Environmental Resources Division

Spring Valley Biological Monitoring Plan 2011-2012 Status and Data Report

March 2013

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Suggested citation: Southern Nevada Water Authority. 2013. Spring Valley Biological Monitoring Plan 2011-2012 Status and Data Report. Southern Nevada Water Authority, Las Vegas, Nevada. March.

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1.0 INTRODUCTION

This report was prepared by the Southern Nevada Water Authority (SNWA) in satisfaction of monitoring and reporting requirements set forth in the *Biological Monitoring Plan for the Spring Valley Stipulation* (Plan) (BWG, 2009). This report satisfies the biological data reporting requirements of Nevada State Engineer (NSE) Ruling 6164, which granted SNWA groundwater rights in the Spring Valley Hydrographic Area 184 (Spring Valley) (NSE, 2012). The location of Spring Valley is presented in Figure 1-1.

This report also satisfies the biological data reporting requirements of the 2006 Stipulated Agreement between SNWA and the U.S. Department of the Interior (DOI) regarding associated SNWA groundwater applications in Spring Valley (Stipulation, 2006).

This report provides the NSE with a summary of biological data collected in 2011-2012, and the current status of each major element of the Plan. The biological data contained in this report are available to the NSE and DOI Stipulation Party representatives in electronic format on the SNWA data-exchange website.

This is the third status and data report in a series of reports associated with the Spring Valley biological monitoring, management and mitigation program. The reports document historic biological conditions and plan status since 2009 (SNWA, 2010 and 2011a).

1.1 Background

On September 8, 2006, prior to the initial NSE hearing for SNWA groundwater applications 54003-54021 in Spring Valley, a Stipulation for Withdrawal of Protests (Stipulation, 2006) was established between SNWA and DOI on behalf of the Bureau of Indian Affairs, the Bureau of Land Management (BLM), the National Park Service, and the U.S. Fish and Wildlife Service (USFWS) (collectively known as the DOI Bureaus) regarding SNWA groundwater applications 54003-54021 in Spring Valley. Exhibits A and B of the Stipulation require the development of hydrologic and biological monitoring plans. As part of the Stipulation, an Executive Committee (EC) was established to oversee the implementation of the agreement. The Biological Work Group (BWG), composed of technical expert representatives of Parties to the Stipulation, was established to develop and oversee implementation of the biological monitoring, management and mitigation program, review program data, and modify the monitoring plan, if necessary. A hydrologic Technical Review Panel (TRP) was also established to oversee the development and implementation of the hydrologic monitoring, management and mitigation program.

On April 16, 2007, the NSE issued Ruling 5726 granting SNWA groundwater rights in Spring Valley for municipal and domestic purposes under permits 54003-54015, 54019, and 54020. As part of

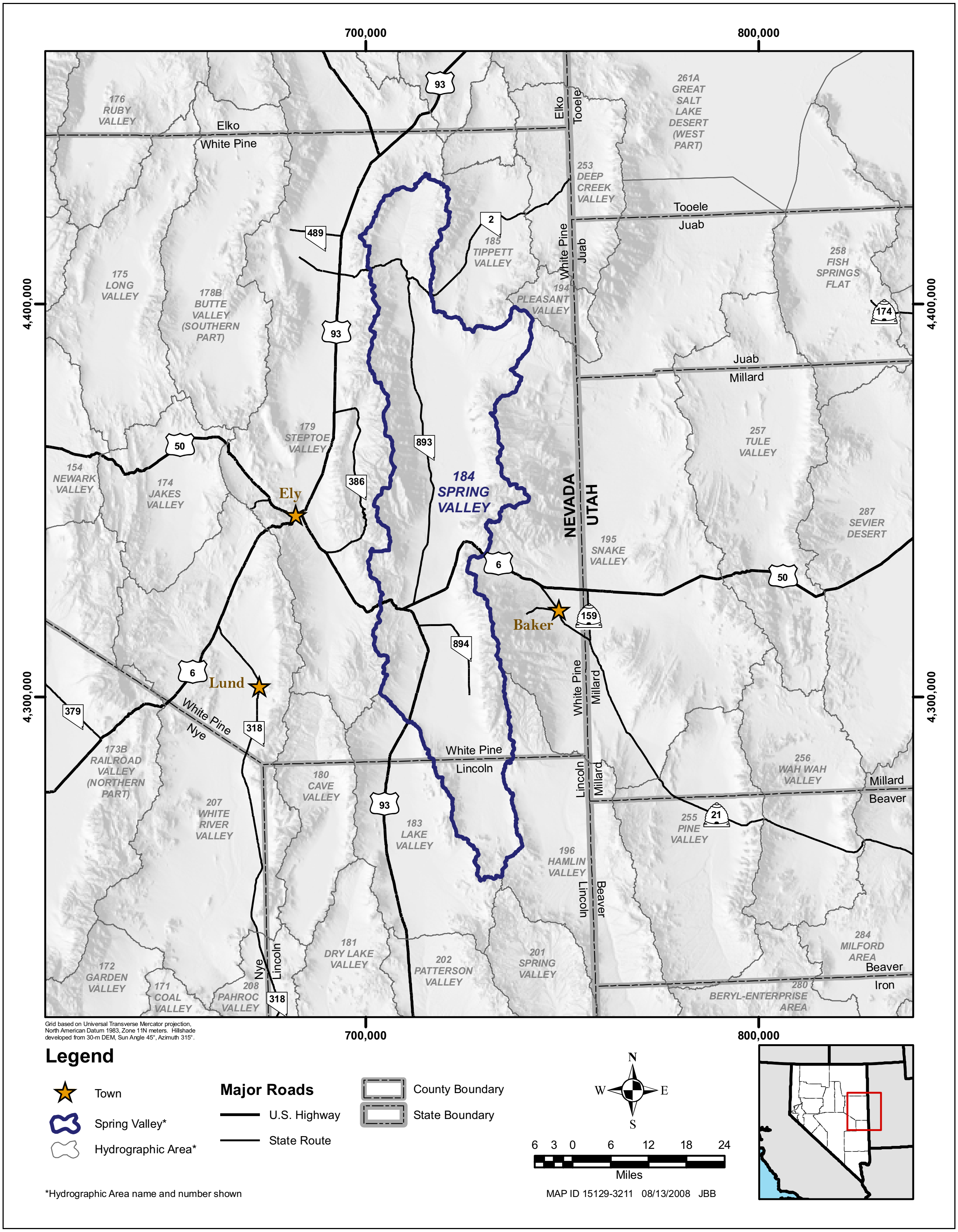

Figure 1-1
Spring Valley Hydrographic Area 184

Ruling 5726, the NSE conditioned SNWA's groundwater rights upon biological and hydrologic monitoring and mitigation programs approved by the NSE (NSE, 2007 at page 56). Ruling 5726 required annual reports be submitted to the NSE detailing the findings of the approved monitoring and mitigation plans (NSE, 2007 at page 56). The Plan (BWG, 2009) and the *Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184)* (SNWA, 2009) were approved by the NSE on January 23, 2009 and February 9, 2009 (respectively). The hydrologic monitoring plan was implemented by SNWA in 2008, and the Plan was implemented by SNWA in 2009.

Following the issuance of Ruling 5726, an opinion by the Nevada Supreme Court concluded that the NSE must re-notice SNWA's original groundwater applications and reopen the protest period (Great Basin Water Network, et. al. v. NSE, et. al., June 17, 2010) (Nevada Supreme Court, 2010). Ruling 5726 was vacated, and a second hearing on the water right applications was held by the NSE from September-November, 2011.

On September 15, 2011, prior to the second NSE hearing for SNWA groundwater applications 54003-54021 in Spring Valley, a separate Stipulation for Withdrawal of Protests (Stipulation, 2011) was established between SNWA and the U.S. Forest Service (USFS) regarding groundwater applications 54003-54021 in Spring Valley. The SNWA-USFS Stipulation requires establishment of additional hydrologic and biological monitoring sites, with biological monitoring to be conducted according to the principles contained in the Plan (BWG, 2009). The USFS also participates in the EC, BWG and TRP established by the [SNWA-DOI] Stipulation.

On March 22, 2012, the NSE issued Ruling 6164 granting SNWA groundwater rights in Spring Valley for municipal and domestic purposes under permits 54003-54015, 54019, and 54020. As part of Ruling 6164, the NSE reviewed and approved the Plan (BWG, 2009) and the updated *Hydrologic Monitoring and Mitigation Plan for Spring Valley* (SNWA, 2011b), and conditioned SNWA's groundwater rights upon compliance with the plans and any amendments to the plans that the NSE requires at a later date pursuant to his authority under Nevada water law (NSE, 2012 at page 217). Ruling 6164 requires that prior to SNWA exporting any groundwater resources from Spring Valley, a minimum of two years of biological and hydrologic baseline data shall be collected by SNWA in accordance with the approved monitoring plans. Ruling 6164 also required annual reports be submitted to the NSE detailing the findings of the approved monitoring plans (NSE, 2012 at page 217). This report is submitted for the purpose of meeting the reporting requirements under both the Stipulation and NSE Ruling 6164.

1.2 Biological Monitoring, Management and Mitigation Program Status

The Plan requires that seven years of baseline biological data be collected prior to SNWA groundwater withdrawal from Spring Valley. Two years of baseline biological data collection were completed in 2009 and 2010 (SNWA, 2010 and 2011a). To meet Plan requirements, full monitoring is planned to resume five years prior to SNWA groundwater withdrawal from Spring Valley. The BWG and EC identified the time until five years prior to groundwater withdrawal from Spring Valley as an "interim period", which if feasible can be used to examine data, test field protocols, make Plan adjustments, and conduct targeted monitoring and studies in support of the Plan and Stipulation goals. As such, in 2011-2012 SNWA conducted surveys, studies and data analyses in excess of the required years of baseline data collection.

In Ruling 6164, the NSE found that the adaptive approach incorporated in the Plan is an accepted scientific approach that is appropriate and advisable for managing a long-term project, and that adaptive management is a critical component in ensuring water development occurs in a manner that is environmentally sound (NSE, 2012 at page 182). As part of this adaptive approach, the BWG plans to routinely evaluate biological and hydrologic data and groundwater flow modeling results, as well as consider any future NSE decisions, changes in permitted points of diversion, and specific production well locations, to inform biological monitoring, management, and mitigation needs. Currently in accordance with the Plan, the BWG is evaluating the first two years of data collection (2009-2010) and conducting scientific evaluations of the Plan, with the goal of revising components, methods and approaches as needed to continue to meet the needs of the Stipulation. The NSE would review and determine approval of any proposed Plan modifications submitted by SNWA under Ruling 6164, and may require additional amendments pursuant to his authority under Nevada water law (NSE, 2012 at page 217).

1.3 Major Activities Performed in 2011-2012

Major activities associated with the Plan performed in 2011-2012 were as follows:

- Conducted surveys and data analyses in excess of the required years of baseline data collection.
    - Data collection efforts spanned all twelve surveys identified in the Plan: physical habitat mapping, site assessment, water quality, springsnail, macroinvertebrate, northern leopard frog (*Rana pipiens*), relict dace (*Relictus solitarius*), Big Springs/Lake Creek native fish community, Pahrump poolfish (*Empetrichthys latos*), vegetation, Rocky Mountain juniper (*Juniperus scopulorum*), and fixed station photography.
    - Efforts included collecting monitoring data, testing sampling techniques, evaluating vegetation transect efficacy and efficiency, exploring species distributions within monitoring sites, and better clarifying relationships between species and habitat indicators.
- Maintained the SNWA data-exchange web site accessible by the NSE, EC, BWG, and TRP. The web site contains monitoring plans, data and reports.
- Upon request, submitted the document *Southern Nevada Water Authority Vegetation Transects: Spring Valley (Hydrographic Area #184)* (SNWA, 2013) and associated vegetation transect geodatabase in January 2013 to the NSE.
- Worked with USFS to identify one biological monitoring spring site to fulfill requirements of the SNWA-USFS Stipulation and initiate the USFS access application.
- BWG and TRP collaborated and shared expert opinions to inform biological and hydrologic monitoring efforts under the Stipulation.
- BWG and TRP held a joint field trip in spring 2012 to visit select hydrologic and biological monitoring sites and provide updates of project activities.

- In accordance with the Plan, the BWG conducted evaluations of various monitoring efforts, including springsnail, relict dace, Pahrump poolfish, and Big Springs/Lake Creek native fish surveys. As part of this process, USFWS hired a consultant to evaluate the springsnail survey and macroinvertebrate sampling efforts at springsnail monitoring sites. SNWA also hired consultants to evaluate the vegetation transects, evaluate the physical habitat mapping effort, and conduct joint biological and hydrologic data analyses.

1.4 Report Scope

This report provides the NSE with a summary of biological data collected in 2011-2012, and the current status of each major element of the Plan. The monitoring sites identified in the Plan are located within the Stipulation Initial Biological Monitoring Area (IBMA), which encompasses Spring Valley, northern Hamlin Valley (Hydrographic Area 196), and the Big Springs/Lake Creek sub-watershed in southern Snake Valley (Hydrographic Area 195) (Stipulation, 2006). The IBMA is depicted in Section 2.0.

Section 2.0 presents the status and data collected for each major element of the Plan. Section 3.0 discusses the planned activities for 2013. Section 4.0 provides a list of references. Appendix A through Appendix G present tables and graphs of the various data discussed in the report.

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2.0 BIOLOGICAL MONITORING PLAN STATUS AND DATA

Plan (BWG, 2009) requirements, current status of each major element of the Plan, and biological data collected in 2011-2012 are presented in this section. Data collection on private property is contingent upon property access.

2.1 Physical Habitat Mapping

The Plan (BWG, 2009) requires that physical habitat mapping be conducted at: 16 springs within Spring and Snake Valleys during the spring and fall seasons; and Big Springs/Lake Creek (Snake Valley) reaches monitored for fish during the late summer or early fall season (Section 2.9). Although the Plan omitted mapping at Shoshone Ponds (Spring Valley) to avoid disturbance to the endangered Pahrump poolfish, mapping has been conducted at the stock pond given the ability to map that pond without entering the water. Small springs are mapped in their entirety, and long springs and large spring complexes are mapped within designated sample areas established in 2009. Physical habitat mapping sites are presented in Figure 2-1.

Physical habitat mapping was conducted at 8 springs and 6 creek reaches in 2011 and 2012 in excess of the required years of baseline data collection. Data were collected in fall 2011 (September 6-8) at Big Springs, Four Wheel Drive Spring, Keegan Spring Complex North, Minerva Spring Complex North, Unnamed 5 Spring, West Spring Valley Complex 1, Willard Spring, Willow-NV Spring, and Big Springs/Lake Creek Reaches 1,3,4,5 and 6; and in spring 2012 (May 9) at Minerva Spring Complex North and Willard Spring. The sites were chosen because they displayed variability in 2009-2010 (SNWA, 2011a). It is important to note that compared to 2009 and 2010 (SNWA, 2010 and 2011a), in 2011 a smaller portion of the original Keegan Spring Complex designated sample area was mapped, omitting the upstream section largely characterized by narrow springbrook channels. Data were collected according to the methods outlined in the Plan (BWG, 2009) and described in the 2010 annual report (SNWA, 2011a). Physical habitat mapping was based on four categories (hydro morphological unit [HMU: pool or channel]; depth range; velocity range; and percent emergent vegetation range) that were combined to define habitat types. The spatial data were recorded with a Trimble GeoXH Global Positioning System (GPS) Unit, and a geodatabase was created in ArcGIS Software version 10.0 (Environmental Systems Research Institute [ESRI]). Physical habitat mapping data are presented in Appendix A.

In 2012, the BWG began an evaluation of the physical habitat mapping effort. As part of this process, SNWA hired BIO-WEST to evaluate physical habitat mapping efficacy and conduct joint biological and hydrologic data analyses. Detailed results and discussion will be available in a forthcoming report.

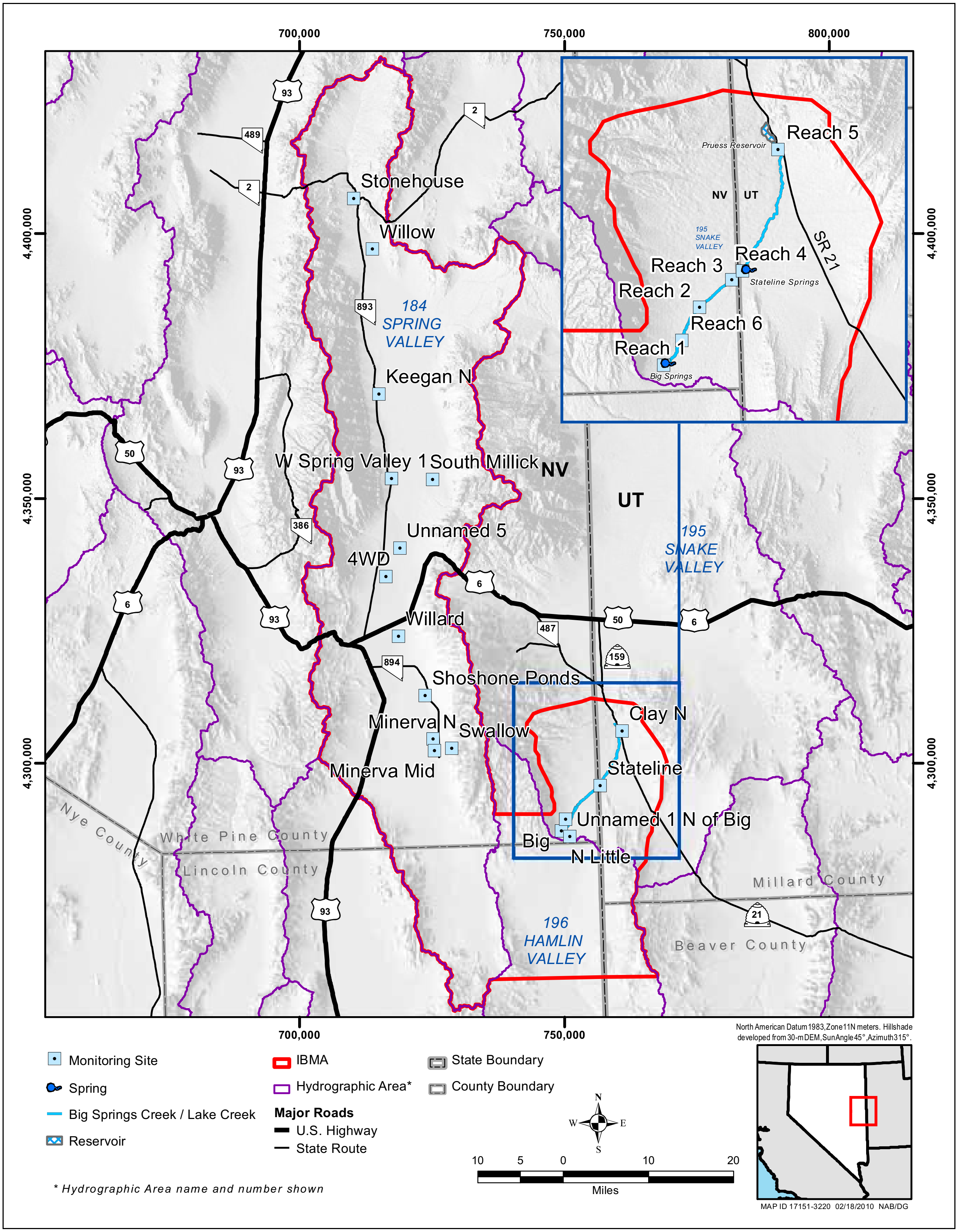

Figure 2-1
Physical Habitat Mapping Monitoring Sites within the IBMA

2.2 Site Assessment

The Plan (BWG, 2009) requires that qualitative site assessments be conducted at: 16 springs within Spring and Snake Valleys, and Shoshone Ponds (Spring Valley), during the spring and fall seasons; and Big Springs/Lake Creek (Snake Valley) reaches monitored for fish during the late summer or early fall season (Section 2.9). Small springs are assessed in their entirety, and long springs and large spring complexes are assessed within designated sample areas established in 2009. Site assessment monitoring sites are presented in Figure 2-2.

