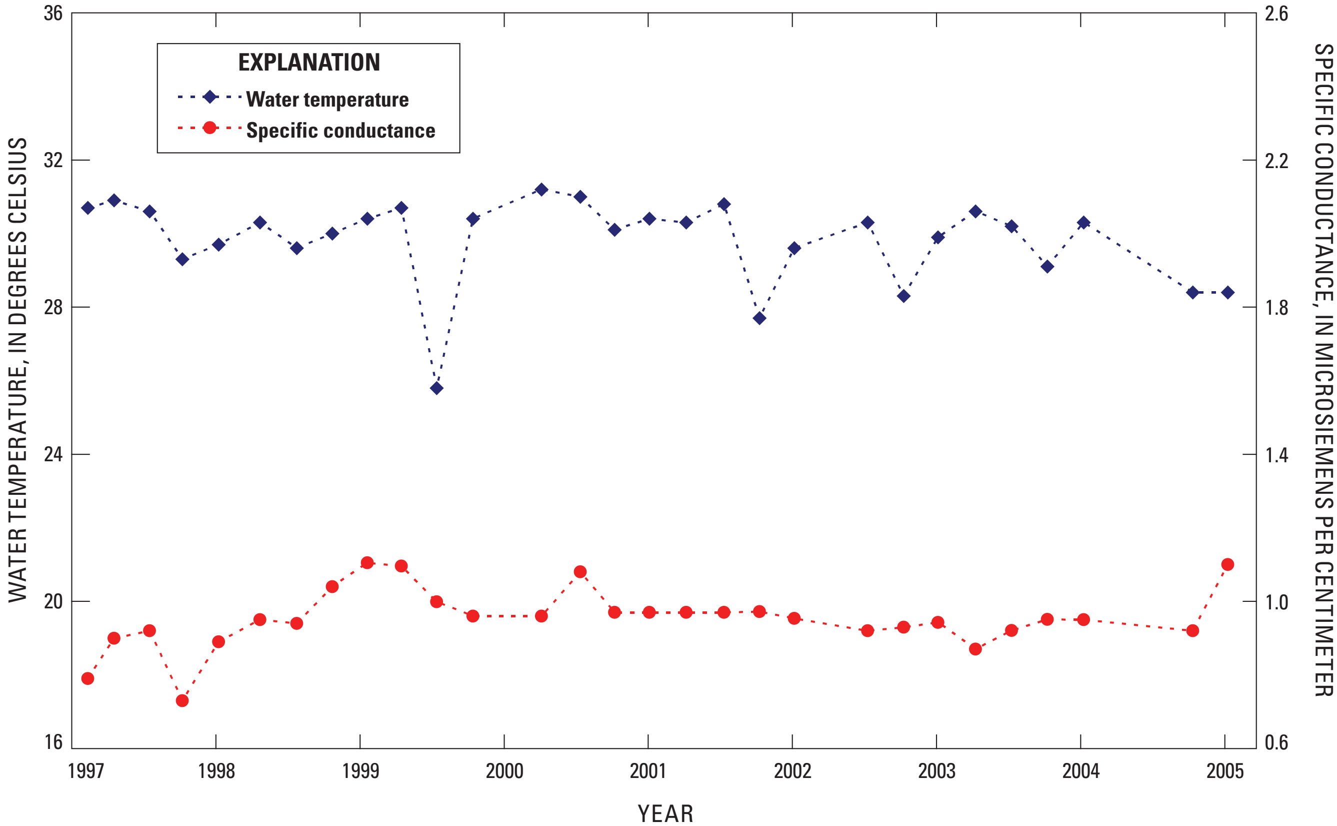

Figure B73. Water-temperature and specific-conductance measurements for site S7a in the Warm Springs area near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