Site assessments were conducted at 7 springs in 2011 in excess of the required years of baseline data collection. Data were collected in fall 2011 (September 6-8) at Four Wheel Drive Spring, Keegan Spring Complex North, Minerva Spring Complex North, Unnamed 5 Spring, West Spring Valley Complex 1, Willard Spring, and Willow-NV Spring during physical habitat mapping (Section 2.1). Data were collected according to the methods outlined in the Plan (BWG, 2009) and described in the 2010 annual report (SNWA, 2011a). Overall disturbance ratings (1=undisturbed, 2=slightly disturbed, 3=moderately disturbed 4=highly disturbed) and presence/absence of diversion, ungulate and recreational disturbances were recorded. Site assessment data are presented in Appendix B.

2.3 Water Quality

The Plan (BWG, 2009) requires that: standard water quality (temperature, conductivity, pH, dissolved oxygen, turbidity, and velocity) and nutrient (nitrogen and phosphorus) data be collected at 16 springs within Spring and Snake Valleys during the spring and fall seasons; continuous temperature data be collected at the same 16 springs; and standard water quality data be collected at Big Springs/Lake Creek (Snake Valley) reaches monitored for fish during the late summer or early fall season (Section 2.9). Small springs are surveyed in their entirety, and long springs and large spring complexes are surveyed within designated sample areas established in 2009. The Plan also integrates standard water quality data collected by NDOW during their annual Shoshone Ponds summer fish survey (Section 2.7 and Section 2.8). Water quality monitoring sites are presented in Figure 2-3.

Water quality sampling was conducted at 5 springs and 4 Big Springs/Lake Creek reaches in 2011 in excess of the required years of baseline data collection. As part of the 2011-2012 springsnail study (Section 2.4), continuous temperature data and supplemental 24-hour water quality data were collected at Minerva Spring Complex North and Unnamed 1 Spring North of Big. As part of the 2011 northern leopard frog (Section 2.6), relict dace (Section 2.7), and Big Springs/Lake Creek fish (Section 2.9) surveys, supplemental 24-hour water quality data were collected at Minerva Spring Complex North, Stonehouse and Keegan Spring Complexes, and Big Springs/Lake Creek Reaches 1, 4, 5 and 6 (respectively). Detailed results and discussion of the water quality sampling will be available in the forthcoming springsnail study report discussed in Section 2.4, and the forthcoming northern leopard frog, relict dace and Big Springs/Lake Creek fish survey report discussed in Section 2.6, Section 2.7 and Section2.9.

Supplemental water quality sampling was also conducted at Shoshone Ponds in 2012 to support Pahrump poolfish Recovery Implementation Team efforts. The following data were collected in summer 2012 (August 6-7): 24-hour water quality sampling was conducted in the surface waters of

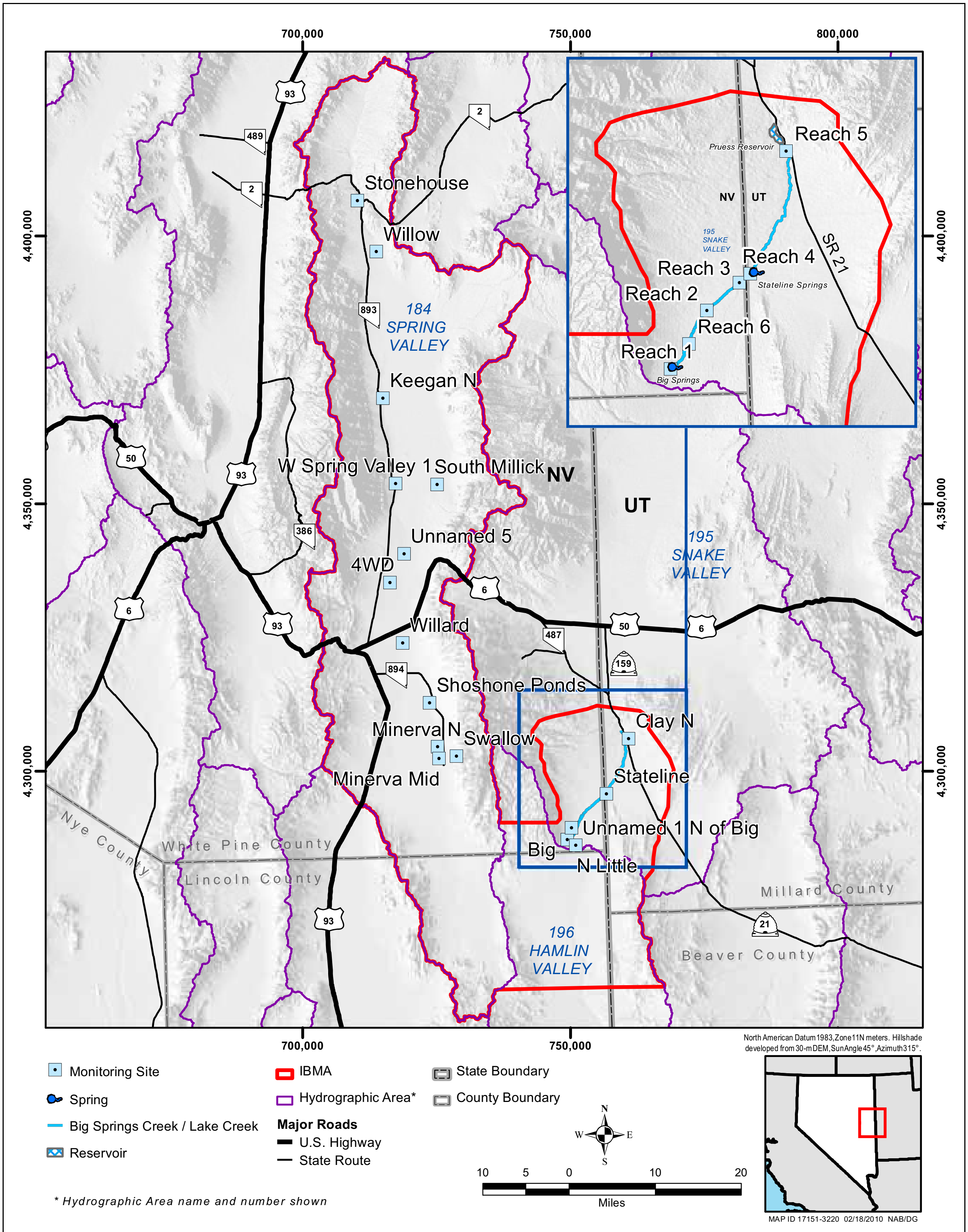

Figure 2-2
Site Assessment Monitoring Sites within the IBMA

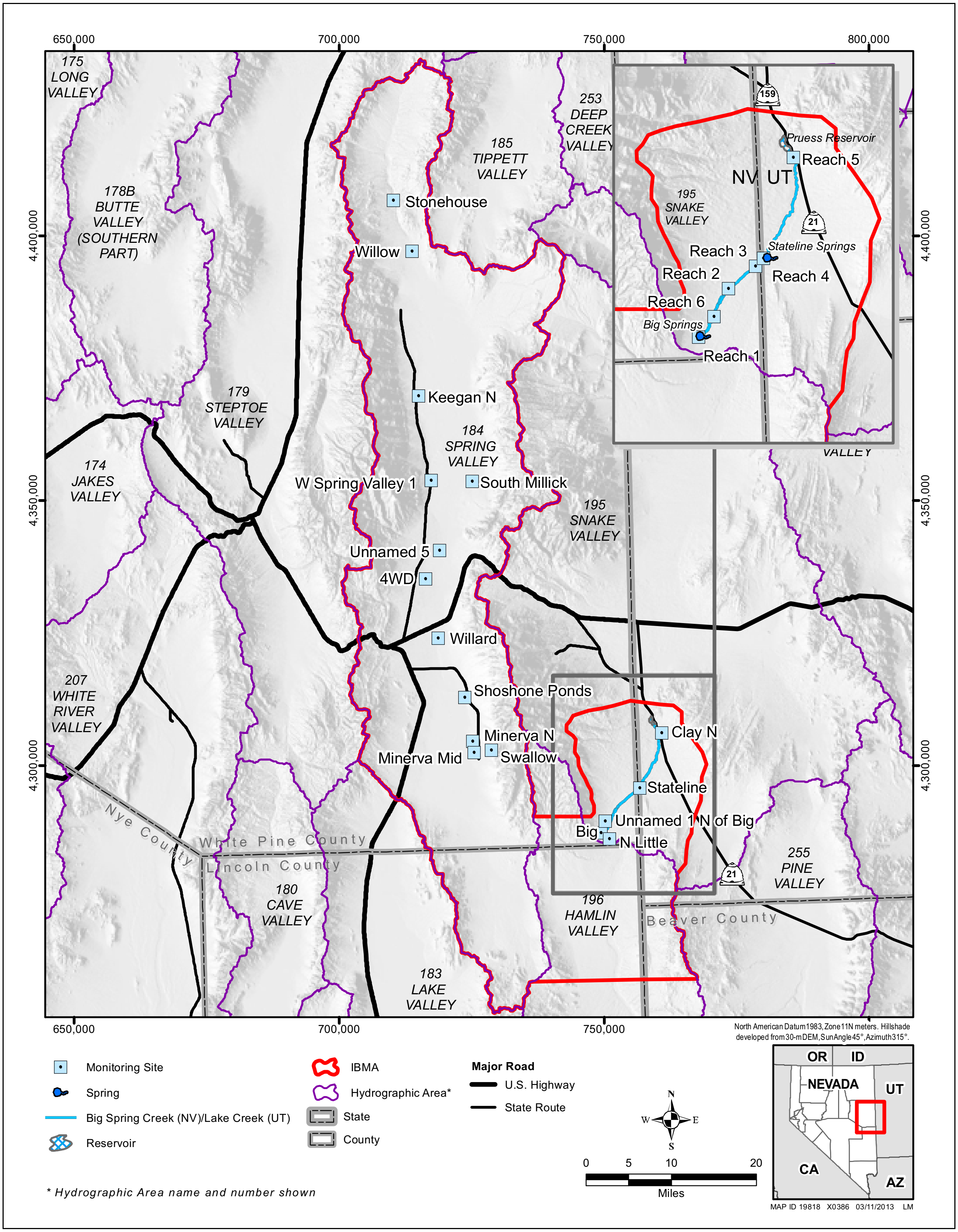

Figure 2-3
Water Quality Monitoring Sites within the IBMA

the North and Middle refuge ponds and the Stock Pond, and vertical water quality profiling was conducted in the Middle and South refuge ponds. Detailed results and discussion of the water quality sampling are available in the field report (SNWA, 2012).

NDOW collected standard water quality data in 2011-2012 as part of their annual Shoshone Ponds fish survey (Section 2.7 and Section 2.8). Data were collected in August 2011 and and 2012 at the North, Middle and South refuge ponds, the Stock Pond, and the Well #2 outflow. NDOW's 2011 and 2012 field trip reports discussed in Section 2.7 and Section 2.8 are provided in Appendix E.

2.4 Springsnails

The Plan (BWG, 2009) requires that springsnail abundance, distribution, and habitat data be collected at nine springs within Spring and Snake Valleys during the spring and fall seasons. Springsnail monitoring sites are presented in Figure 2-4.

A springsnail study was conducted in 2011-2012 in excess of the required years of baseline data collection. Data were collected periodically from April 2011 to April 2012 at Minerva Spring Complex North (1 channel) and Unnamed 1 Spring North of Big (two channels). The sites were chosen because they displayed relatively high springsnail abundance in 2009-2010 (SNWA, 2011a), and sustain different springsnail species (*Pyrgulopsis kolobensis* and *P. anguina*, respectively) (BWG, 2009). Springsnail (extent, abundance and distribution), macroinvertebrate, and habitat (24-hour water quality, vegetation cover and composition) data were collected, and sampling techniques were explored. Detailed results and discussion will be available in a forthcoming study report.

In 2011-2012, the BWG conducted an evaluation of the springsnail monitoring effort. As part of this process, USFWS hired Dr. Don Sada (Desert Research Institute) to evaluate springsnail survey efficacy. Detailed results and discussion will be available in forthcoming reports.

2.5 Macroinvertebrates

The Plan (BWG, 2009) requires that macroinvertebrate sampling be conducted at 13 springs within Spring and Snake Valleys during the spring and fall seasons. Small springs are surveyed in their entirety, and long springs and large spring complexes are surveyed within designated sample areas established in 2009. Macroinvertebrate monitoring sites are presented in Figure 2-5.

As part of the 2011-2012 springsnail study (Section 2.4), macroinvertebrate sampling was conducted at Minerva Spring Complex North (1 channel) and Unnamed 1 Spring North of Big (two channels). As part of the BWG 2011-2012 evaluation of the springsnail monitoring effort (Section 2.4), the macroinvertebrate sampling effort was evaluated at springsnail monitoring sites. Detailed results and discussion will be available in the forthcoming reports discussed in Section 2.4.

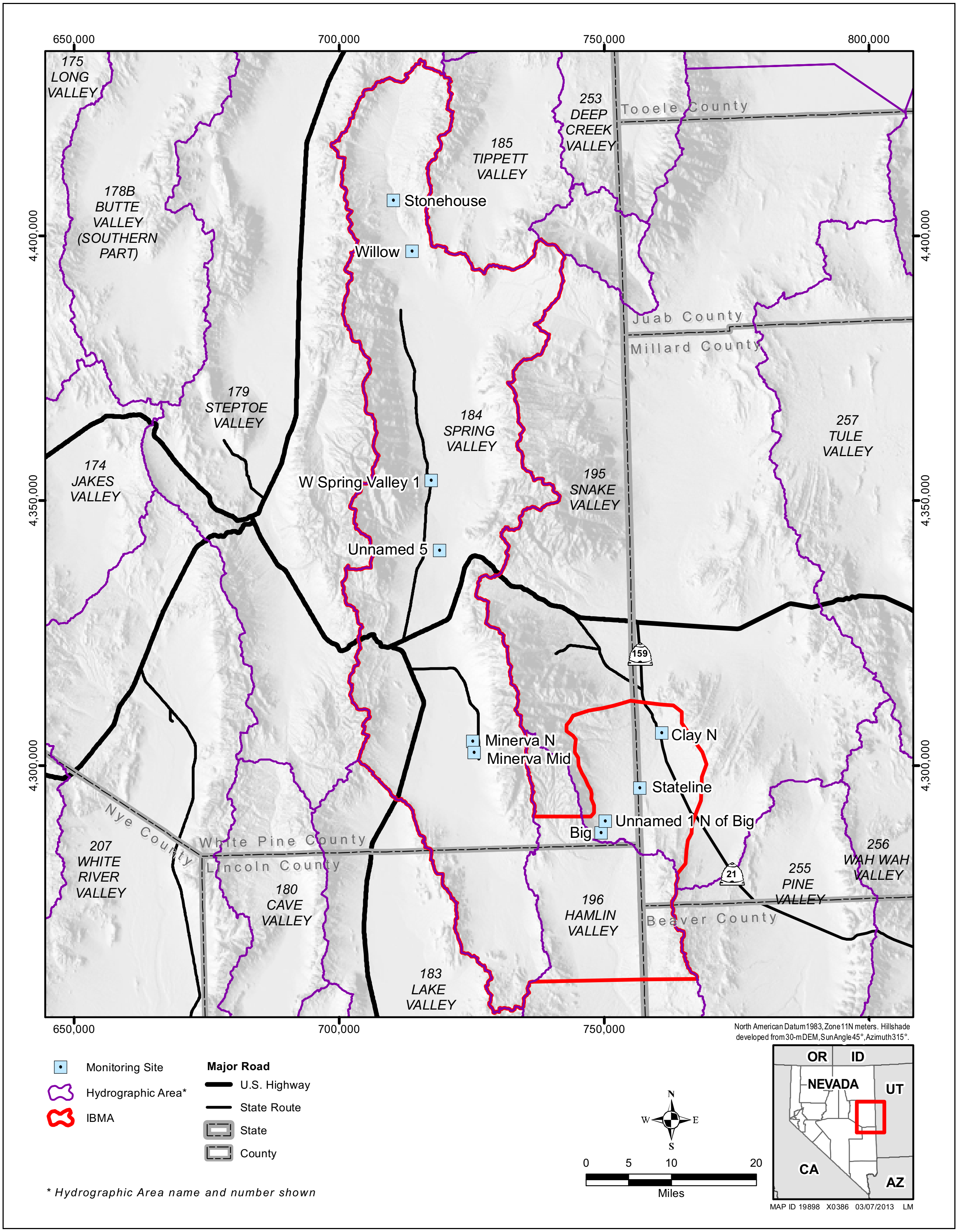

Figure 2-4
Springsnail Monitoring Sites within the IBMA

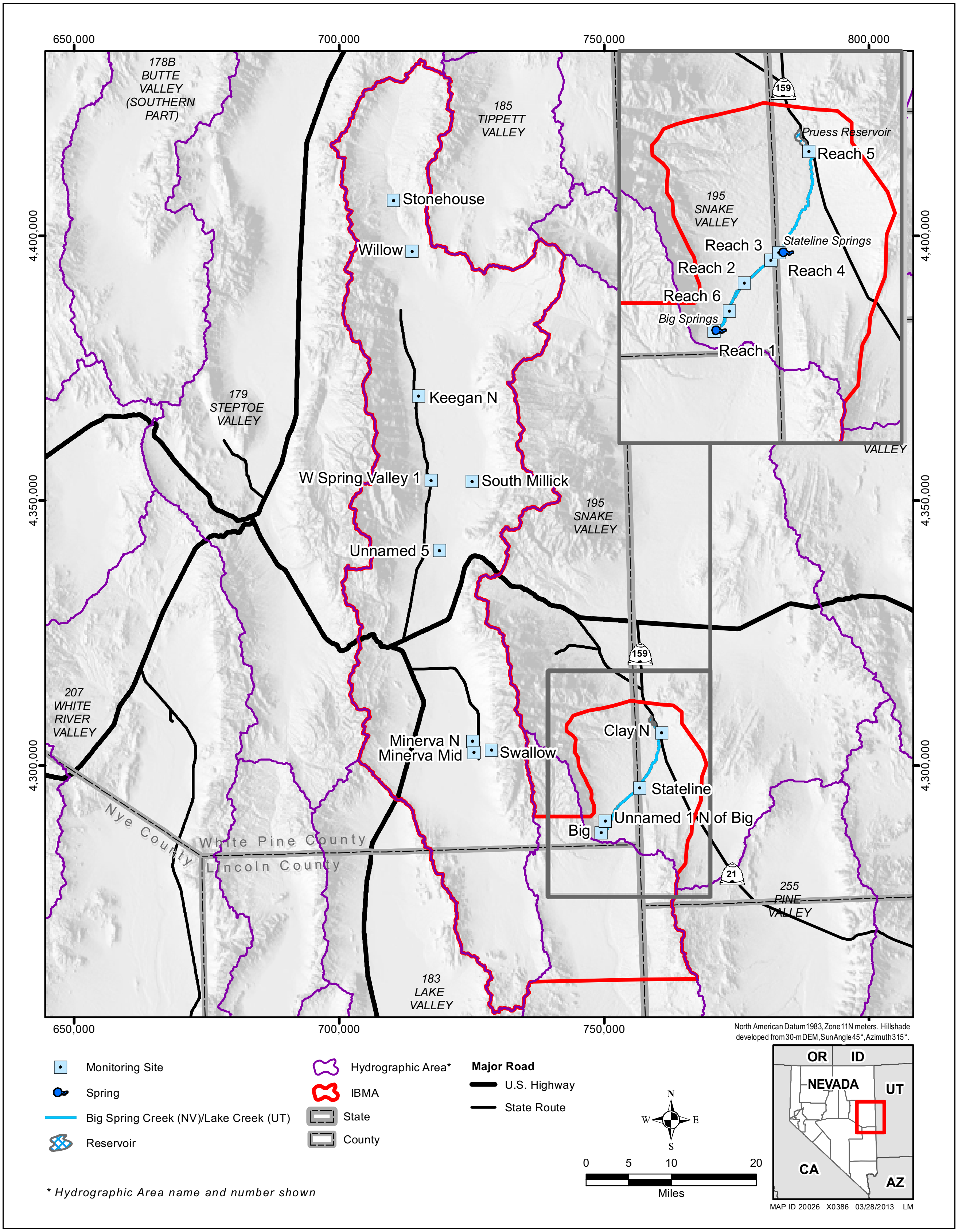

Figure 2-5
Macroinvertebrate Monitoring Sites within the IBMA

2.6 Northern Leopard Frogs

The Plan (BWG, 2009) requires that northern leopard frog egg mass and breeding habitat data be collected during the spring season at any spring monitoring sites identified in the Plan (Spring and Snake Valleys) where the species is documented. Northern leopard frog presence surveys were conducted in the first two years of data collection (2009-2010) at: 16 springs and wetlands throughout Spring and Snake Valleys; Shoshone Ponds (Spring Valley); and Big Springs/Lake Creek (Snake Valley). In accordance with the Plan, sites with no historic records of species presence and no signs of northern leopard frogs after two consecutive survey seasons were dropped from the survey protocol; if northern leopard frogs are incidentally documented at one of these sites in the future, the surveys at that site will be re-initiated (SNWA, 2011a). For the egg mass surveys, small springs are surveyed in their entirety, and long springs and large spring complexes are surveyed within designated sample areas established in 2009. Northern leopard frog previous presence and current egg mass monitoring sites are presented in Figure 2-6.

Northern leopard frog egg mass and breeding habitat data were collected at 5 springs in 2011-2012 in excess of the required years of baseline data collection. Data were collected in spring 2011 (April 12-26) at Minerva Spring Complex North, Shoshone Ponds, Unnamed 5 Spring, West Spring Valley Complex 1, and Keegan Spring Complex North; and in spring 2012 (April 9-May 9) at Minerva Spring Complex North, Shoshone Ponds, Unnamed 5 Spring, and Keegan Spring Complex North. The sites were chosen because egg masses were documented at these five sites in 2009-2010 (SNWA, 2011a). Data were collected according to the methods outlined in the Plan (BWG, 2009), changes agreed upon by the BWG (SNWA, 2010 at page 4-1), and methods described in the 2010 annual report (SNWA, 2011a). Data in 2012 were also collected according to a goal in the Plan (BWG, 2009 at page 5-16) to shift to Columbia spotted frog breeding survey protocols currently implemented by Utah Division of Wildlife Resources (UDWR, 2004); i.e., to collect habitat data not at individual egg masses (as in 2009-2011), but around egg mass clusters. Supplemental 24-hour water quality data were also collected at Minerva Spring Complex North in 2011. Detailed results and discussion will be provided in a forthcoming survey report. Northern leopard frog data are presented in Appendix C.

2.7 Relict Dace

The Plan (BWG, 2009) requires that relict dace age class and distribution data be collected at 2 springs within Spring Valley during the spring and fall seasons. These large spring complexes are surveyed within designated sample areas established in 2009. The Plan also integrates relict dace population estimates and age class structure data collected by NDOW during their annual Shoshone Ponds summer fish survey. Relict dace monitoring sites are presented in Figure 2-7.

Relict dace surveys were conducted at 2 springs in 2011-2012 in excess of the required years of baseline data collection. Data were collected in spring 2011 (May 23-25) at Keegan Spring Complex North and Stonehouse Spring Complex. For the fall 2011 and spring 2012 surveys, trapping efforts were extended beyond the original designated sample areas to determine relict dace distribution across the spring complexes. In fall 2011 (September 20-22) data were collected at Keegan Spring Complex and Stonehouse Spring Complex, and in spring 2012 (May 21-23) data were collected at Keegan Spring Complex. Data were collected according to the methods outlined in the Plan (BWG, 2009) and described in the 2010 annual report (SNWA, 2011a). Supplemental 24-hour water quality

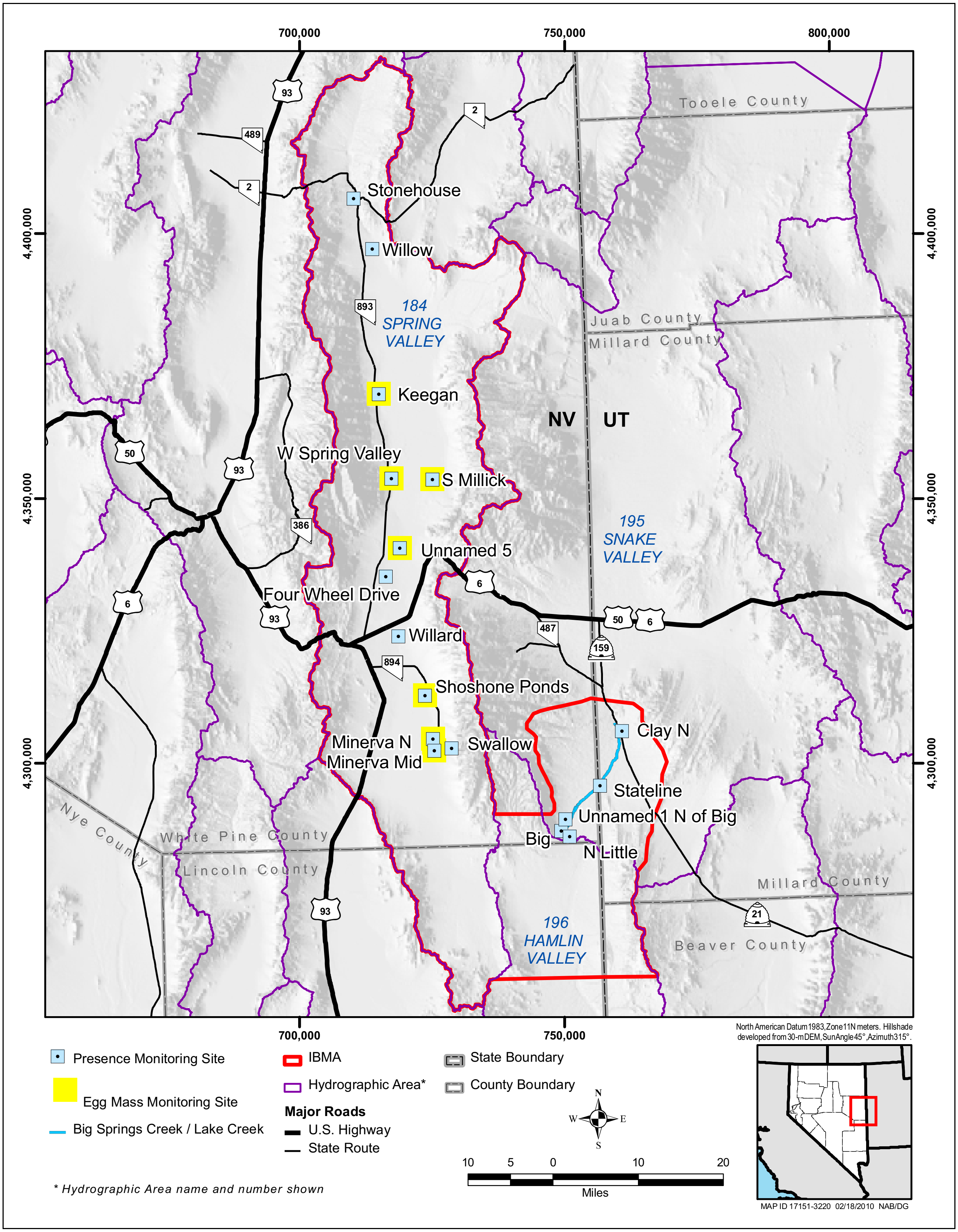

Figure 2-6
Northern Leopard Frog Monitoring Sites within the IBMA

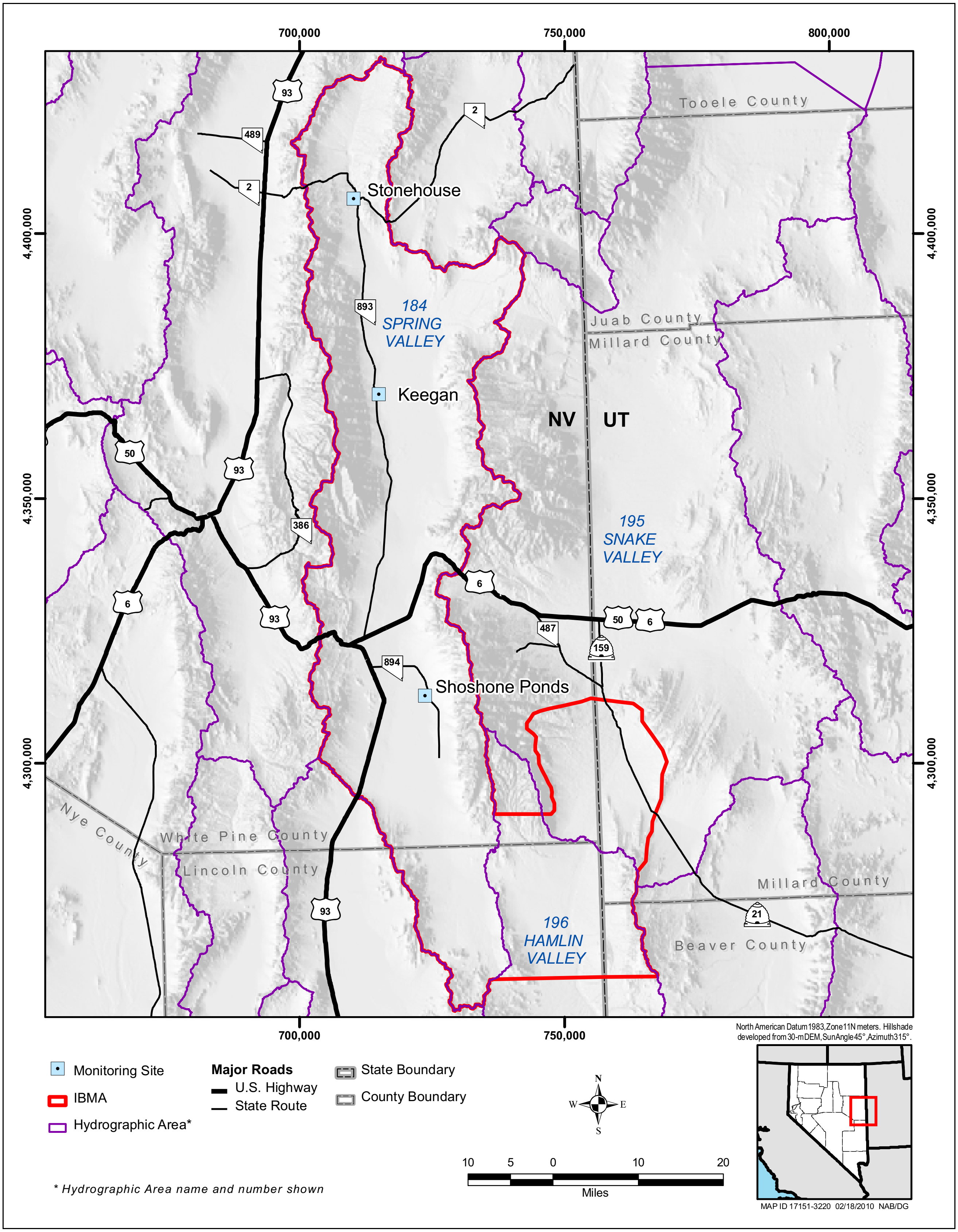

Figure 2-7
Relict Dace Monitoring Sites within the IBMA

data were also collected at Keegan Spring Complex and Stonehouse Spring Complex in fall 2011, and supplemental habitat data (water depth and aquatic vegetation cover) were collected at Keegan Spring Complex in spring 2012. Detailed results and discussion will be provided in a forthcoming survey report. Relict dace catch per unit effort (CPUE, fish/trap hour) and fish length data are presented in Appendix D.

NDOW conducted their annual Shoshone Ponds fish survey in 2011-2012. Relict dace data were collected in August 2011 and August 2012 at the South refuge pond. Standard water quality data were collected as part of their fish survey. SNWA also conducted vertical water quality profiling at the South refuge pond prior to the 2012 NDOW fish survey, as part of an SNWA 2012 Shoshone Ponds water quality study (Section 2.3). Detailed results and discussion of the SNWA water quality sampling are available in the SNWA field report (SNWA, 2012) discussed in Section 2.3, and NDOW's 2011 and 2012 field trip reports are provided in Appendix E.

In 2011-2012, the BWG conducted an evaluation of the relict dace monitoring effort. Detailed results and discussion will be available in a forthcoming report.

2.8 Pahrump Poolfish

The Plan (BWG, 2009) integrates Pahrump poolfish population estimates and age class structure data collected by NDOW during their annual Shoshone Ponds summer fish surveys. The Parhump poolfish monitoring site is presented in Figure 2-8.

NDOW conducted their annual Shoshone Ponds fish survey in 2011-2012. Pahrump poolfish data were collected in August 2011 and August 2012 at the North and Middle refuge ponds, the Stock Pond, and the Well #2 outflow. Standard water quality data were collected as part of their fish survey. To support Pahrump poolfish Recovery Implementation Team efforts, SNWA also conducted a 2012 Shoshone Ponds water quality study (24-hour water quality sampling and vertical water quality profiling) in the North and Middle refuge ponds and the Stock Pond prior to the 2012 NDOW fish survey (Section 2.3). Detailed results and discussion of the SNWA water quality sampling are available in the SNWA field report (SNWA, 2012) discussed in Section 2.3, and NDOW's 2011 and 2012 field trip reports are provided in Appendix E.

In 2011-2012, the BWG conducted an evaluation of the Pahrump poolfish monitoring effort. Detailed results and discussion will be available in a forthcoming report.

2.9 Big Springs/Lake Creek Native Fish Community

The Plan (BWG, 2009) requires that native fish species composition, relative abundance, age class structure, and distribution data be collected within Big Springs/Lake Creek (Snake Valley) reaches during the late summer or early fall season. In accordance with the Plan, five representative reaches 100 meters long were selected across the system in 2009. In accordance with changes agreed upon by the BWG (SNWA, 2010 at page 4-2), a sixth reach was added in 2010 in an effort determine the best placement of reaches between Big Springs and Stateline Springs. Reach 1-6 start and end locations were recorded in Zone 11 North, North American Datum 1983 (Zone 11N NAD 83) using a Trimble

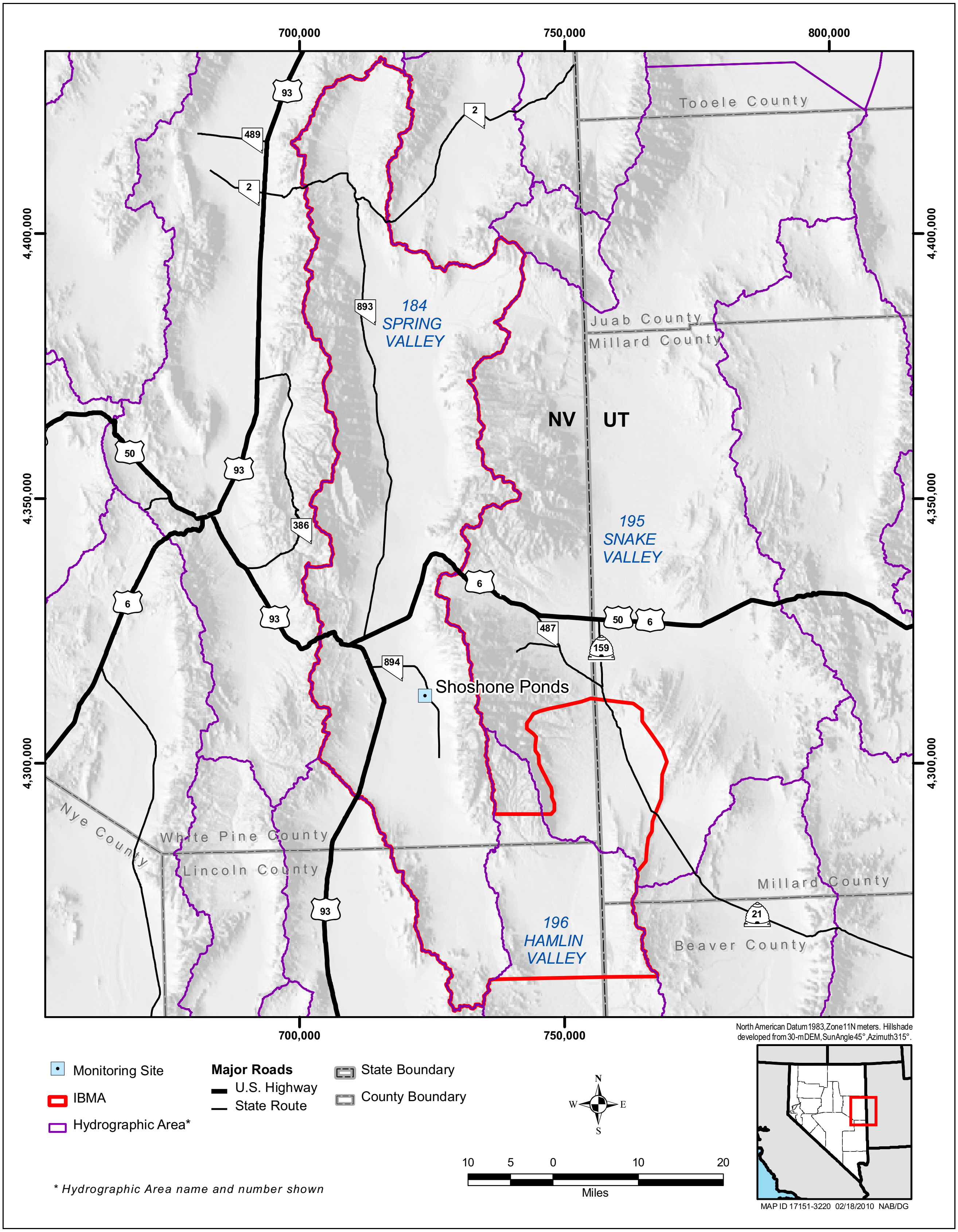

Figure 2-8
Pahrump Poolfish Monitoring Sites within the IBMA

GeoXH GPS Unit, and a geodatabase of Reach start and end locations was created in ArcGIS Software version 10.0 (ESRI). Native fish monitoring reaches are presented in Figure 2-9.

Native fish surveys were conducted at 4 Big Springs/Lake Creek reaches in 2011 in excess of the required years of baseline data collection Data were collected in late summer/early fall 2011 (August 30-31) at Reaches 1, 4, 5, and 6 (Reaches 2 and 3 were not sampled due to equipment problems). The addition of a seventh reach at Big Springs proper was investigated, but the area was determined to be inappropriate for the electrofishing sampling method. Data were collected according to the methods outlined in the Plan (BWG, 2009) and described in the 2010 annual report (SNWA, 2011a). At each reach, fish were sampled by three-pass depletion survey with a backpack electrofisher (Smith Root LR-24), and native fish species composition, relative abundance (catch per unit effort; CPUE), distribution, and age class structure (mean fish length) data were collected. Total fish numbers for each reach were estimated using a three-pass linear regression (estimate = x-axis intercept; fit of the line = R-squared value, RSV). Supplemental 24-hour water quality and supplemental habitat data (water depth, water velocity, substrate, and aquatic vegetation cover) were also collected at each reach. Detailed results and discussion will be provided in a forthcoming survey report. Big Springs/Lake Creek native fish Reach estimates, catch per unit effort (CPUE, fish/second), species composition, relative abundace, and fish length data are presented in Appendix F.