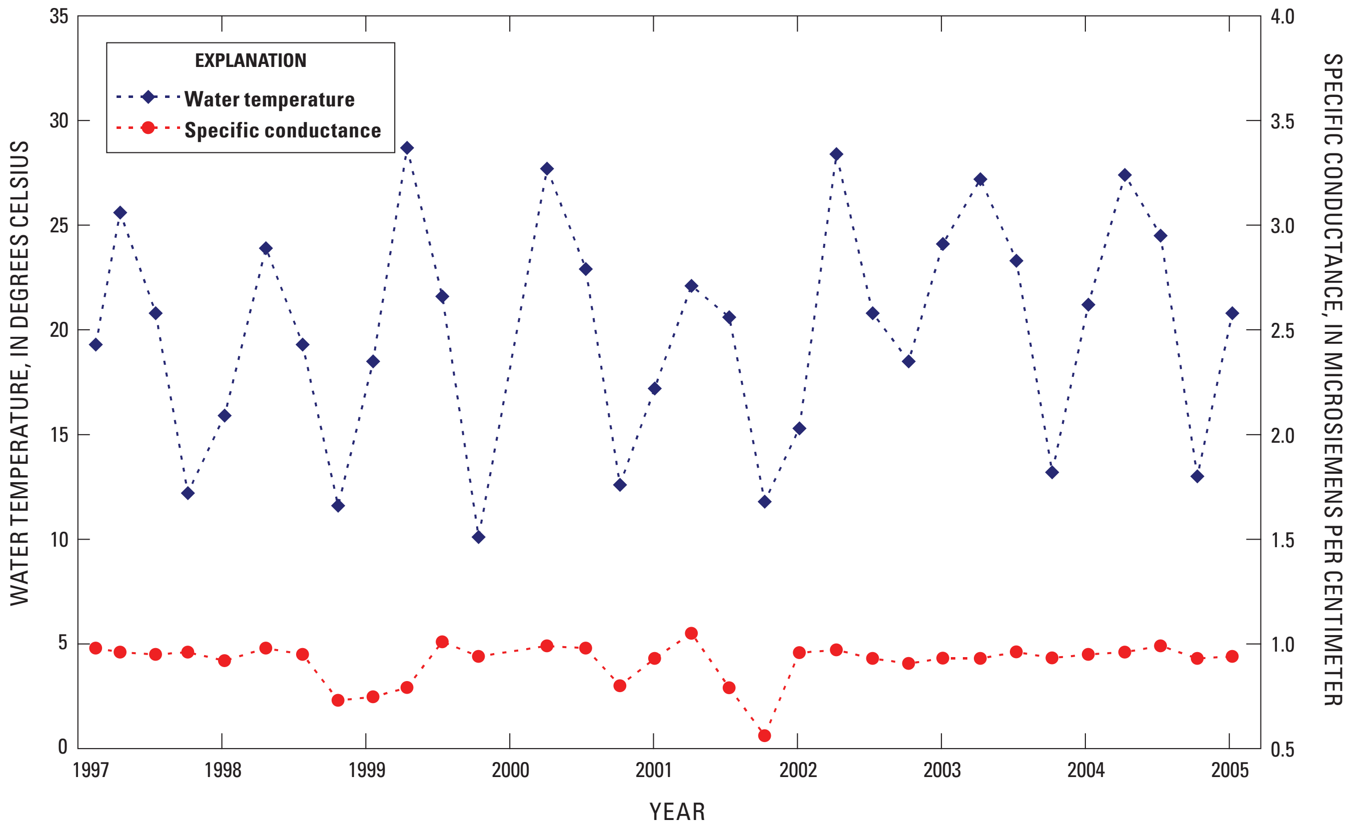

Figure B74. Water-temperature and specific-conductance measurements for site S65 in the Warm Springs area near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

Table B53. Water-temperature and specific-conductance measurements by Converse Consultants at site S6 in the Warm Springs area near Moapa, Nevada, 1997–2005.

Table B53 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B54. Water-temperature and specific-conductance measurements by Converse Consultants at site S7a in the Warm Springs area near Moapa, Nevada, 1997–2005.

Table B54 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B55. Water-temperature and specific-conductance measurements by Converse Consultants at site S65 in the Warm Springs area near Moapa, Nevada, 1997–2005.

Table B55 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Appendix C. National Geodetic Survey OPUS Solution Reports for Bench Marks Established in the Warm Springs Area near Moapa, Nevada

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WSBM-1 Jones Spring Box

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 FILE: PJONES0370.04o 000181204    WSBM-1 JONES SPRING BOX

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: ray.overgaard@lvvwd.com                DATE: June 18, 2004
RINEX FILE: pjon037r.04o                           TIME: 17:03:39 UTC


  SOFTWARE: page5 0310.28 master.pl               START: 2004/02/06 17:26:00
 EPHEMERIS: igs12565.eph [precise]                 STOP: 2004/02/06 20:54:00
  NAV FILE: brdc0370.04n OBS                       USED: 6407 / 6719 :
95%
  ANT NAME: TRM39105.00                      # FIXED AMB: 34 / 34 :
100%
ARP HEIGHT: 2.0                              OVERALL RMS: 0.012(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)          ITRF00 (EPOCH:2004.1006)

         X: -2140784.624(m)       0.013(m)        -2140785.306(m)   0.013(m)
         Y: -4650263.659(m)       0.018(m)        -4650262.351(m)   0.018(m)
         Z:  3792408.497(m)       0.013(m)         3792408.467(m)   0.013(m)

       LAT: 36 42 54.57120        0.022(m)      36 42 54.58793      0.022(m)
     E LON: 245 16 50.36615       0.006(m)     245 16 50.31915      0.006(m)
     W LON: 114 43 9.63385        0.006(m)      114 43 9.68085      0.006(m)
    EL HGT:      514.513(m)       0.009(m)             513.772(m)   0.009(m)
 ORTHO HGT:      541.260(m)       0.026(m)   [Geoid03 NAVD88]

PLANE COORDINATES    North(Y)        East(X)    Convergence (deg) Point Scale
  UTM(Zone 11): 4065699.133(m)  703693.822(m)      1.36393077      1.00011119
SPC(2701 NV E): 8218368.507(m)  277184.288(m)      0.51655125      0.99997337

US NATIONAL GRID DESIGNATOR: 11SQA0369465699(NAD 83)


                              BASE STATIONS USED
PID       DESIGNATION                     LATITUDE   LONGITUDE    DISTANCE(m)
AI8811 RAIL RAILROAD VALLEY CORS ARP   N381649.535  W1153953.379   192820.1
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP  N360934.026  W1151128.797    74796.5
AI8817 ECHO ECHO CANYON S.P. CORS ARP  N375455.904  W1141551.242   139221.2

                      NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                      N364330.247  W1144238.752     1342.7


This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
```

SE ROA 49128

WSBM-1 Jones Spring Box

```
 FILE: 63371260.04o 000186248       WSBM-1 JONES SPRING BOX

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: wstout@stantec.com                     DATE: July 06, 2004
RINEX FILE: 6337126s.04o                           TIME: 13:24:32 UTC


  SOFTWARE: page5  0310.28 master13.pl            START: 2004/05/05  18:39:00
 EPHEMERIS: igs12693.eph [precise]                 STOP: 2004/05/05  21:49:00
  NAV FILE: brdc1260.04n                       OBS USED:  7338 /  7789   :  94%
  ANT NAME: TRM22020.00+GP                   # FIXED AMB:    46 /    47   :  98%
ARP HEIGHT: 1.513                           OVERALL RMS: 0.015(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)           ITRF00 (EPOCH:2004.3438)

         X:     -2140784.616(m)   0.008(m)         -2140785.303(m)   0.008(m)
         Y:     -4650263.643(m)   0.020(m)         -4650262.335(m)   0.020(m)
         Z:      3792408.487(m)   0.016(m)          3792408.455(m)   0.016(m)

       LAT:   36 42 54.57129      0.025(m)        36 42 54.58793      0.025(m)
     E LON:  245 16 50.36617      0.007(m)       245 16 50.31899      0.007(m)
     W LON:  114 43  9.63383      0.007(m)       114 43  9.68101      0.007(m)
    EL HGT:           514.493(m)  0.010(m)                513.752(m)  0.010(m)
 ORTHO HGT:           541.240(m)  0.027(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4065699.136(m)   703693.822(m)     1.36393077      1.00011119
SPC(2701 NV E):  8218368.510(m)   277184.288(m)     0.51655125      0.99997337