In 2011-2012, the BWG conducted an evaluation of the Big Springs/Lake Creek native fish community monitoring effort. Detailed results and discussion will be available in a forthcoming report.

2.10 Vegetation

The Plan (BWG, 2009) requires that vegetation cover and composition data be collected during the summer at transects within: 19 spring and wetland/meadow sites within Spring and Snake Valleys; phreatophytic shrublands within Spring, Hamlin and Snake Valleys; and two lower elevation Rocky Mountain juniper woodland populations in Spring Valley. Vegetation monitoring sites are presented in Figure 2-10.

In accordance with the Plan, 179 vegetation transects were established in 2009. The transects include: 122 line transects in spring, wetland and meadow habitats at biological monitoring sites within Spring and Snake Valleys; 25 line transects in greasewood (*Sarcobatus verminculatus*)-dominated phreatophytic shrubland habitats distributed across five IBMA regions (Spring Valley North, Spring Valley Middle, Spring Valley South, Hamlin Valley North, and Snake Valley South); and 32 belt transects (each composed of three 20-m line transects) in the two lower elevation Rocky Mountain juniper woodland populations within Spring Valley (SNWA, 2013). Transect endpoints were marked with capped rebar monuments, and transect endpoint and landmark locations were recorded and post-processed using professional survey-grade GPS equipment (SNWA, 2013). A geodatabase of transect endpoint and landmark locations and digitally-generated transect lines was completed in 2012. Upon request, in January 2013 SNWA submitted the vegetation transect geodatabase and the document *Southern Nevada Water Authority Vegetation Transects: Spring Valley (Hydrographic Area #184)* (SNWA, 2013) to the NSE. The document provides detailed information on the vegetation monitoring transects, including methods for transect

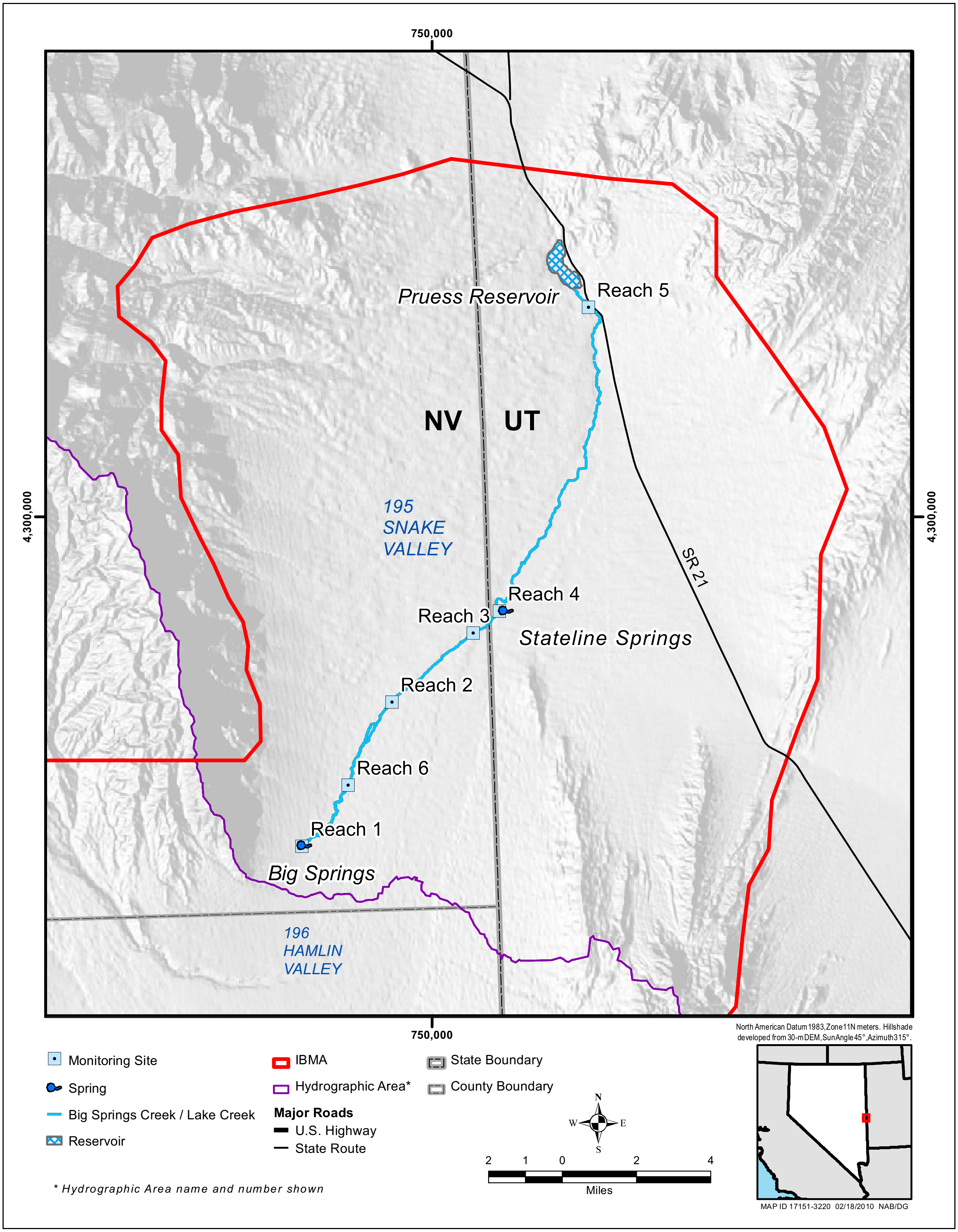

Figure 2-9
Big Springs/Lake Creek Fish Monitoring Reaches within the IBMA

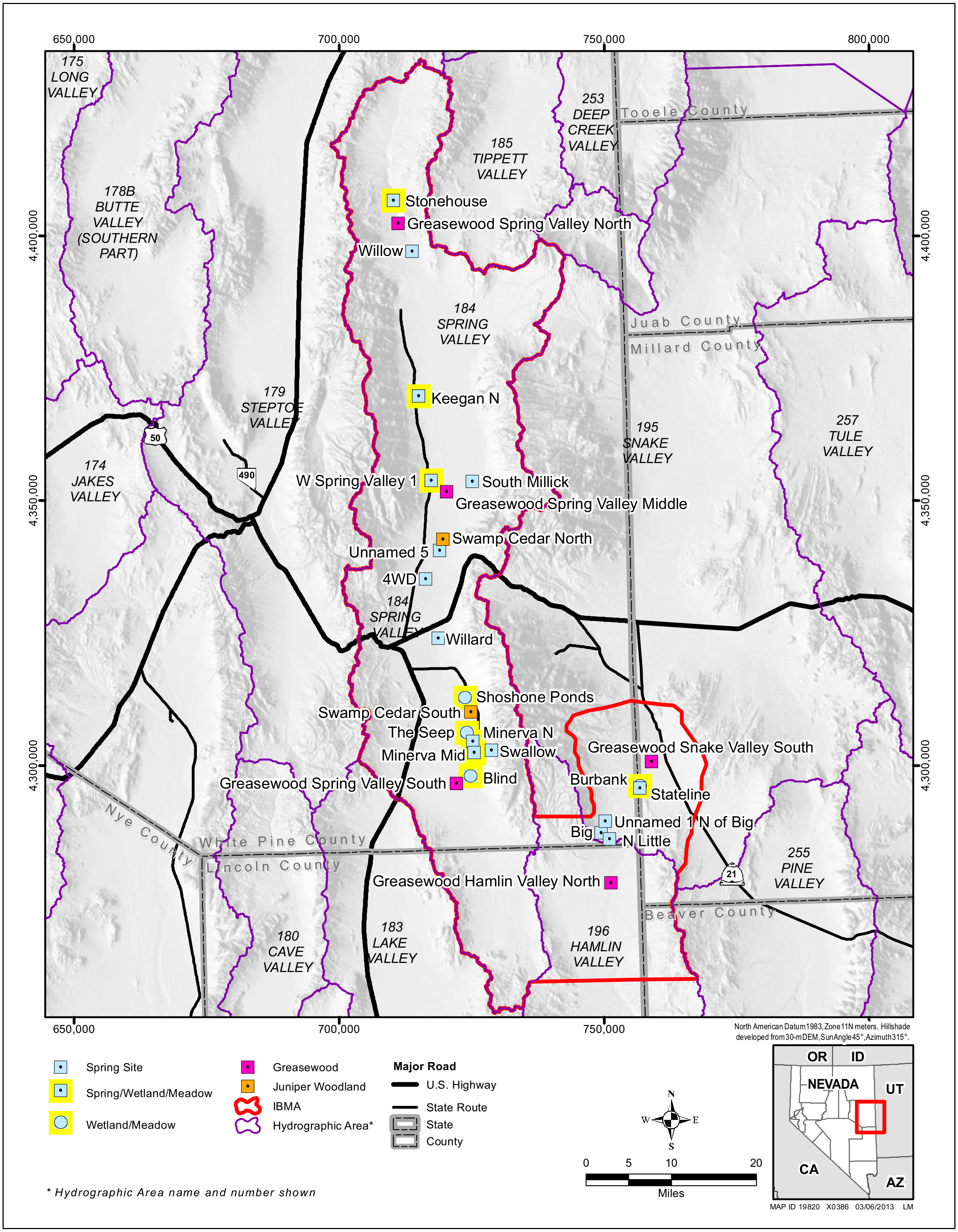

Figure 2-10
Vegetation Monitoring Sites within the IBMA

design and establishment, their spatial distribution, the types of habitats that they traverse, and their locations in relation to hydrological monitoring network components.

In 2012, SNWA began an evaluation of the vegetation survey effort. SNWA hired KS2 Ecological Field Services to evaluate vegetation transect efficacy and efficiency, and to test sampling protocols. As part of this effort vegetation cover and composition data were collected in summer 2012 (August) at 14 representative transect segments in spring/wetland/meadow habitat (Keegan Spring Complex North, Minerva Spring Complex Middle, and Shoshone Ponds), phreatophytic shrubland habitat (Greasewood Spring Valley South and Greasewood Spring Valley Middle), and phreatophytic woodland habitat (Swamp Cedar South), and 2009-2010 data were further analyzed. Detailed results and discussion will be available in a forthcoming report.

2.11 Rocky Mountain Junipers

The Plan (BWG, 2009) requires that stem elongation, tree height, tree circumference and tree count data be collected at transects within two lower elevation Rocky Mountain juniper woodland populations in Spring Valley during the summer season. The Rocky Mountain juniper monitoring sites are presented in Figure 2-11.

In accordance with the Plan, 32 belt transects were established in 2009. The transects were distributed across the two lower elevation Rocky Mountain juniper woodland populations within Spring Valley (16 transects per population) (SNWA, 2013). Within each population, based on topography and understory vegetation composition inferring typical moisture conditions, the transects were distributed across Dry Sites and Wet Sites. The belt transects are 20-m long by 5-m wide, with three 20-m line transects located along the middle and long edges of the belts (Rocky Mountain juniper data are collected within the belt transects, and vegetation cover and composition data [Section 2.10] are collected along the line transects). Transect endpoints were marked with capped rebar monuments, and transect endpoint and landmark locations were recorded and post-processed using professional survey-grade GPS equipment (SNWA, 2013). As discussed in Section 2.10, a vegetation transect geodatabase and detailed vegetation transect report (SNWA, 2013) were provided in January 2013 to the NSE.

In 2011, SNWA determined that some of the trees in Swamp Cedar North and Swamp Cedar South may have been incorrectly identified in 2009-2010 as *J. scopulorum* (Rocky Mountain juniper), when they were actually of the *J. osteosperma* (Utah juniper) species. All 32 belt transects were visited in fall and winter 2011 to verify juniper tree species. The field effort confirmed that trees in only one transect had been previously incorrectly identified: within the exception of Swamp Cedar South transect 116 where all trees were *J. osteosperma*, all other trees had been correctly identified as *J. scopulorum*. The SNWA Oracle database was updated to display the correct tree species in the vegetation cover and composition data for transect 116 (including comments to explain the modification), and to add comments in the vegetation transect coordinate data regarding tree species verification.

Stem elongation, tree height, tree circumference and tree count data were collected at 6 transects in 2011 in excess of the required years of baseline data collection. Data were collected in summer 2011 (August 22-24) at Swamp Cedar North transects 103 and 104, and Swamp Cedar South transects 114,

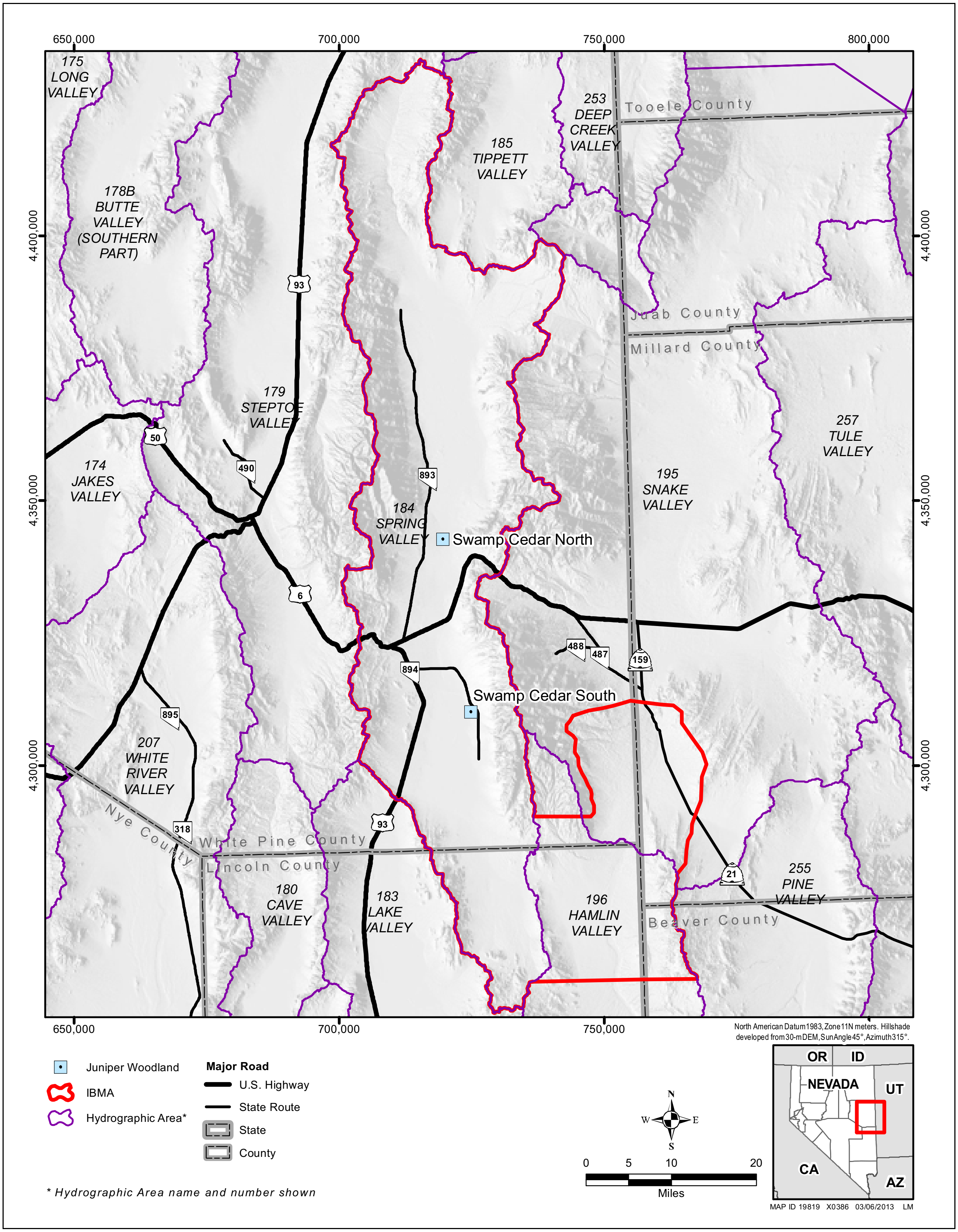

Figure 2-11
Rocky Mountain Juniper Monitoring Sites within the IBMA

115, 116, and 117. These transects were chosen because they were easily accessible. Data were collected according to the methods outlined in the Plan (BWG, 2009) and described in the 2010 annual report (SNWA, 2011a). Tree height was measured on 25 mature (height≥ 1 meter) and 25 juvenile (height < 1 meter) trees, and stem elongation data were collected by measuring tagged branches. Juniper data are presented in Appendix G.

2.12 Fixed Station Photography

The Plan (BWG, 2009) requires that fixed station photography be conducted at: 16 springs within Spring and Snake Valleys, and Shoshone Ponds (Spring Valley), during the spring and fall seasons; transects monitored for vegetation (Spring, Hamlin and Snake Valleys) during the summer season (Section 2.10); and Big Springs/Lake Creek (Snake Valley) reaches monitored for fish during the late summer or early fall season (Section 2.9). The fixed station photography monitoring sites are presented in Figure 2-12.

In accordance with the Plan, photography stations were established in 2009. In accordance with changes agreed upon by the BWG (SNWA, 2010 at page 4-1), the number of stations to monitor and the number of photographs to be taken at each station was reduced in 2010 in an effort to increase efficiency. The photography stations currently include: 53 stations at spring monitoring sites (located to capture representative aquatic areas where biological surveys are conducted); 6 stations at Big Springs/Lake Creek fish monitoring reaches (one location at each reach); and 179 stations at vegetation transects (one endpoint at each of the 179 transects [Section 2.10]). Photography stations at springs were marked with capped rebar monuments, and the station and landmark locations were recorded and post-processed using professional survey-grade GPS equipment. A geodatabase of photography station and landmark locations was completed in 2012.

Fixed station photography was conducted at 7 springs in 2011 in excess of the required years of baseline data collection. Photographs were taken in fall 2011 (September 6-8) during physical habitat mapping (Section 2.1) at Four Wheel Drive Spring, Keegan Spring Complex North, Minerva Spring Complex North, Unnamed 5 Spring, West Spring Valley Complex 1, Willard Spring, and Willow-NV Spring. Data were collected according to the methods outlined in the Plan (BWG, 2009) and described in the 2010 annual report (SNWA, 2011a). Photographs taken at each site are listed in Appendix H. Copies of the photographs are available upon request.

2.13 Data Management and Reporting

A data management system was developed in 2009 to manage data required under the Spring Valley Stipulation (Stipulation, 2006) and NSE Ruling 6164 (NSE, 2012). The data management workflow process includes archival storage of original data, standardized data sheets and geographic information system (GIS) files, rigorous multistep Quality Assurance/Quality Control (QA/QC) of digital data, storage of final data in a secure network location, and file back-ups on a regularly scheduled basis. Data required under the Stipulation and Ruling 6164 are also uploaded into a secure Relational Database Management System. Final data are provided to the NSE, EC, BWG, and TRP via a data-exchange web site, and are available to the public.