US NATIONAL GRID DESIGNATOR: 11SQA0369465699(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   74796.5
AI8817 ECHO ECHO CANYON S.P. CORS ARP      N375455.904 W1141551.242  139221.2
AM7015 KING KINGMAN CORS ARP               N351150.480 W1140229.275  179188.7

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752    1342.7

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
```

SE ROA 49129

WSBM-2 Pipeline Jones Flume

```
FILE: PLJF2022.04O 000197690       WSBM-2 PIPELINE JONES FLUME

                               NGS OPUS SOLUTION REPORT
                               ========================

      USER: harper@usgs.gov                         DATE: August 06, 2004
RINEX FILE: pljf202q.04o                            TIME: 23:23:16 UTC


  SOFTWARE: page5  0407.16 master.pl               START: 2004/07/20  16:37:00
 EPHEMERIS: igs12802.eph [precise]                  STOP: 2004/07/20  19:22:00
  NAV FILE: brdc2020.04n                        OBS USED:  4913 /  5407   :
91%
  ANT NAME: ASH701975.01B                    # FIXED AMB:    44 /    52   :
85%
ARP HEIGHT: 1.618994284                      OVERALL RMS: 0.023(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)            ITRF00 (EPOCH:2004.5512)

         X:     -2140422.324(m)   0.032(m)          -2140423.016(m)   0.032(m)
         Y:     -4650504.929(m)   0.093(m)          -4650503.621(m)   0.093(m)
         Z:      3792297.200(m)   0.061(m)           3792297.167(m)   0.061(m)

       LAT:   36 42 50.36476      0.014(m)        36 42 50.38133      0.015(m)
     E LON:  245 17  7.69085      0.014(m)       245 17  7.64348      0.015(m)
     W LON:  114 42 52.30915      0.014(m)       114 42 52.35652      0.015(m)
    EL HGT:           502.227(m)   0.114(m)                501.487(m)   0.114(m)
 ORTHO HGT:           528.987(m)   0.117(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4065579.735(m)   704126.795(m)     1.36677342      1.00011337
SPC(2701 NV E):  8218242.737(m)   277615.388(m)     0.51941452      0.99997419

US NATIONAL GRID DESIGNATOR: 11SQA0412765580(NAD 83)



                               BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   74935.1
DG4673 NVCS CARLTON SQUARE CORS ARP        N361311.196 W1151019.335   68482.8
DG4263 NVLK A M SMITH WTF CORS ARP         N360410.758 W1144847.501   72049.9

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752    1278.2

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
```

SE ROA 49130

WSBM-3 Baldwin Spring

```
FILE: BALDW0370.04o 000179255    WSBM-3 BALDWIN SPRING

                             NGS OPUS SOLUTION REPORT
                             ========================

      USER: sean.corkill@lvvwd.com               DATE: June 14, 2004
RINEX FILE: bald037r.04o                         TIME: 16:47:25 UTC

  SOFTWARE: page5 0310.28 master11.pl           START: 2004/02/06 17:48:00
 EPHEMERIS: igs12565.eph [precise]               STOP: 2004/02/06 22:21:00
  NAV FILE: brdc0370.04n OBS                     USED: 8527 / 8987 :
95%
  ANT NAME: TRM39105.00                   # FIXED AMB: 38 / 38 :
100%
ARP HEIGHT: 2.0                           OVERALL RMS: 0.011(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)         ITRF00 (EPOCH:2004.1007)

         X: -2140993.956(m)       0.011(m)         -2140994.639(m) 0.012(m)
         Y: -4649779.403(m)       0.014(m)         -4649778.096(m) 0.014(m)
         Z:  3792880.888(m)       0.016(m)          3792880.858(m) 0.016(m)

       LAT:  36 43 13.68727       0.022(m)          36 43 13.70397 0.022(m)
     E LON: 245 16 34.54462       0.005(m)         245 16 34.49760 0.006(m)
     W LON: 114 43 25.45538       0.005(m)         114 43 25.50240 0.006(m)
    EL HGT:       514.520(m)      0.005(m)              513.779(m) 0.005(m)
 ORTHO HGT:       541.243(m)      0.025(m)    [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)      East(X)    Convergence (deg) Point Scale
  UTM(Zone 11):  4066278.958(m) 703287.239(m)    1.36146974       1.00010915
SPC(2701 NV E):  8218954.202(m) 276786.380(m)    0.51398731       0.99997262

US NATIONAL GRID DESIGNATOR: 11SQA0328766279(NAD 83)


                                BASE STATIONS USED
PID        DESIGNATION                   LATITUDE   LONGITUDE    DISTANCE(m)
AI8811 RAIL RAILROAD VALLEY CORS ARP   N381649.535  W1153953.379    192119.4
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP  N360934.026  W1151128.797     75061.4
AI8817 ECHO ECHO CANYON S.P. CORS ARP  N375455.904  W1141551.242    138770.8

                       NEAREST NGS PUBLISHED CONTROL POINT
GR0790       M 301                     N364354.     W1144332.         1257.1


This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
```

WSBM-3 Baldwin Spring

```
 FILE: 98511260.04o 000186245       WSBM-3 BALDWIN SPRING

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: wstout@stantec.com                      DATE: July 06, 2004
RINEX FILE: 9851126s.04o                            TIME: 13:20:22 UTC


  SOFTWARE: page5  0310.28 master10.pl             START: 2004/05/05  18:08:00
 EPHEMERIS: igs12693.eph [precise]                  STOP: 2004/05/05  21:37:00
  NAV FILE: brdc1260.04n                        OBS USED:  8091 /  8608   :  94%
  ANT NAME: TRM22020.00+GP                    # FIXED AMB:    60 /    61   :  98%
ARP HEIGHT: 1.532                             OVERALL RMS: 0.013(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)           ITRF00 (EPOCH:2004.3438)

         X:     -2140993.957(m)   0.012(m)          -2140994.645(m)   0.012(m)
         Y:     -4649779.394(m)   0.036(m)          -4649778.087(m)   0.036(m)
         Z:      3792880.876(m)   0.020(m)           3792880.844(m)   0.020(m)