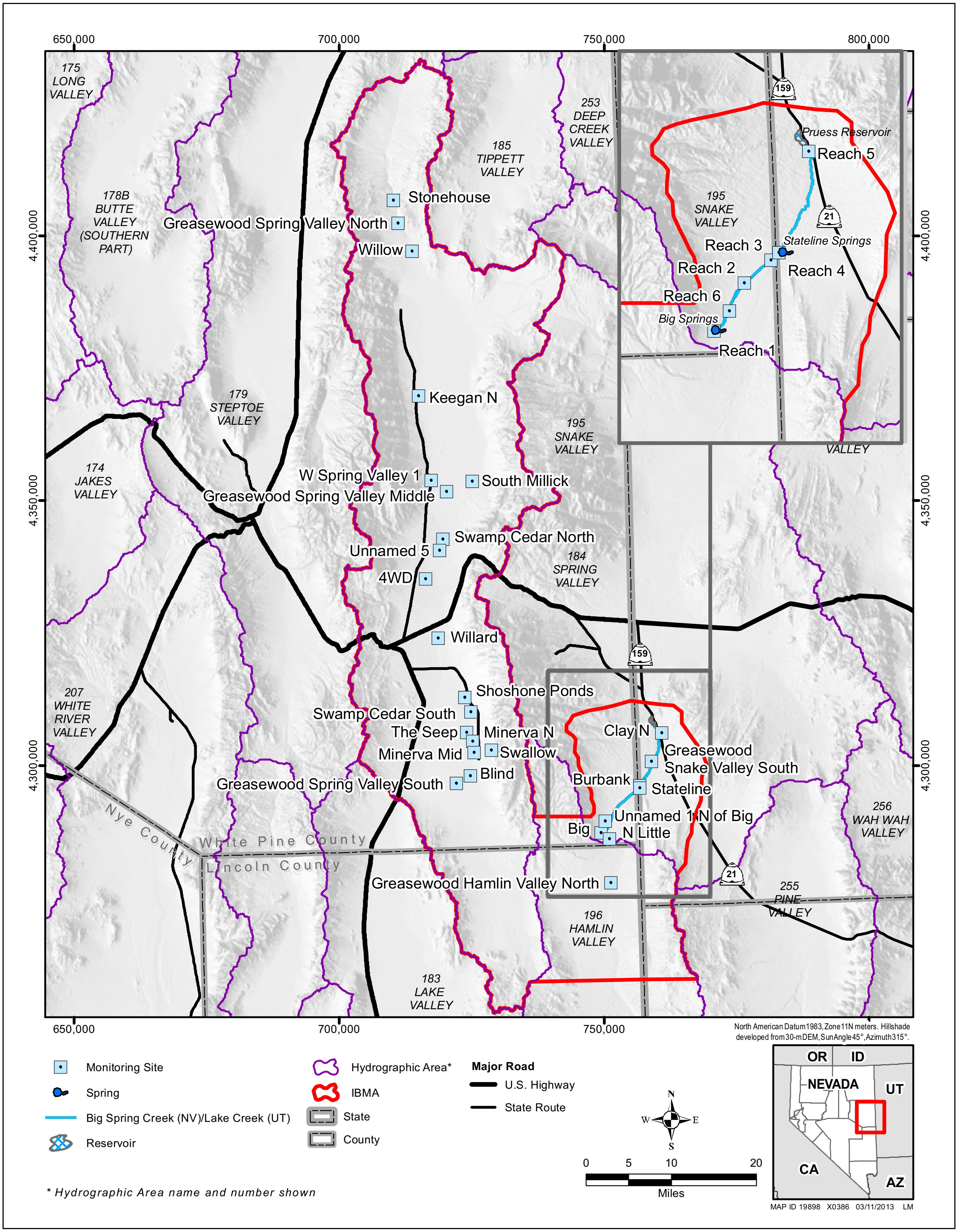

Figure 2-12
Fixed Station Photography Monitoring Sites within the IBMA

A data-exchange web site accessible by the NSE, EC, BWG, and TRP members was implemented in 2008. This secure web site is used to distribute monitoring data to the NSE and BWG within 90 days of required data collection. SNWA is also using the data-exchange web site to distribute additional biological data and reports in excess of the required years of baseline data collection.

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3.0 ANTICIPATED 2013 BIOLOGICAL MONITORING PLAN ACTIVITIES

Anticipated Plan activities in 2013 are summarized below.

- SNWA will continue to conduct interim-period surveys and data analyses as feasible, and distribute data and reports via the data-exchange web site.
- SNWA will coordinate activites with the other members of the BWG .
- BWG plans to complete current evaluations of springsnail, relict dace, Pahrump poolfish, and Big Springs/Lake Creek native fish monitoring efforts.
- SNWA will work with USFS to obtain right-of-way access for biological monitoring at Chokecherry Spring.

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4.0 REFERENCES

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Appendix A

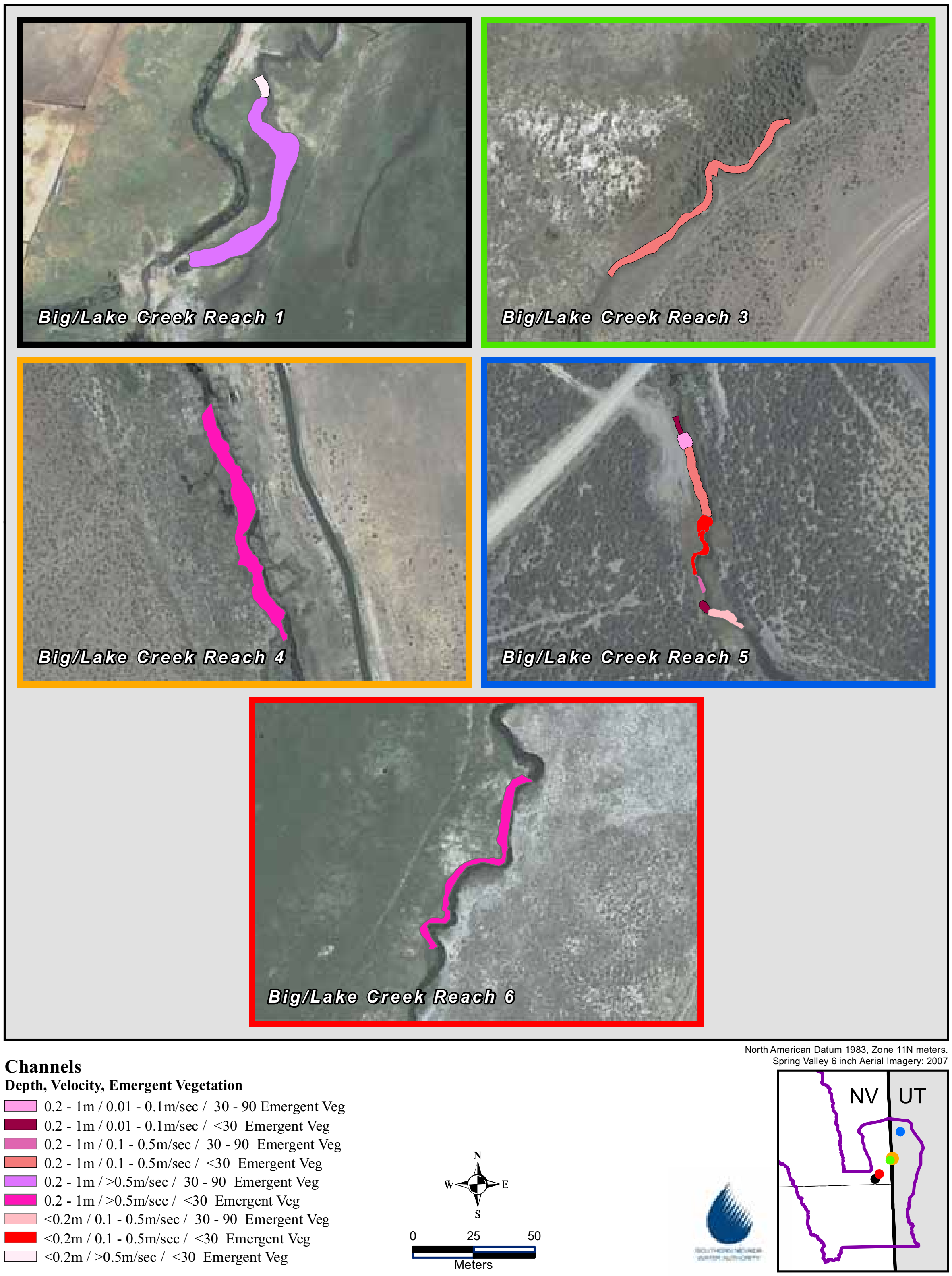
Physical Habitat Mapping Data

Table A-1 Physical Habitat Map Summary
Mapped Aquatic Area (m^2) by Site and Hydromorphological Unit (Pools, Channels), 2011-2012

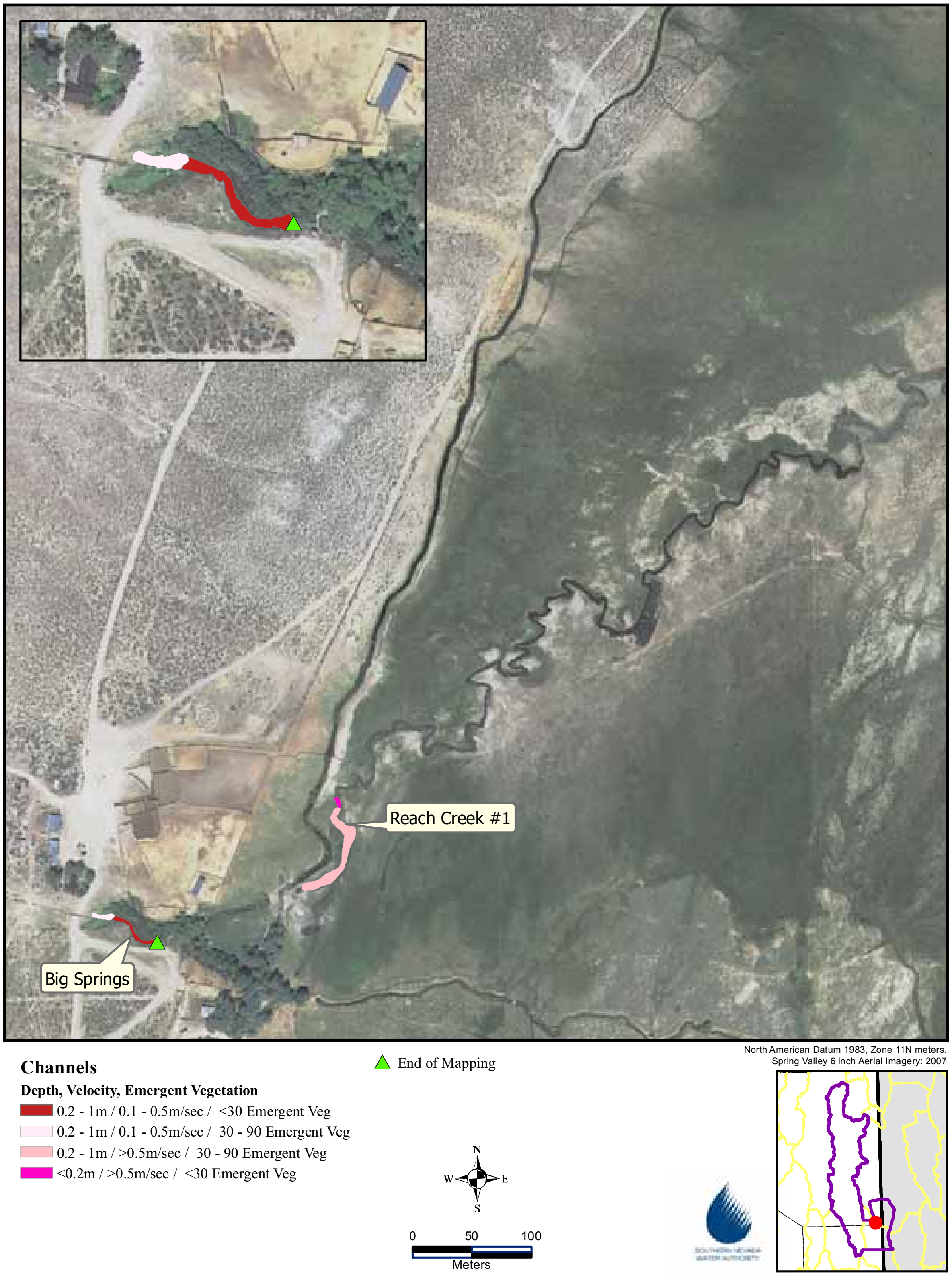
Site[1]	Fall 2011			Spring 2012		
	Channels	Pools	Total Area	Channels	Pools	Total Area
Big Springs/Lake Creek Reach 1	689	0	689			Not surveyed
Big Springs/Lake Creek Reach 3	342	0	342			Not surveyed
Big Springs/Lake Creek Reach 4	593	0	593			Not surveyed
Big Springs/Lake Creek Reach 5	309	0	309			Not surveyed
Big Springs/Lake Creek Reach 6	372	0	372			Not surveyed
Big Springs	247	0	247			Not Surveyed
Four Wheel Drive Spring	151	197	348			Not surveyed
Keegan Spring Complex North[2]	1137	11503	12640			Not surveyed
Minerva Spring Complex North	554	1266	1820	331	1304	1635
Unnamed 5 Spring	1218	1695	2913			Not surveyed
West Spring Valley Complex 1	995	391	1386			Not surveyed
Willard Spring	0	0.4	0.4	37	46	83
Willow-NV Spring	130	41	171			Not surveyed

[1] Long springs and large spring complexes are mapped within designated sample areas, and standing water in surrounding wetlands are not mapped.
[2] Compared to 2009 and 2010 (SNWA, 2010 and 2011a), in 2011 a smaller portion of the original Keegan Spring Complex designated sample area was mapped, omitting the upstream section largely characterized by narrow springbrook channels.

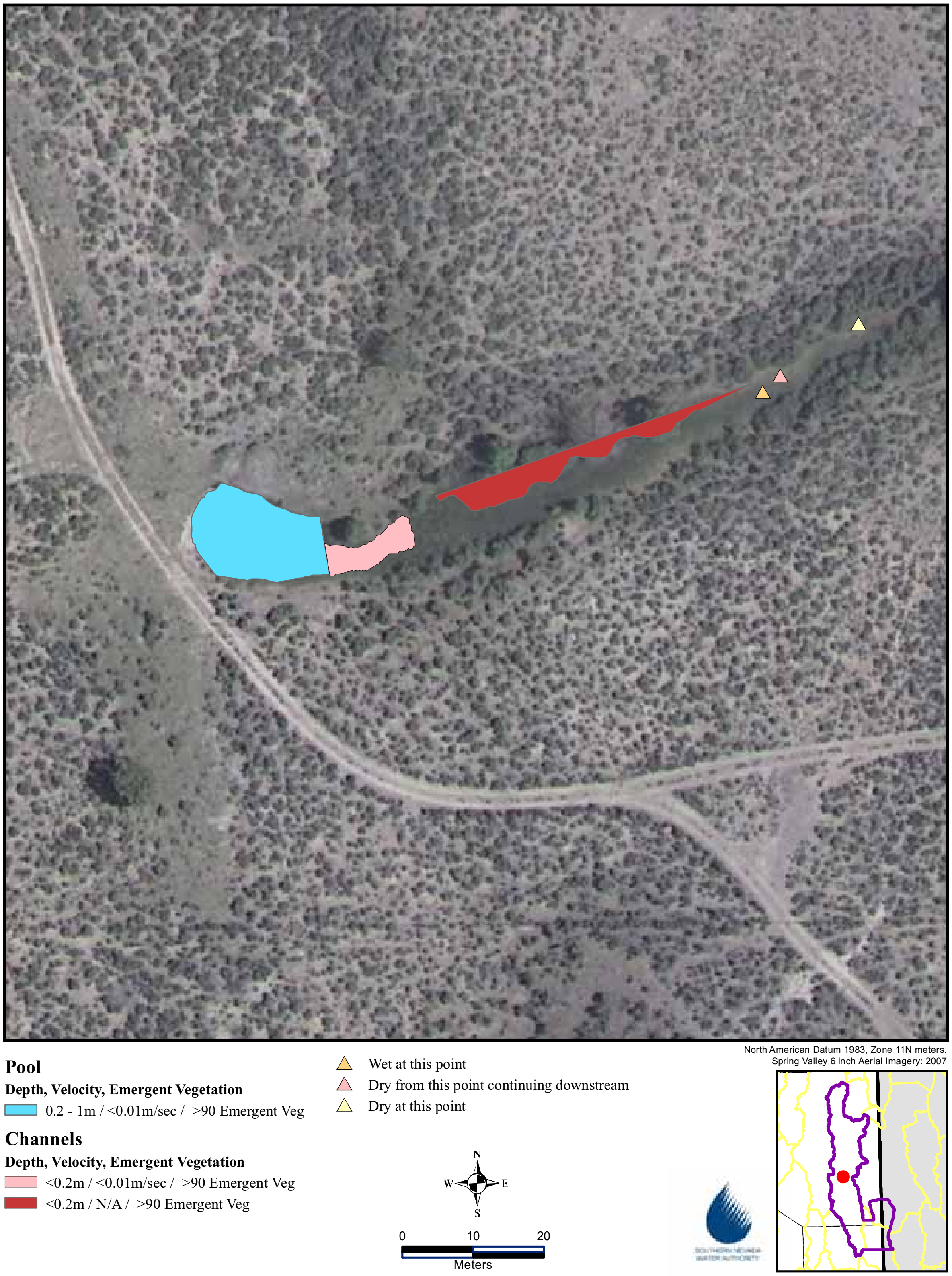
Figure A-1 Physical Habitat Maps 2011-2012



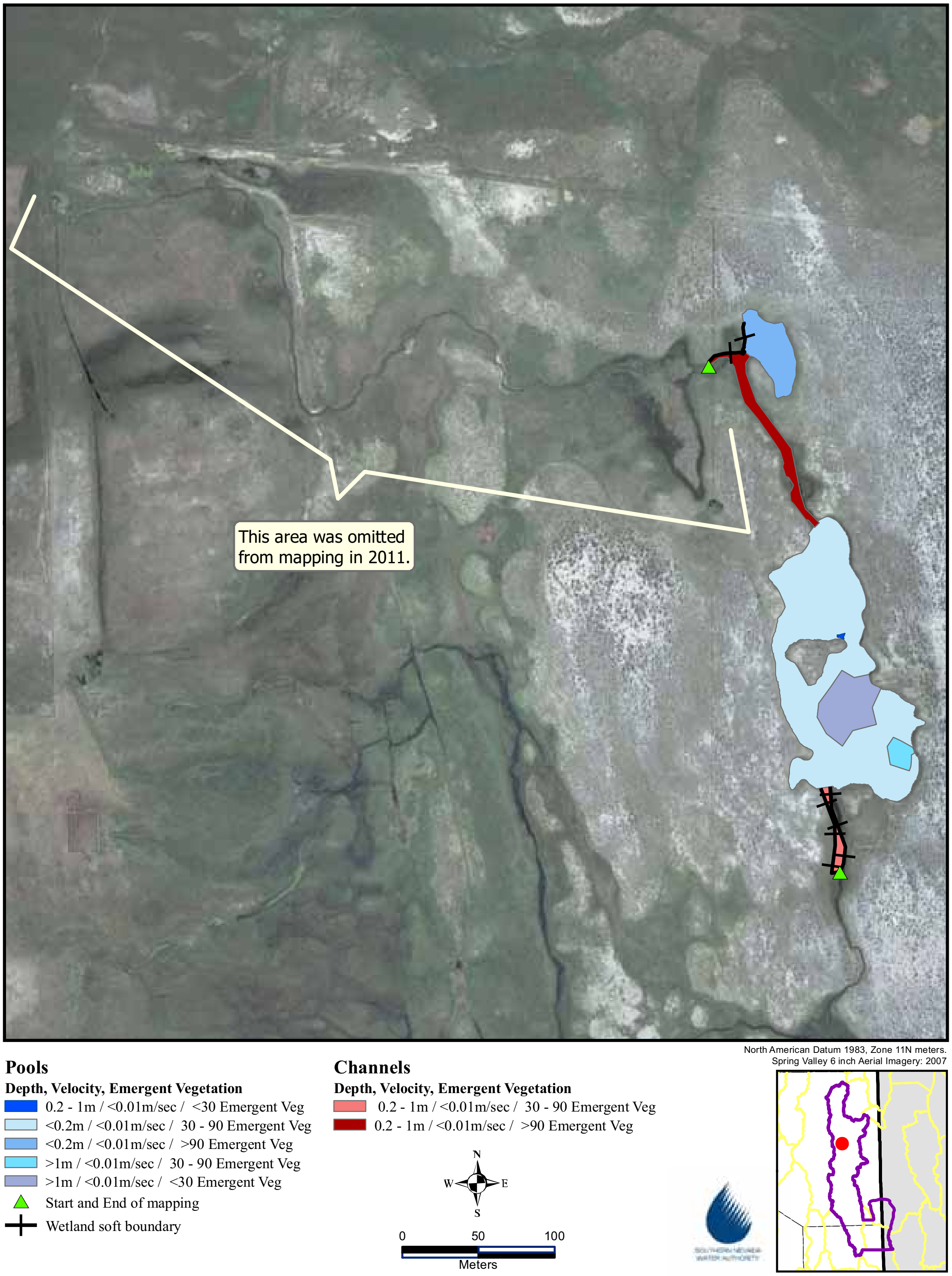
Big Springs/Lake Creek, Late Summer/Early Fall 2011-2012