       LAT:   36 43 13.68711      0.024(m)        36 43 13.70372      0.024(m)
     E LON:  245 16 34.54444      0.005(m)       245 16 34.49723      0.005(m)
     W LON:  114 43 25.45556      0.005(m)       114 43 25.50277      0.005(m)
    EL HGT:          514.506(m)   0.038(m)                513.766(m)   0.038(m)
 ORTHO HGT:          541.229(m)   0.045(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4066278.953(m)   703287.235(m)     1.36146971      1.00010915
SPC(2701 NV E):  8218954.197(m)   276786.375(m)     0.51398727      0.99997262

US NATIONAL GRID DESIGNATOR: 11SQA0328766279(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   75061.4
AI8817 ECHO ECHO CANYON S.P. CORS ARP      N375455.904 W1141551.242  138770.8
AM7015 KING KINGMAN CORS ARP               N351150.480 W1140229.275  179877.2

                 NEAREST NGS PUBLISHED CONTROL POINT
GR0790      M 301                          N364354.    W1144332.       1257.1

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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SE ROA 49132

WSBM-4 Warm Springs Road near Iverson Flume

```
  FILE: 63371280.04o 000186246       WSBM-4 WARM SPRINGS ROAD NEAR IVERSON FLUME

                             NGS OPUS SOLUTION REPORT
                             ========================

      USER: wstout@stantec.com                       DATE: July 06, 2004
RINEX FILE: 6337128p.04o                             TIME: 13:22:43 UTC


  SOFTWARE: page5  0310.28 master10.pl              START: 2004/05/07  15:10:00
 EPHEMERIS: igs12695.eph [precise]                   STOP: 2004/05/07  19:09:00
  NAV FILE: brdc1280.04n                         OBS USED:  8626 /  9082   :  95%
  ANT NAME: TRM22020.00+GP                     # FIXED AMB:    41 /    45   :  91%
ARP HEIGHT: 1.509                              OVERALL RMS: 0.018(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)           ITRF00 (EPOCH:2004.3490)

         X:     -2140193.907(m)   0.006(m)          -2140194.595(m)   0.006(m)
         Y:     -4650873.598(m)   0.027(m)          -4650872.290(m)   0.026(m)
         Z:      3791988.550(m)   0.030(m)           3791988.518(m)   0.029(m)


       LAT:   36 42 37.69617      0.026(m)        36 42 37.71281      0.025(m)
     E LON:  245 17 22.26060      0.007(m)       245 17 22.21339      0.006(m)
     W LON:  114 42 37.73940      0.007(m)       114 42 37.78661      0.006(m)
    EL HGT:          509.641(m)   0.027(m)              508.900(m)   0.027(m)
 ORTHO HGT:          536.419(m)   0.037(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4065197.918(m)   704497.654(m)     1.36908269      1.00011524
SPC(2701 NV E):  8217855.531(m)   277980.509(m)     0.52179138      0.99997489

US NATIONAL GRID DESIGNATOR: 11SQA0449865198(NAD 83)



                             BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   74823.8
AI8817 ECHO ECHO CANYON S.P. CORS ARP      N375455.904 W1141551.242  139494.8
AM7015 KING KINGMAN CORS ARP               N351150.480 W1140229.275  178428.4

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752    1625.2

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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WSBM-5 Iverson Flume

```
FILE: IVRF1340.02o 000181214   WSBM-5 Iverson Flume

                            NGS OPUS SOLUTION REPORT
                            ========================

      USER: timothy.wolf\@lvvwd.com                    DATE: June 20, 2002
RINEX FILE: ivrf1340.02o                               TIME: 00:45:56 UTC
      Iverson Flume

  SOFTWARE: page5  0203.19                            START: 2002/05/14  18:19:00
 EPHEMERIS: igs11662.eph [precise]                     STOP: 2002/05/14  21:32:00
  NAV FILE: brdc1340.02n                          OBS USED:  6548 /  8503   :  77%
  ANT NAME: TRM33429.00-GP                      # FIXED AMB:    56 /    88   :  64%
ARP HEIGHT: 2.064                                OVERALL RMS: 0.031(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)           ITRF00 (EPOCH:2002.3667)

         X:     -2140100.670(m)   0.040(m)         -2140101.316(m)   0.039(m)
         Y:     -4650849.449(m)   0.039(m)         -4650848.146(m)   0.039(m)
         Z:      3792063.111(m)   0.035(m)          3792063.095(m)   0.035(m)

       LAT:   36 42 40.81624      0.043(m)        36 42 40.83353      0.044(m)
     E LON:  245 17 25.26635      0.045(m)       245 17 25.22076      0.056(m)
     W LON:  114 42 34.73365      0.045(m)       114 42 34.77924      0.056(m)
    EL HGT:          505.380(m)   0.020(m)              504.638(m)   0.020(m)
 ORTHO HGT:          532.232(m)   0.032(m) [Geoid99 NAVD88]

       UTM:          Zone  11
  NORTHING:      4065295.862(m)
   EASTING:       704569.942(m)

       SPC:      Zone  2701(NV)
  NORTHING:      8217952.382(m)
   EASTING:       278054.227(m)

                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE LONGITUDE   DISTANCE(m)
AJ1826 lvwd LAS VEGAS VALLEY CORS ARP      N360934 W1151128       74945
AI8817 echo ECHO CANYON S.P. CORS ARP      N375455 W1141551      139381
AM7015 king KINGMAN CORS ARP               N351150 W1140229      178493

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330 W1144235        1521

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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WSBM-6 Pederson Spring

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 FILE: 98511270.04o 000186254       WSBM-6 PEDERSON SPRING

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: wstout@stantec.com                     DATE: July 06, 2004
RINEX FILE: 9851127r.04o                           TIME: 13:28:22 UTC


  SOFTWARE: page5  0310.28 master16.pl            START: 2004/05/06  17:05:00
 EPHEMERIS: igs12694.eph [precise]                 STOP: 2004/05/06  19:18:00
  NAV FILE: brdc1270.04n                       OBS USED:  5013 /  5505   :  91%
  ANT NAME: TRM22020.00+GP                   # FIXED AMB:    38 /    39   :  97%
ARP HEIGHT: 1.352                           OVERALL RMS: 0.014(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)          ITRF00 (EPOCH:2004.3463)

         X:     -2140635.851(m)   0.021(m)         -2140636.539(m)   0.021(m)
         Y:     -4650789.717(m)   0.050(m)         -4650788.409(m)   0.050(m)
         Z:      3791874.611(m)   0.033(m)          3791874.579(m)   0.033(m)

       LAT:   36 42 32.62813      0.023(m)        36 42 32.64476      0.022(m)
     E LON:  245 17  4.67332      0.006(m)       245 17  4.62611      0.006(m)
     W LON:  114 42 55.32668      0.006(m)       114 42 55.37389      0.006(m)
    EL HGT:           528.567(m)  0.057(m)                527.826(m)  0.057(m)
 ORTHO HGT:           555.339(m)  0.062(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4065031.300(m)  704064.957(m)     1.36611433     1.00011306
SPC(2701 NV E):  8217695.352(m)  277545.456(m)     0.51885352     0.99997406

US NATIONAL GRID DESIGNATOR: 11SQA0406565031(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   74444.4
AI8817 ECHO ECHO CANYON S.P. CORS ARP      N375455.904 W1141551.242  139768.1
AM7015 KING KINGMAN CORS ARP               N351150.480 W1140229.275  178431.5

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752    1828.5

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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SE ROA 49135

WSBM-7 Warm Spring West

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 FILE: 63371270.04o 000186256       WSBM-7 WARM SPRINGS WEST

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: wstout@stantec.com                        DATE: July 06, 2004
RINEX FILE: 6337127q.04o                              TIME: 13:30:09 UTC


  SOFTWARE: page5  0310.28 master12.pl               START: 2004/05/06  16:35:00
 EPHEMERIS: igs12694.eph [precise]                    STOP: 2004/05/06  20:44:00
  NAV FILE: brdc1270.04n                          OBS USED:  9299 / 10186   :  91%
  ANT NAME: TRM22020.00+GP                      # FIXED AMB:    76 /    77   :  99%
ARP HEIGHT: 1.489                               OVERALL RMS: 0.018(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)            ITRF00 (EPOCH:2004.3464)

         X:     -2140471.493(m)   0.017(m)          -2140472.180(m)   0.017(m)
         Y:     -4650688.064(m)   0.041(m)          -4650686.756(m)   0.041(m)
         Z:      3792067.647(m)   0.025(m)           3792067.615(m)   0.025(m)

       LAT:   36 42 40.77093      0.024(m)        36 42 40.78757      0.024(m)
     E LON:  245 17  8.97619      0.006(m)       245 17  8.92901      0.006(m)
     W LON:  114 42 51.02381      0.006(m)       114 42 51.07099      0.006(m)
    EL HGT:           514.841(m)  0.041(m)                514.100(m)  0.041(m)
 ORTHO HGT:           541.609(m)  0.048(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4065284.811(m)   704165.745(m)     1.36690186      1.00011356
SPC(2701 NV E):  8217947.310(m)   277649.968(m)     0.51959559      0.99997426

US NATIONAL GRID DESIGNATOR: 11SQA0416665285(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   74711.2
AI8817 ECHO ECHO CANYON S.P. CORS ARP      N375455.904 W1141551.242  139497.0
AM7015 KING KINGMAN CORS ARP               N351150.480 W1140229.275  178630.4

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752    1559.9

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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WSBM-8 Plummer Springs

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 FILE: lowerspg.04o 000186250        WSBM-8 PLUMMER SPRINGS

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: wstout@stantec.com                      DATE: July 06, 2004
RINEX FILE: lowe127r.04o                            TIME: 13:26:19 UTC


  SOFTWARE: page5  0310.28 master11.pl             START: 2004/05/06  17:44:00
 EPHEMERIS: igs12694.eph [precise]                  STOP: 2004/05/06  21:10:00
  NAV FILE: brdc1270.04n                        OBS USED:  6437 /  8167   :  79%
  ANT NAME: TRM22020.00+GP                    # FIXED AMB:    59 /    62   :  95%
ARP HEIGHT: 1.497                             OVERALL RMS: 0.018(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)           ITRF00 (EPOCH:2004.3465)

         X:     -2140333.281(m)   0.025(m)         -2140333.969(m)   0.025(m)
         Y:     -4650782.745(m)   0.059(m)         -4650781.438(m)   0.059(m)
         Z:      3792016.409(m)   0.035(m)          3792016.377(m)   0.035(m)

       LAT:   36 42 38.89120      0.025(m)        36 42 38.90782      0.025(m)
     E LON:  245 17 15.62940      0.008(m)       245 17 15.58221      0.008(m)
     W LON:  114 42 44.37060      0.008(m)       114 42 44.41779      0.008(m)
    EL HGT:           506.840(m)  0.064(m)                506.099(m)  0.064(m)
 ORTHO HGT:           533.613(m)  0.068(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4065230.818(m)   704332.224(m)     1.36799107      1.00011440
SPC(2701 NV E):  8217890.869(m)   277815.607(m)     0.52069416      0.99997458

US NATIONAL GRID DESIGNATOR: 11SQA0433265231(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   74758.8
AI8817 ECHO ECHO CANYON S.P. CORS ARP      N375455.904 W1141551.242  139505.8
AM7015 KING KINGMAN CORS ARP               N351150.480 W1140229.275  178519.3

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752    1594.2

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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WSBM-9 Moapa Gage

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 FILE: moapa.04o 000186252          WSBM-9 MOAPA GAGE

                              NGS OPUS SOLUTION REPORT
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      USER: wstout@stantec.com                         DATE: July 06, 2004
RINEX FILE: moap128o.04o                               TIME: 13:28:36 UTC


  SOFTWARE: page5  0310.28 master13.pl                START: 2004/05/07  14:43:00
 EPHEMERIS: igs12695.eph [precise]                     STOP: 2004/05/07  19:16:00
  NAV FILE: brdc1280.04n                           OBS USED:  9839 / 10565   :  93%
  ANT NAME: TRM22020.00+GP                     # FIXED AMB:    55 /    60   :  92%
ARP HEIGHT: 1.482                              OVERALL RMS: 0.018(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)            ITRF00 (EPOCH:2004.3489)