Big Springs, Fall 2011



Four Wheel Drive Spring, Fall 2011



Keegan Spring Complex North, Fall 2011

Pools

Depth, Velocity, Emergent Vegetation

- >1m / <0.01m/sec / 30 - 90 Emergent Veg
- 0.2 - 1m / <0.01m/sec / <30 Emergent Veg
- <0.2m / <0.01m/sec / >90 Emergent Veg

Channels

Depth, Velocity, Emergent Vegetation

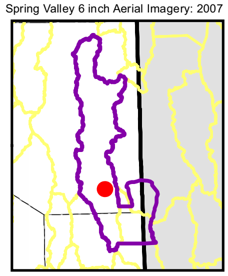
- <0.2m / 0.01 - 0.1m/sec / >90 Emergent Veg
- <0.2m / 0.1 - 0.5m/sec / 30 - 90 Emergent Veg

End of Mapping

N W E S

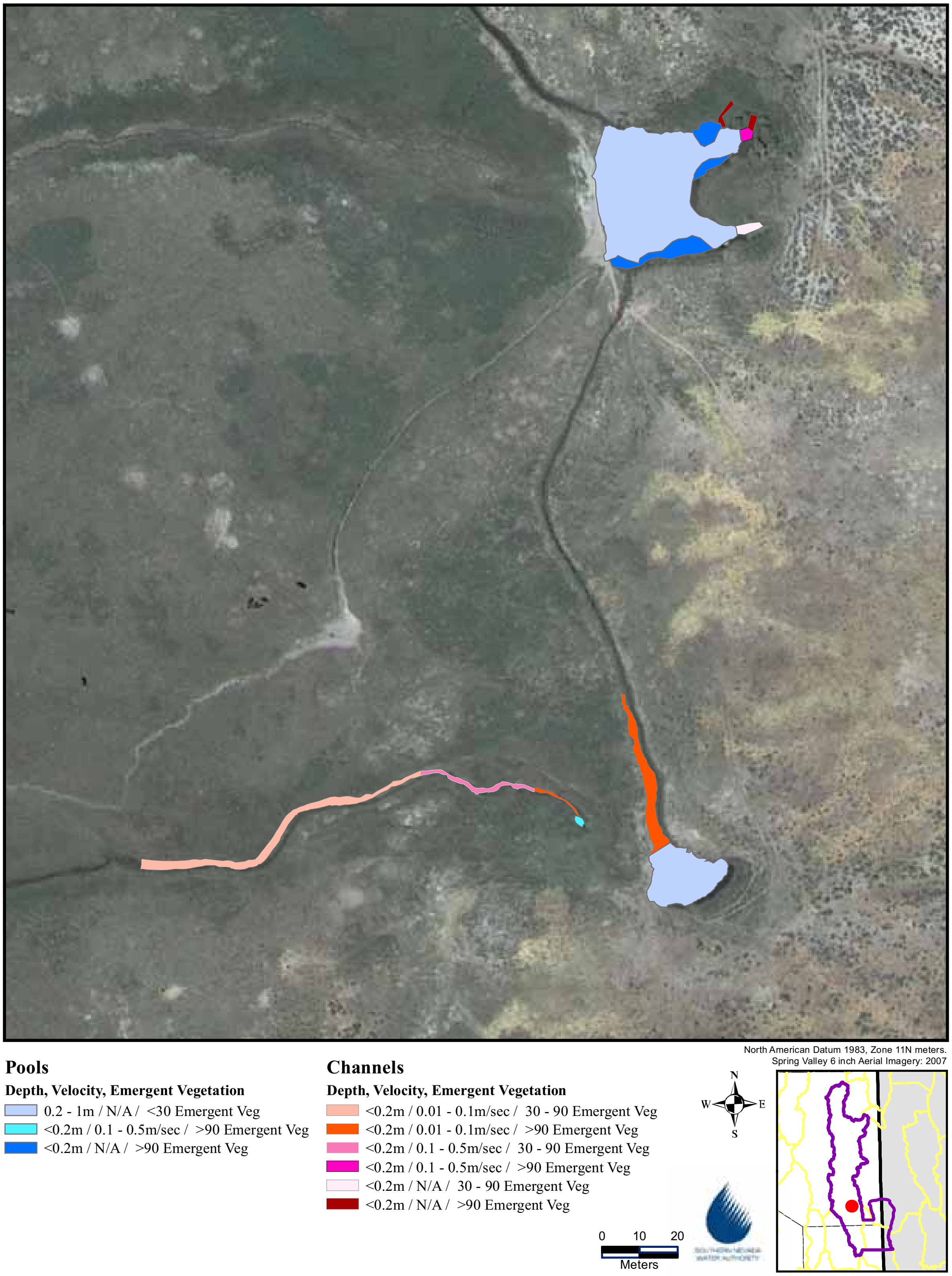
0 10 20 Meters

North American Datum 1983, Zone 11N meters.
Spring Valley 6 inch Aerial Imagery: 2007

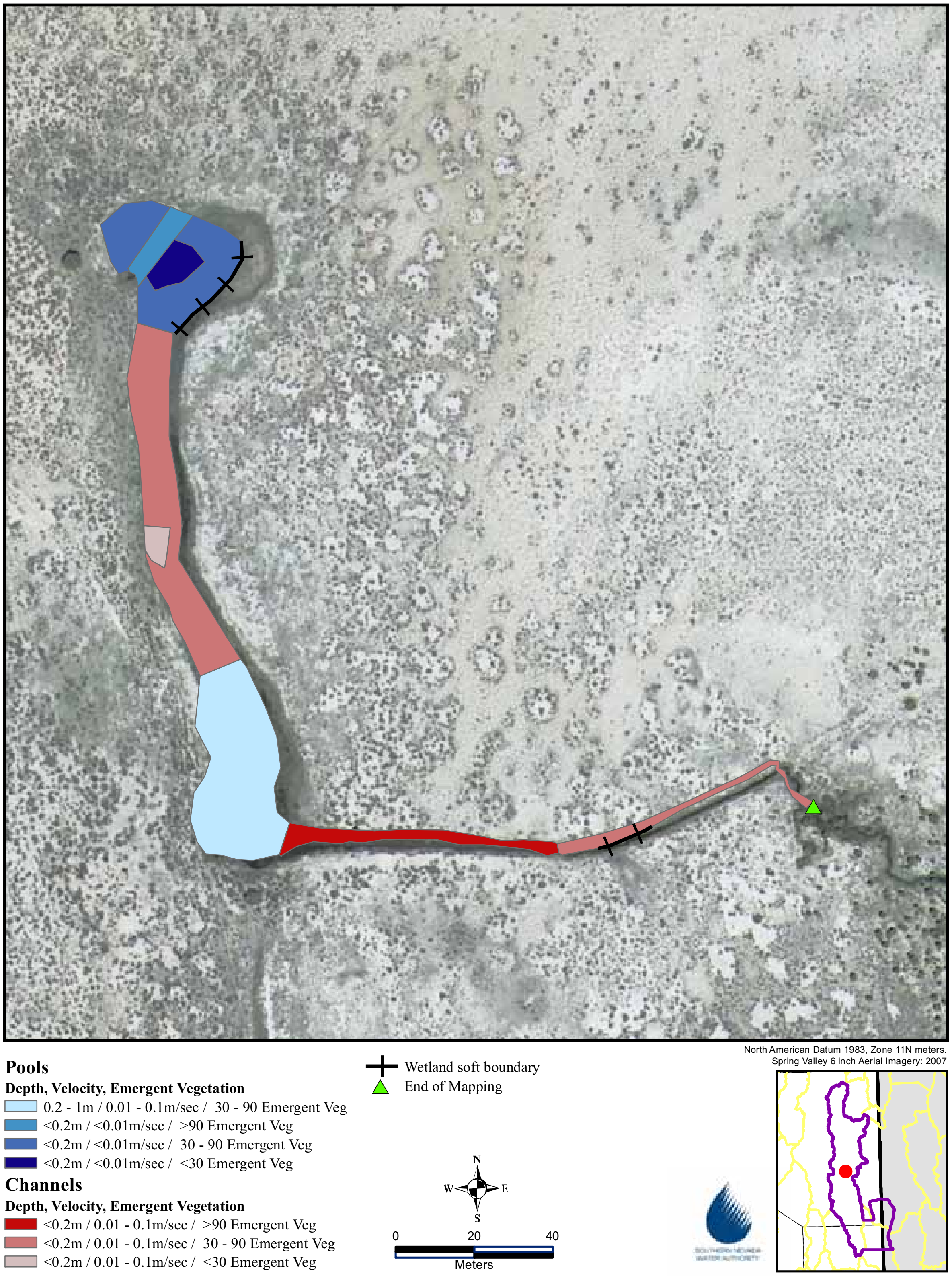


MAP ID 19757 X0386 ER 02/26/2013 LM

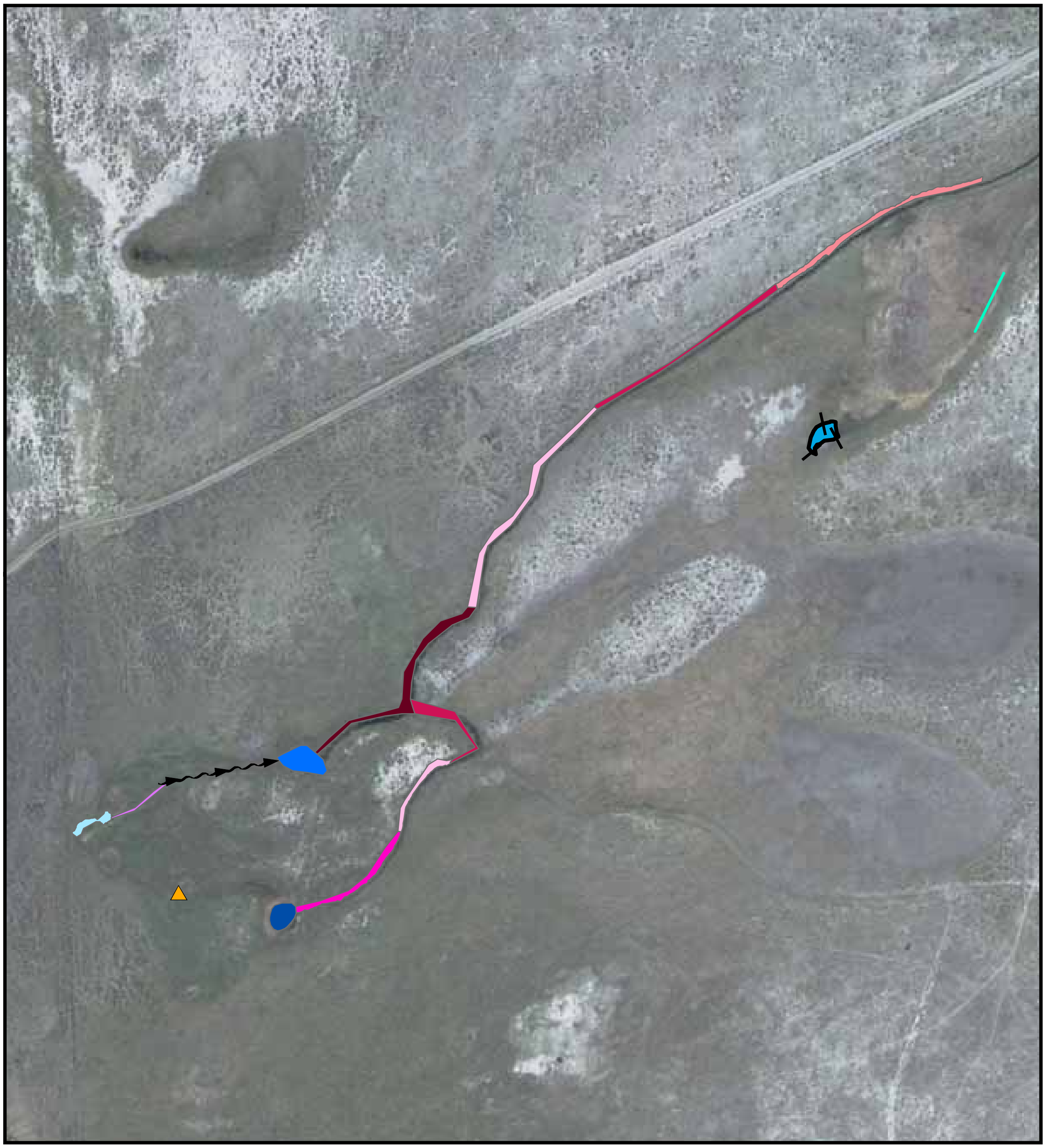
Minerva Spring Complex North, Fall 2011



Minerva Spring Complex North, Spring 2012



Unnamed 5 Spring, Fall 2011



Pools

Depth, Velocity, Emergent Vegetation

- 0.2 - 1m / <0.01m/sec / 30 - 90 Emergent Veg
- 0.2 - 1m / <0.01m/sec / <30 Emergent Veg
- 0.2 - 1m / <0.01m/sec / >90 Emergent Veg
- <0.2m / <0.01m/sec / >90 Emergent Veg
- >1m / <0.01m/sec / 30 - 90 Emergent Veg
- Very small wetland at this point
- Direction of undefined flow
- Wetland soft boundary

Channels

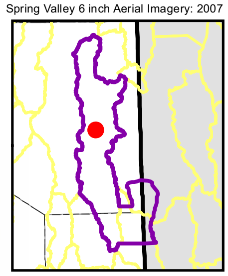
Depth, Velocity, Emergent Vegetation

- 0.2 - 1m / <0.01m/sec / >90 Emergent Veg
- 0.2 - 1m / 0.01 - 0.1m/sec / 30 - 90 Emergent Veg
- 0.2 - 1m / 0.01 - 0.1m/sec / >90 Emergent Veg
- 0.2 - 1m / <0.01m/sec / 30 - 90 v
- <0.2m / 0.01 - 0.1m/sec / >90 Emergent Veg
- <0.2m / <0.01m/sec / >90 Emergent Veg

North American Datum 1983, Zone 11N meters.
Spring Valley 6 inch Aerial Imagery: 2007

N W E S

0 25 50
Meters



MAP ID 19759 X0386 ER 02/26/2013 LM

West Spring Valley Complex 1, Fall 2011

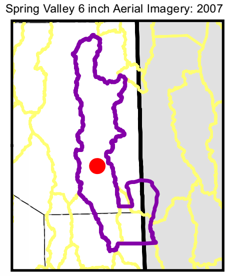
Pool
Depth, Velocity, Emergent Vegetation
<0.2m / <0.01m/sec / <30 Emergent Veg

Moist soil

N
W E
S

0 10 20
Meters

North American Datum 1983, Zone 11N meters.
Spring Valley 6 inch Aerial Imagery: 2007



MAP ID 19761 X0386 ER 02/26/2013 LM

Willard Spring, Fall 2011

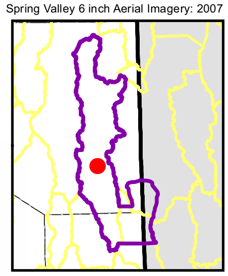
North American Datum 1983, Zone 11N meters.
Spring Valley 6 inch Aerial Imagery: 2007