         X:     -2138947.267(m)   0.011(m)          -2138947.955(m)   0.011(m)
         Y:     -4651393.485(m)   0.031(m)          -4651392.178(m)   0.030(m)
         Z:      3792031.313(m)   0.014(m)           3792031.281(m)   0.014(m)

       LAT:   36 42 39.75208      0.020(m)        36 42 39.76870      0.020(m)
     E LON:  245 18 16.64346      0.005(m)       245 18 16.59627      0.005(m)
     W LON:  114 41 43.35654      0.005(m)       114 41 43.40373      0.005(m)
    EL HGT:           496.181(m)  0.030(m)                495.441(m)  0.030(m)
 ORTHO HGT:           522.985(m)  0.039(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4065293.640(m)   705845.624(m)     1.37814070      1.00012205
SPC(2701 NV E):  8217931.299(m)   279329.556(m)     0.53083001      0.99997751

US NATIONAL GRID DESIGNATOR: 11SQA0584665294(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   75663.6
AI8817 ECHO ECHO CANYON S.P. CORS ARP      N375455.904 W1141551.242  139059.9
AM7015 KING KINGMAN CORS ARP               N351150.480 W1140229.275  178031.7

                 NEAREST NGS PUBLISHED CONTROL POINT
GR0789      K 301                          N364305.    W1144136.        801.7

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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WSBM-10 L.D.S. East Well

```
FILE: LDSE1360.020 000181207   WSBM-10 L.D.S. EAST WELL


                           NGS OPUS SOLUTION REPORT
                           ========================

      USER: timothy.wolf\@lvvwd.com                DATE: June 20, 2002
RINEX FILE: ldse1360.02o                           TIME: 00:49:18 UTC
      LDS East

  SOFTWARE: page5  0203.19                        START: 2002/05/16  16:39:00
 EPHEMERIS: igs11664.eph [precise]                 STOP: 2002/05/16  18:48:00
  NAV FILE: brdc1360.02n                       OBS USED:  4462 /  4699   :  95%
  ANT NAME: TRM39105.00                      # FIXED AMB:    29 /    31   :  94%
ARP HEIGHT: 2.045                             OVERALL RMS: 0.020(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)            ITRF00 (EPOCH:2002.3719)

         X:     -2139830.827(m)   0.012(m)         -2139831.473(m)   0.011(m)
         Y:     -4650119.731(m)   0.041(m)         -4650118.428(m)   0.041(m)
         Z:      3793106.491(m)   0.028(m)          3793106.474(m)   0.028(m)

       LAT:   36 43 22.98995      0.028(m)        36 43 23.00722      0.028(m)
     E LON:  245 17 22.85263      0.007(m)       245 17 22.80702      0.009(m)
     W LON:  114 42 37.14737      0.007(m)       114 42 37.19298      0.009(m)
    EL HGT:           507.381(m)   0.045(m)               506.639(m)   0.045(m)
 ORTHO HGT:           534.195(m)   0.051(m) [Geoid99 NAVD88]

       UTM:          Zone  11
  NORTHING:      4066594.241(m)
   EASTING:       704478.975(m)

       SPC:      Zone  2701(NV)
  NORTHING:      8219251.782(m)
   EASTING:       277982.483(m)

                             BASE STATIONS USED
PID       DESIGNATION                        LATITUDE LONGITUDE   DISTANCE(m)
AJ1826 lvwd LAS VEGAS VALLEY CORS ARP      N360934 W1151128       75976
AI8817 echo ECHO CANYON S.P. CORS ARP      N375455 W1141551      138151
AM7015 king KINGMAN CORS ARP               N351150 W1140229      179736

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330 W1144238         218

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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WSBM-11 L.D.S. Gage

```
FILE: LDSG1340.020 000181206    WSBM-11 L.D.S. GAGE


                           NGS OPUS SOLUTION REPORT
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      USER: timothy.wolf\@lvvwd.com                DATE: June 20, 2002
RINEX FILE: ldsg1340.02o                           TIME: 00:44:33 UTC
      LDS Gage

  SOFTWARE: page5  0203.19                        START: 2002/05/14  17:58:00
 EPHEMERIS: igs11662.eph [precise]                 STOP: 2002/05/14  21:24:00
  NAV FILE: brdc1340.02n                       OBS USED:  7792 /  8875   :  88%
  ANT NAME: TRM39105.00                      # FIXED AMB:    51 /    54   :  94%
ARP HEIGHT: 2.045                             OVERALL RMS: 0.020(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)           ITRF00 (EPOCH:2002.3666)

         X:     -2140313.027(m)   0.013(m)          -2140313.673(m)   0.013(m)
         Y:     -4650051.452(m)   0.025(m)          -4650050.149(m)   0.025(m)
         Z:      3792916.802(m)   0.002(m)           3792916.786(m)   0.003(m)

       LAT:   36 43 15.35091      0.019(m)        36 43 15.36821      0.019(m)
     E LON:  245 17  4.05180      0.005(m)       245 17  4.00620      0.006(m)
     W LON:  114 42 55.94820      0.005(m)       114 42 55.99380      0.006(m)
    EL HGT:           505.831(m)  0.021(m)                505.089(m)  0.021(m)
 ORTHO HGT:           532.642(m)  0.033(m) [Geoid99 NAVD88]

       UTM:           Zone  11
  NORTHING:       4066347.663(m)
   EASTING:        704018.131(m)

       SPC:       Zone  2701(NV)
  NORTHING:       8219012.081(m)
   EASTING:        277518.107(m)

                             BASE STATIONS USED
PID       DESIGNATION                        LATITUDE LONGITUDE   DISTANCE(m)
AJ1826 lvwd LAS VEGAS VALLEY CORS ARP        N360934 W1151128       75517
AI8817 echo ECHO CANYON S.P. CORS ARP        N375455 W1141551      138510
AM7015 king KINGMAN CORS ARP                 N351150 W1140229      179674

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                            N364330 W1144238         635

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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SE ROA 49140