Pool
Depth, Velocity, Emergent Vegetation
<0.2m / N/A / >90 Emergent Veg

Channel
Depth, Velocity, Emergent Vegetation
<0.2m / N/A / >90 Emergent Veg

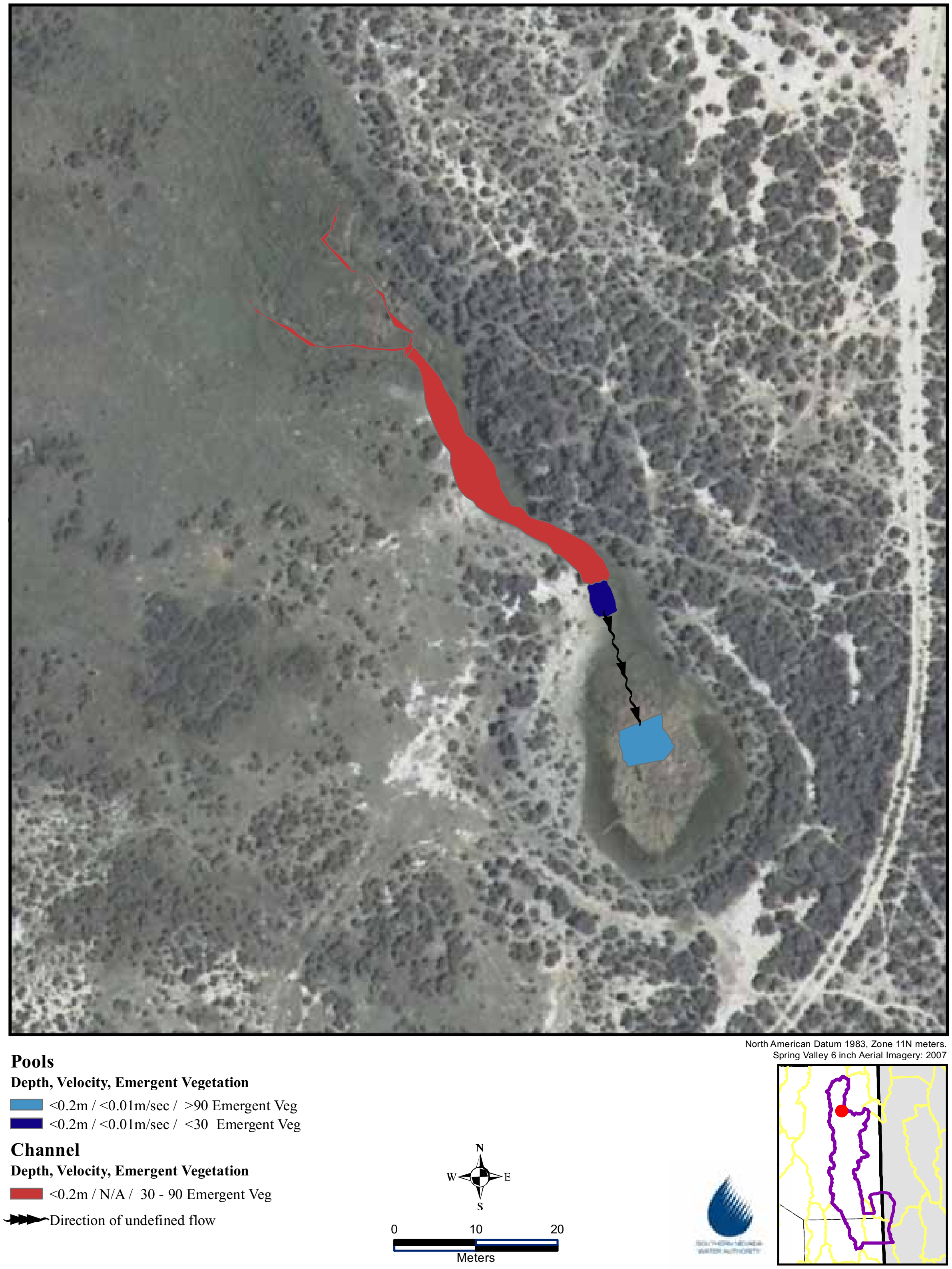
N W E S

0 10 20
Meters



MAP ID 19762 X0386 ER 02/26/2013 LM

Willard Spring, Spring 2012

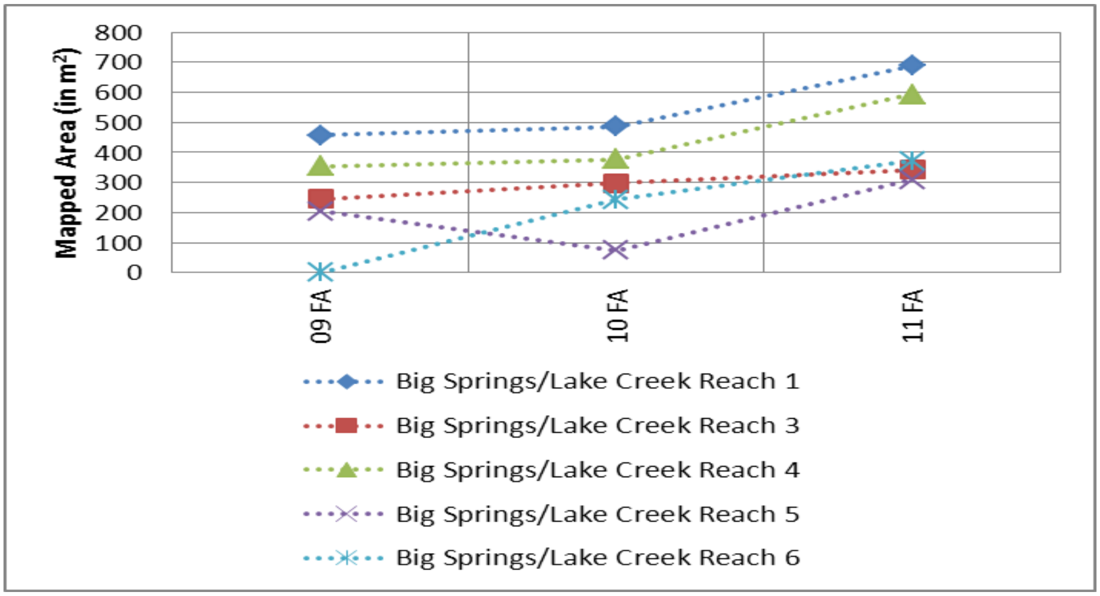


Willow Spring, Fall 2011

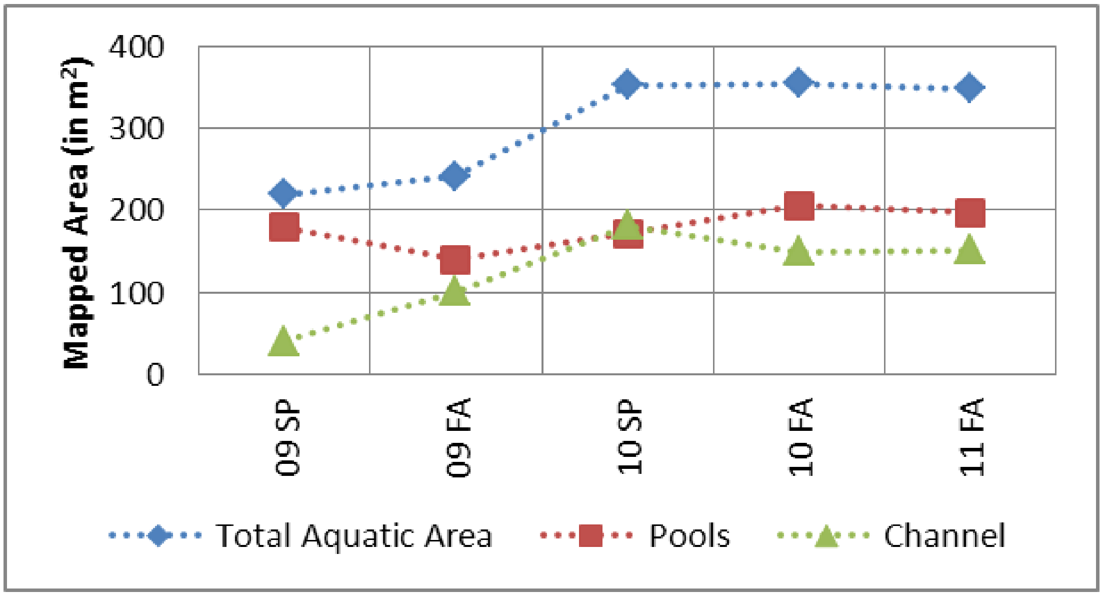
Figure A-2 Physical Habitat Map Time Series Graphs: Mapped Aquatic Area

Time series by year (09 = 2009) and season (SP = Spring, FA = Fall)

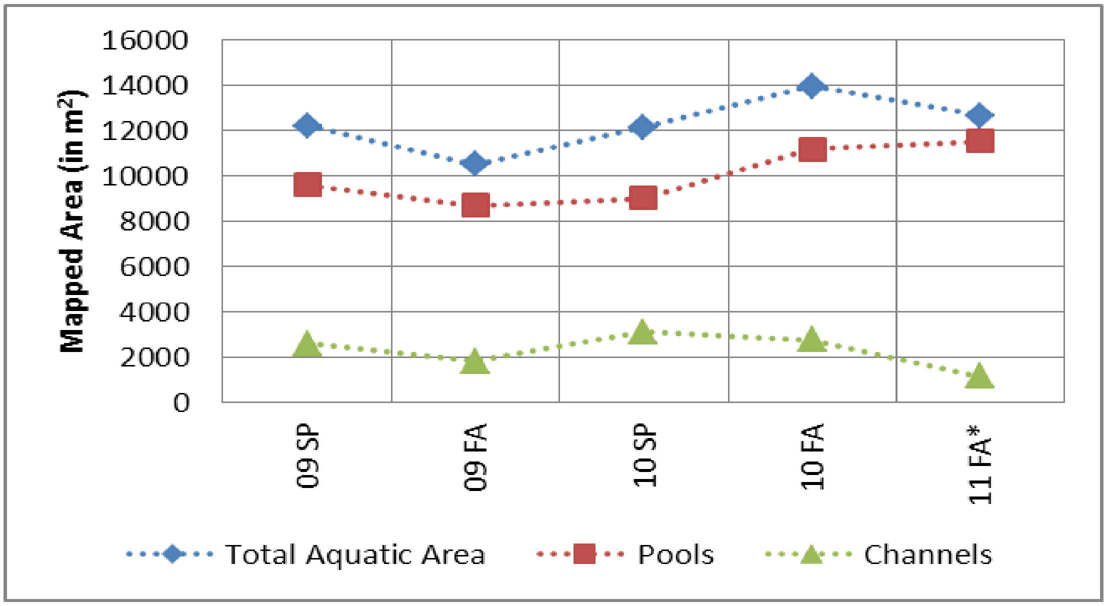
Data shown only for sites visited in 2011 and 2012. Previous data collected for other monitoring sites see SNWA (2011a).



Big Springs/Lake Creek Reaches (Reach 2 not mapped in 2011)

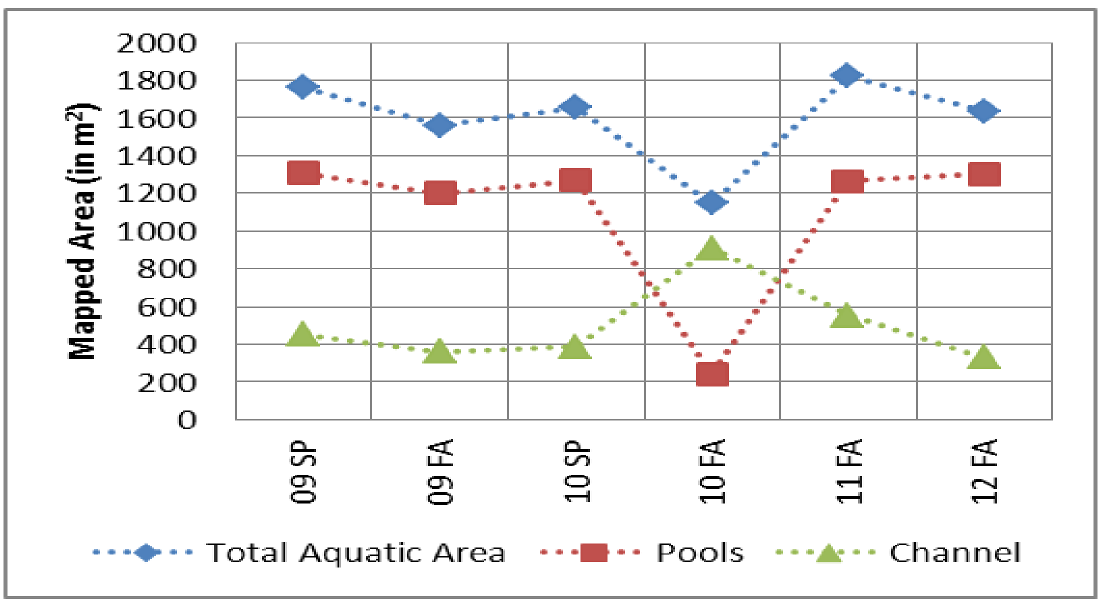


Four Wheel Drive Spring

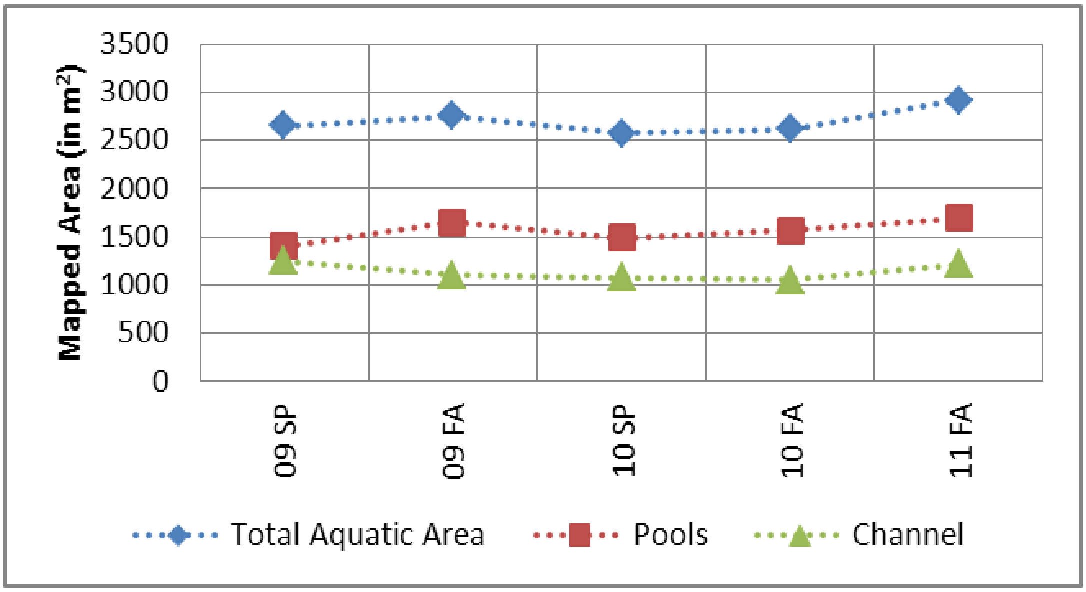


Keegan Spring Complex North

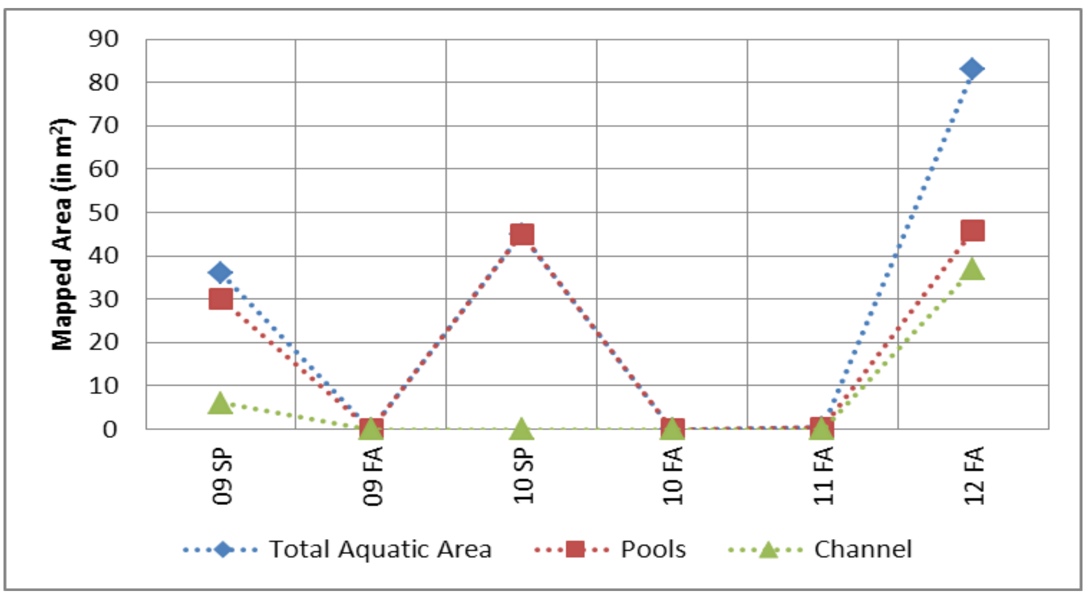
Compared to 2009 and 2010 (SNWA, 2010 and 2011a), in 2011 a smaller portion of the original Keegan Spring Complex designated sample area was mapped, omitting the upstream section largely characterized by narrow springbrook channels.



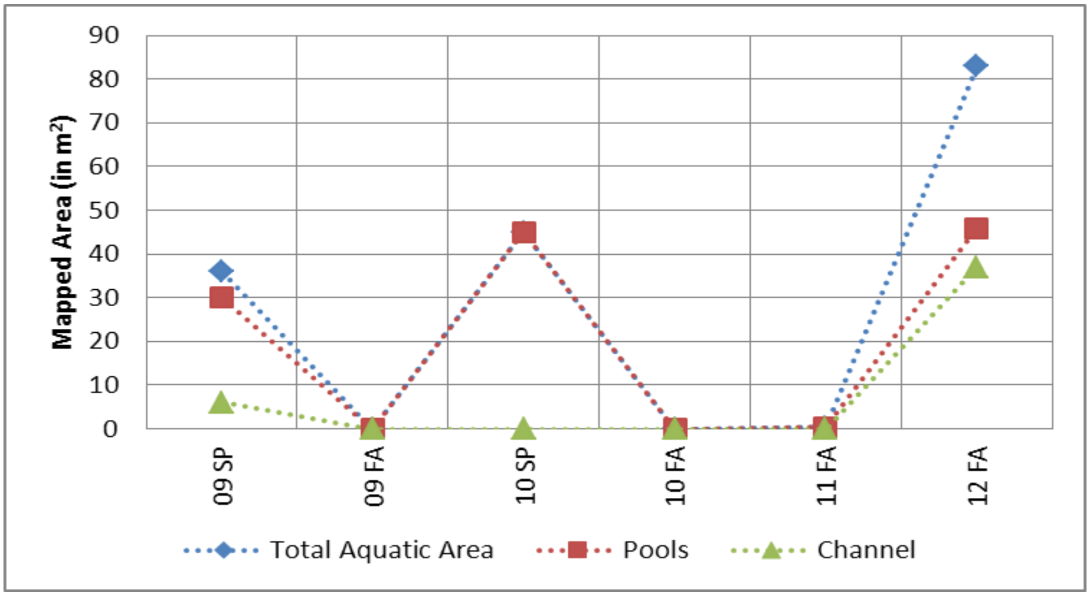
Minerva Spring Complex North



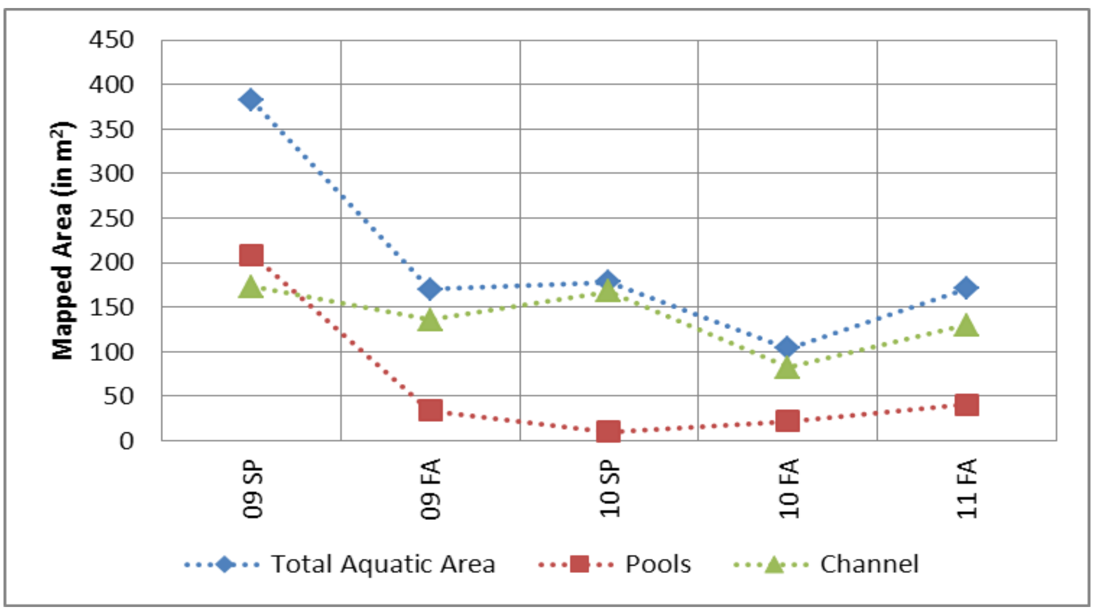
Unnamed 5 Spring



West Spring Valley Complex 1



Willard Spring



Willow - NV Spring

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Appendix B

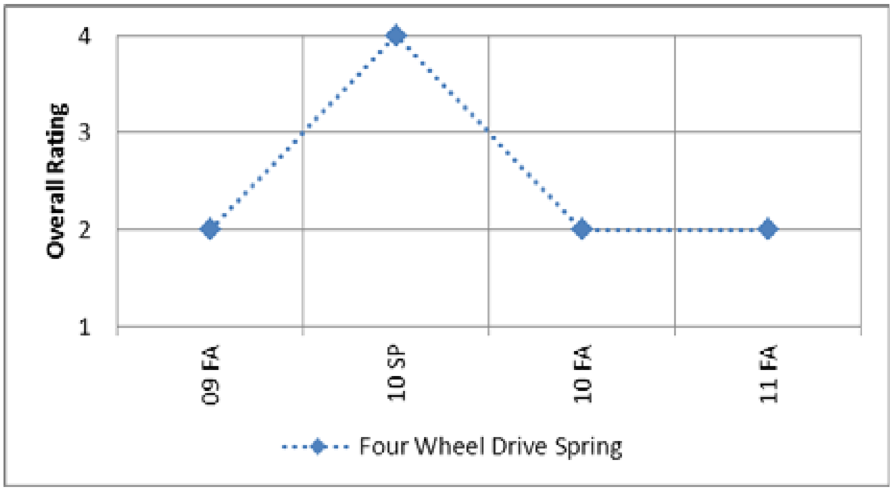
Site Assessment Data

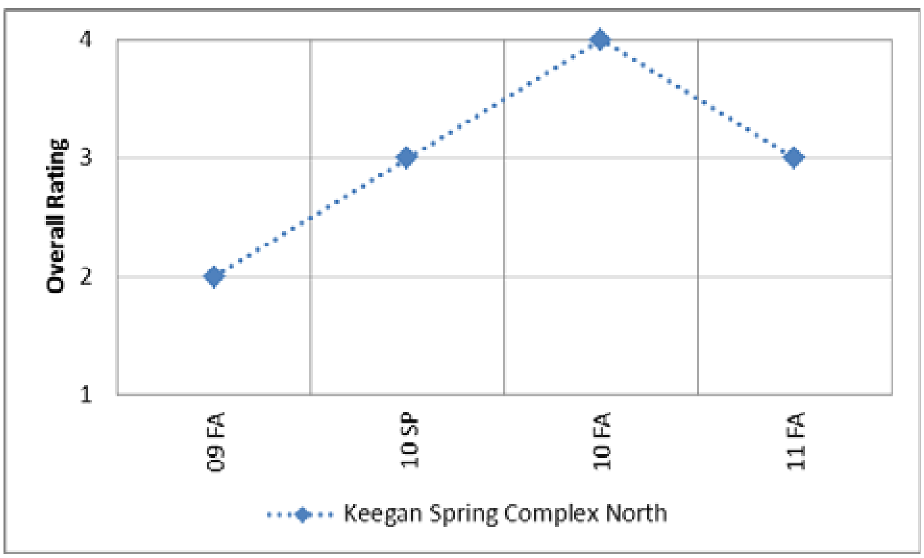
Table B-1 Site Assessment Summary by Site, 2011