WSBM-11 L.D.S. Gage

```
FILE: LDS11541.04O 000184850       WSBM-11 L.D.S. GAGE

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: harper@usgs.gov                         DATE: June 30, 2004
RINEX FILE: lds1154r.04o                            TIME: 21:09:39 UTC


  SOFTWARE: page5  0310.28 master6.pl              START: 2004/06/02  17:36:00
 EPHEMERIS: igs12733.eph [precise]                  STOP: 2004/06/03  16:02:00
  NAV FILE: brdc1540.04n                        OBS USED: 35159 / 37598   :
94%
  ANT NAME: ASH701975.01B                     # FIXED AMB:   164 /   192   :
85%
ARP HEIGHT: 1.49675615                        OVERALL RMS: 0.022(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)           ITRF00 (EPOCH:2004.4214)

         X:     -2140313.037(m)   0.001(m)         -2140313.726(m)   0.001(m)
         Y:     -4650051.484(m)   0.008(m)         -4650050.176(m)   0.008(m)
         Z:      3792916.800(m)   0.006(m)          3792916.767(m)   0.006(m)

       LAT:   36 43 15.35021      0.003(m)       36 43 15.36681      0.003(m)
     E LON:  245 17  4.05198      0.004(m)      245 17  4.00472      0.004(m)
     W LON:  114 42 55.94802      0.004(m)      114 42 55.99528      0.004(m)
    EL HGT:          505.856(m)   0.009(m)              505.115(m)   0.008(m)
 ORTHO HGT:          532.593(m)   0.026(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4066347.642(m)   704018.136(m)     1.36639033      1.00011282
SPC(2701 NV E):  8219012.059(m)   277518.111(m)     0.51889441      0.99997401

US NATIONAL GRID DESIGNATOR: 11SQA0401866348(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   75516.6
DG4673 NVCS CARLTON SQUARE CORS ARP        N361311.196 W1151019.335   69046.4
DG4263 NVLK A M SMITH WTF CORS ARP         N360410.758 W1144847.501   72803.4

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752     627.6

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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SE ROA 49141

JA_15327

WSBM-12 Baldwin Flume

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FILE: BF011551.04O 000184853        WSBM-12 BALDWIN FLUME

                              NGS OPUS SOLUTION REPORT
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      USER: harper@usgs.gov                           DATE: June 30, 2004
RINEX FILE: bf01155q.04o                              TIME: 21:10:27 UTC


  SOFTWARE: page5  0310.28 master16.pl               START: 2004/06/03  16:19:00
 EPHEMERIS: igs12734.eph [precise]                    STOP: 2004/06/04  16:18:00
  NAV FILE: brdc1550.04n                          OBS USED: 50723 / 51143   :
99%
  ANT NAME: ASH701975.01B                      # FIXED AMB:   157 /   158   :
99%
ARP HEIGHT: 1.571906808                        OVERALL RMS: 0.015(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)            ITRF00 (EPOCH:2004.4240)

         X:     -2140792.871(m)   0.009(m)         -2140793.561(m)   0.009(m)
         Y:     -4649818.555(m)   0.010(m)         -4649817.248(m)   0.010(m)
         Z:      3792942.552(m)   0.004(m)          3792942.519(m)   0.003(m)

       LAT:   36 43 16.23194      0.009(m)       36 43 16.24851      0.009(m)
     E LON:  245 16 42.56429      0.008(m)      245 16 42.51701      0.008(m)
     W LON:  114 43 17.43571      0.008(m)      114 43 17.48299      0.008(m)
    EL HGT:           512.486(m)   0.006(m)              511.746(m)   0.006(m)
 ORTHO HGT:           539.212(m)   0.026(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4066362.117(m)   703484.353(m)     1.36282560      1.00011014
SPC(2701 NV E):  8219034.425(m)   276984.675(m)     0.51532798      0.99997299

US NATIONAL GRID DESIGNATOR: 11SQA0348466362(NAD 83)


                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   75238.1
DG4673 NVCS CARLTON SQUARE CORS ARP        N361311.196 W1151019.335   68752.7
DG4263 NVLK A M SMITH WTF CORS ARP         N360410.758 W1144847.501   72768.0

                 NEAREST NGS PUBLISHED CONTROL POINT
GR1414      L 301                          N364330.247 W1144238.752    1052.2

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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WSBM-13 M-10

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FILE: M10A1552.04O 000184851        WSBM-13 M-10

                              NGS OPUS SOLUTION REPORT
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      USER: harper@usgs.gov                         DATE: June 30, 2004
RINEX FILE: m10a155v.04o                            TIME: 21:07:21 UTC


  SOFTWARE: page5  0310.28 master18.pl             START: 2004/06/03  21:25:00
 EPHEMERIS: igs12734.eph [precise]                  STOP: 2004/06/04  16:06:00
  NAV FILE: brdc1550.04n                        OBS USED: 32800 / 34914   :
94%
  ANT NAME: ASH701975.01B                    # FIXED AMB:   180 /   206   :
87%
ARP HEIGHT: 1.555131722                      OVERALL RMS: 0.025(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)            ITRF00 (EPOCH:2004.4243)

         X:     -2141146.056(m)   0.008(m)          -2141146.745(m)   0.008(m)
         Y:     -4649330.864(m)   0.015(m)          -4649329.556(m)   0.015(m)
         Z:      3793353.766(m)   0.006(m)           3793353.734(m)   0.005(m)

       LAT:   36 43 32.65049      0.005(m)        36 43 32.66711      0.006(m)
     E LON:  245 16 21.41777      0.005(m)       245 16 21.37050      0.005(m)
     W LON:  114 43 38.58223      0.005(m)       114 43 38.62950      0.005(m)
    EL HGT:          521.710(m)   0.017(m)               520.970(m)   0.016(m)
 ORTHO HGT:          548.411(m)   0.030(m) [Geoid03 NAVD88]

PLANE COORDINATES     North(Y)         East(X)   Convergence (deg) Point Scale
  UTM(Zone 11):  4066855.676(m)   702947.675(m)     1.35945477      1.00010745
SPC(2701 NV E):  8219535.800(m)   276455.428(m)     0.51186987      0.99997199

US NATIONAL GRID DESIGNATOR: 11SQA0294866856(NAD 83)


                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AJ1826 LVWD LAS VEGAS VALLEY CORS ARP      N360934.026 W1151128.797   75365.3
DG4673 NVCS CARLTON SQUARE CORS ARP        N361311.196 W1151019.335   68856.3
DG4263 NVLK A M SMITH WTF CORS ARP         N360410.758 W1144847.501   73213.6

                 NEAREST NGS PUBLISHED CONTROL POINT
GR0790      M 301                          N364354.    W1144332.        680.0

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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Appendix D. Discharge and Water-Quality Data Collected by the U.S. Geological Survey During September 10–12, 1963, in the Warm Springs Area Near Moapa, Nevada

SE ROA 49144

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WSBM-1 Jones Spring Box

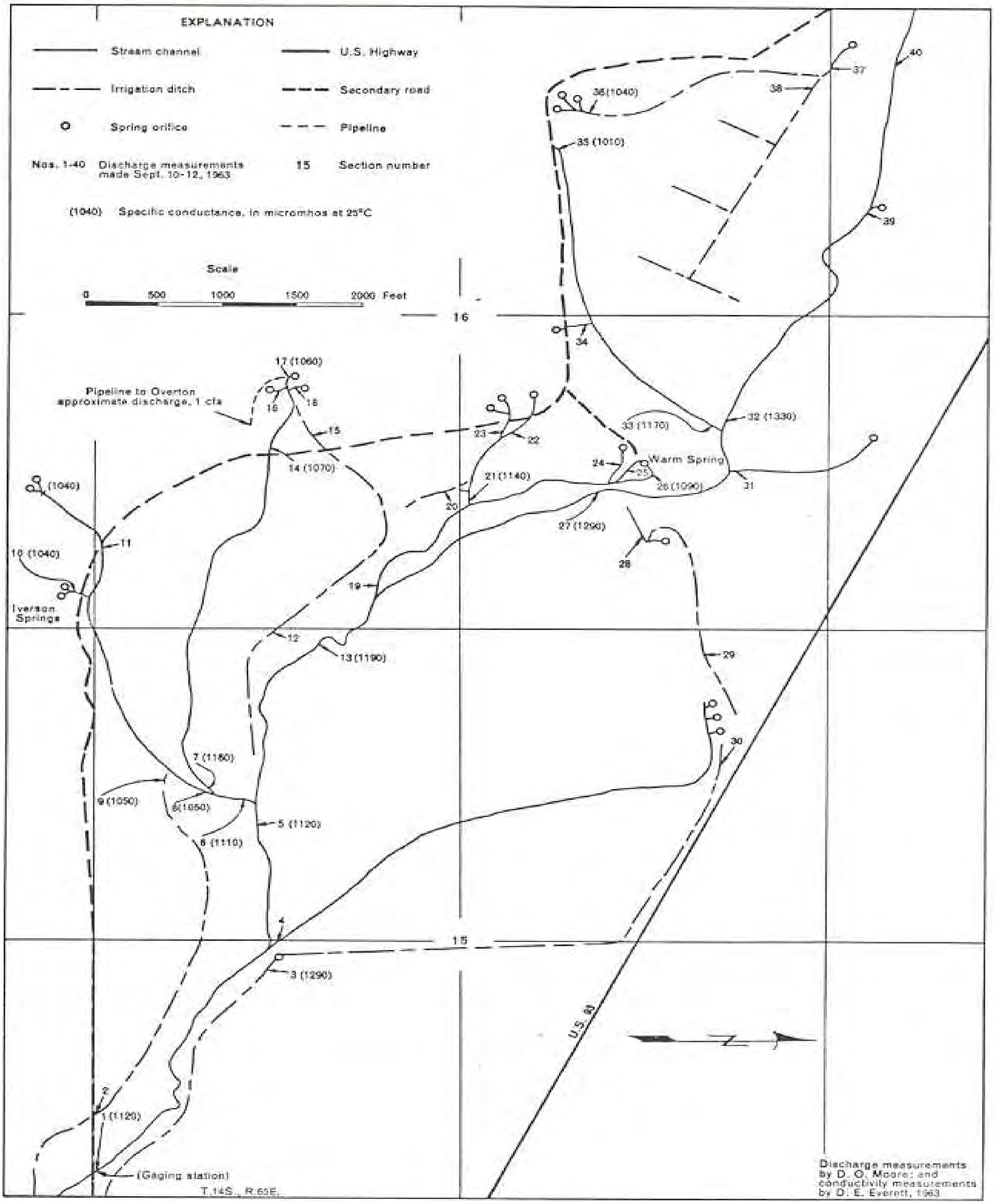

Figure D1. Sketch map showing location of discharge measurement sites in the Warm Springs area, September 12, 1963. (From Eakin, 1964.)

SE ROA 49146

JA_15332

Table D1. Index of discharge and specific-conductance measurements in the Warm Springs area, September 10–12, 1963.

TableD1 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Appendix E. Discharge and Water-Quality Data Collected by the U.S. Geological Survey, U.S. Fish and Wildlife Service, Nevada Division of Water Resources, and Southern Nevada Water Authority on February 6–7, 2001, in the Warm Springs Area Near Moapa, Nevada

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Table E1. Index of discharge and water-quality measurement sites in the Warm Springs area, near Moapa, Nevada.

TableE1 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table E2. Discharge measurements made on February 7, 2001, in the Warm Springs area near Moapa, Nevada.

TableE2 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table E3. Water-quality data collected on February 6–7, 2001, in the Warm Springs area near Moapa, Nevada.

TableE3 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Prepared by the USGS Publishing Network,

Publishing Service Center, Tacoma, Washington
Bill Gibbs
Debra Grillo
Bobbie Jo Richey
Linda Rogers
Sharon Wahlstrom

Publishing Service Center, Sacramento, California
Myrna DeBortoli
Mary Gibbs

For more information concerning the research in this report, contact the
Director, Nevada Water Science Center
U.S. Geological Survey, 2730 N. Deer Run Road
Carson City, Nevada 89701
http://nv.water.usgs.gov

SE ROA 49154

Beck and others

Water-Surface Elevations, Discharge, and Water-Quality Data for Selected Sites in the Warm Springs Area near Moapa, Nevada

OFR 2006-1311