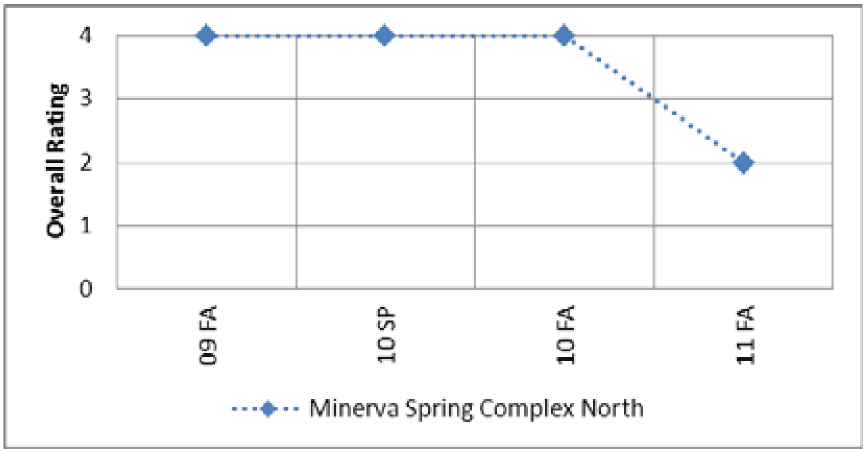
Sites	Overall Disturbance Rating	Modification for Diversion	Ungulate Use	Recreation Disturbance
Willow-NV Spring	3	No	Yes	Yes
Four Wheel Drive Spring	2	Yes	Yes	No
Keegan Spring Complex North	3	No	Yes	Yes
Minerva Spring Complex North	2	Yes	Yes	Yes
Unnamed 5 Spring	2	Yes	Yes	Yes
West Spring Valley Complex 1	2	Yes	Yes	No
Willard Spring	2	No	Yes	Yes

Figure B-1 Site Assessment Time Series Graphs: Overall Disturbance Rating

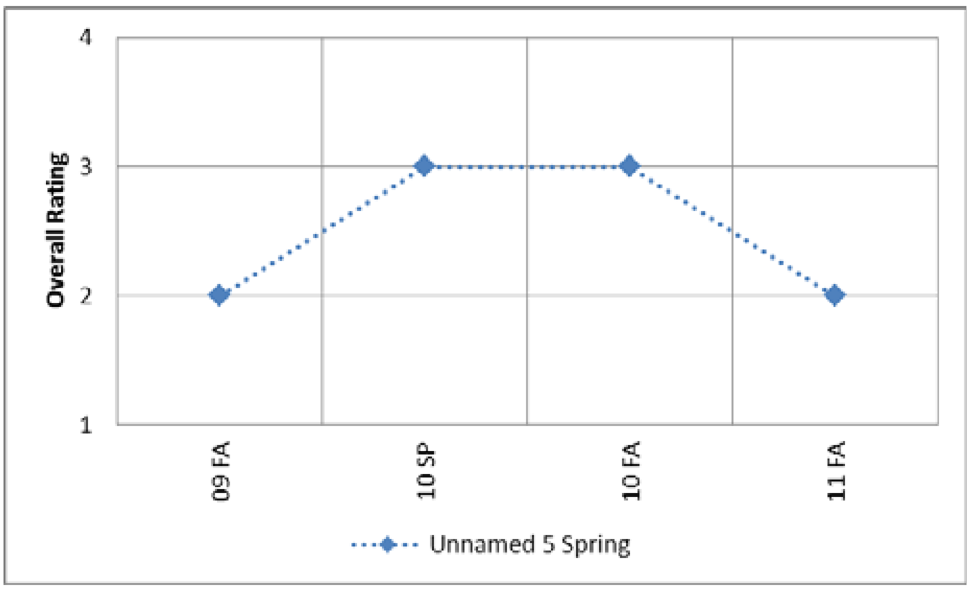
Time series by year (09 = 2009) and season (SP = Spring, FA = Fall)
Data shown only for sites visited in 2011 and 2012. Previous data collected for other monitoring sites see SNWA (2011a).



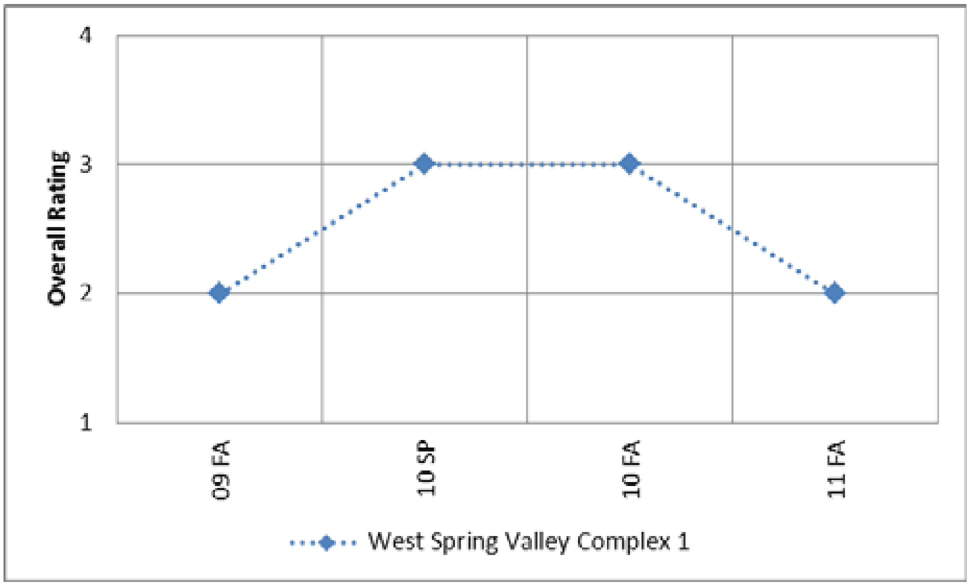


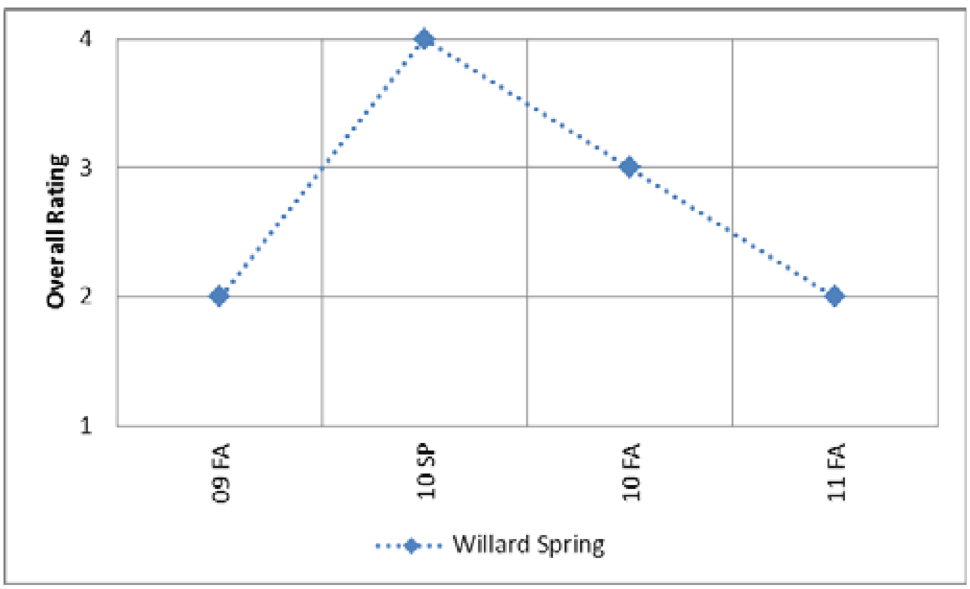


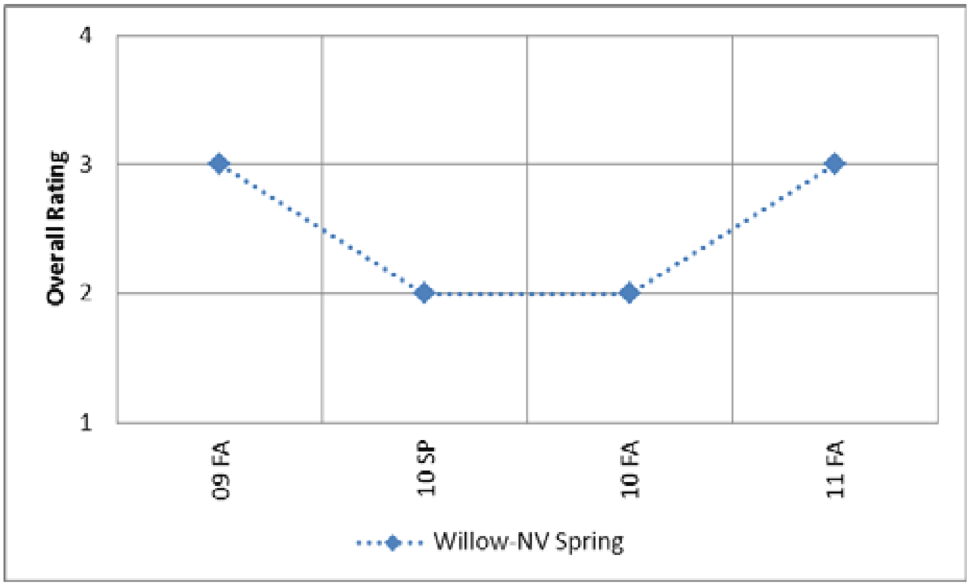
Overall Rating
4
3
2
1
0
09 FA
10 SP
10 FA
11 FA
Minerva Spring Complex North



Overall Rating
4
3
2
1
09 FA
10 SP
10 FA
11 FA
Unnamed 5 Spring


4
3
2
1
Overall Rating
09 FA
10 SP
10 FA
11 FA
West Spring Valley Complex 1


4
3
2
1
Overall Rating
09 FA
10 SP
10 FA
11 FA
Willard Spring


Overall Rating
4
3
2
1
09 FA
10 SP
10 FA
11 FA
Willow-NV Spring

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Appendix C

Northern Leopard Frog Data

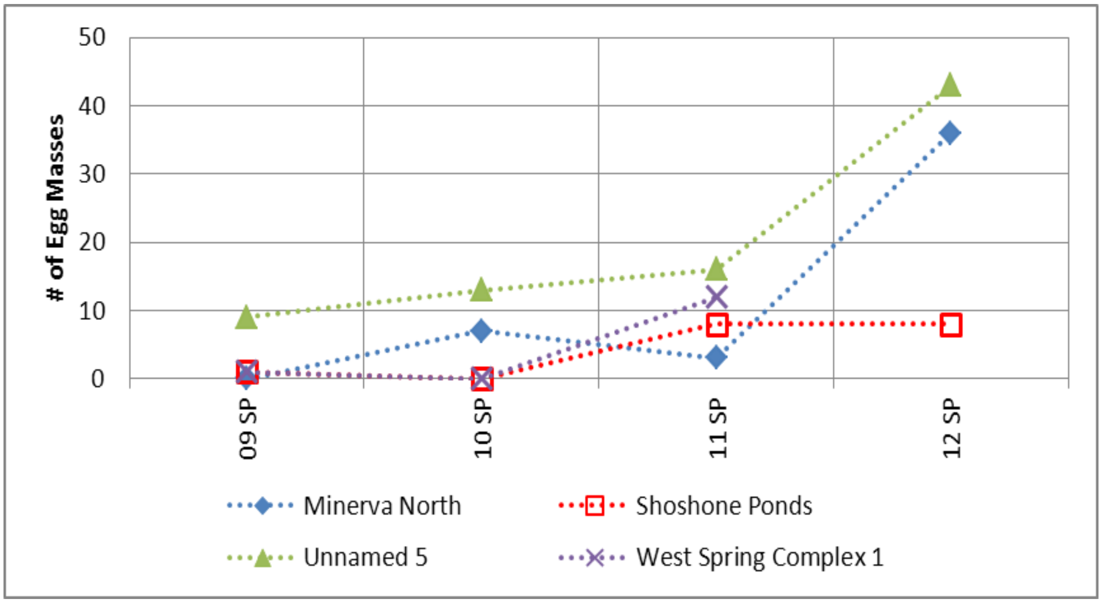
Table C-1 Northern Leopard Frog Egg Mass Survey Results, Spring 2011-2012

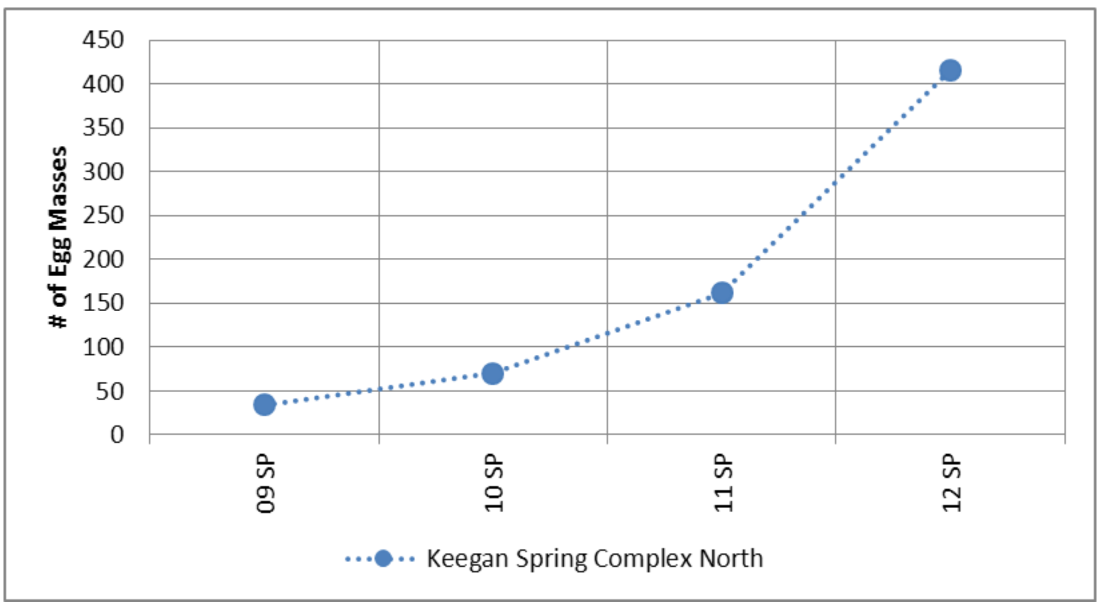
Site	Survey Period		Egg Mass Total	
	2011	2012	2011	2012
Keegan Spring Complex North[1]	3/15-5/11	3/26-5/08	162	416
Unnamed 5 Spring	3/15-5/10	3/28-5/09	16	43
Minerva Spring Complex North[1]	3/16-5/10	3/27-5/08	3	36
West Spring Valley Complex 1[1]	4/12-5/11	no visit	12	NA
Shoshone Ponds	3/16-5/11	3/27-5/08	8	8
Minerva Spring Complex Middle[1]	4/14	no visit	0	NA
South Millick Spring[1]	4/13	3/28-8/09	0	0
Overall	3/15-5/11	3/26-8/09	201	504

[1] Northern leopard frogs have been documented and are expected to breed in the spring complex at large (outside of sampling area)

Figure C-1 Northern Leopard Frog Time Series Graphs: Egg Mass Counts

Time Series by year (09 = 2009) and season (SP = Spring)





Appendix D

Relict Dace Data

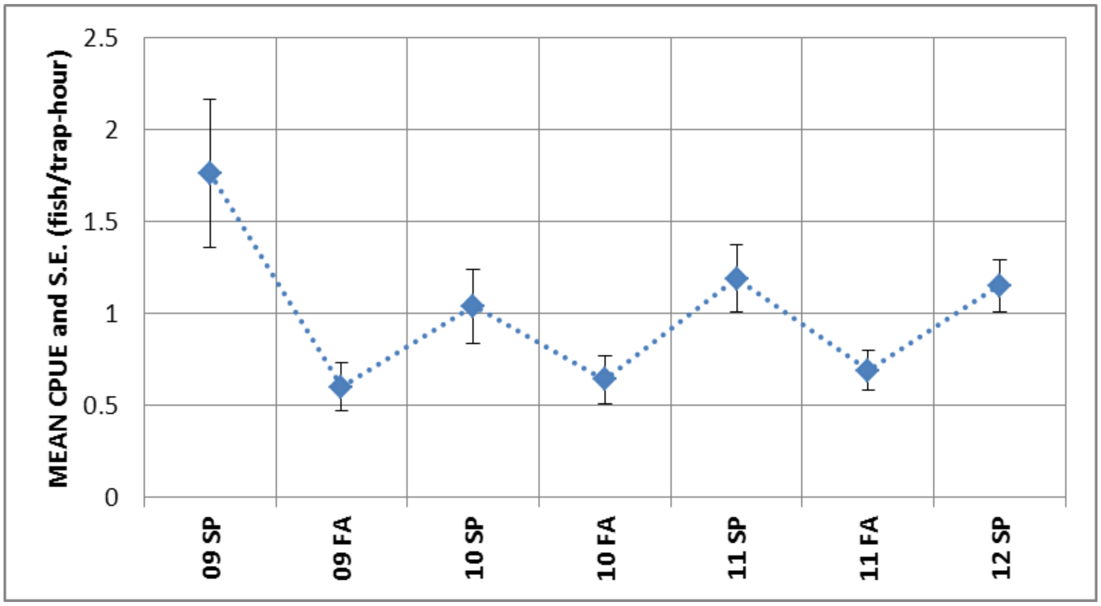
Table D-1 Relict Dace Catch per Unit Effort (CPUE) and Length by Site, Year, and Season, 2011-2012

Site	Year	Season	# of Traps	Total Fish Captured	Mean CPUE (fish/trap-hour)	# of Fish Measured	Mean Fish Length (mm)	Length Range (mm)
Keegan Spring Complex North[1]	2011	Spring	39	900	1.19 (SE=0.18)	262	50.5 (SE=0.9)	23-101
		Fall	58	867	0.69 (SE=0.11)	222	43.7 (SE=1.0)	21-95
	2012	Spring	114	2573	1.15 (SE=0.14)	443	55.7 (SE=0.6)	26-110
Stonehouse Spring Complex[1]	2011	Spring	30	402	0.74 (SE=0.12)	146	64.9 (SE=1.3)	31-109
		Fall	40	261	0.32 (SE=0.10)	64	61.3 (SE=12.8)	23-92

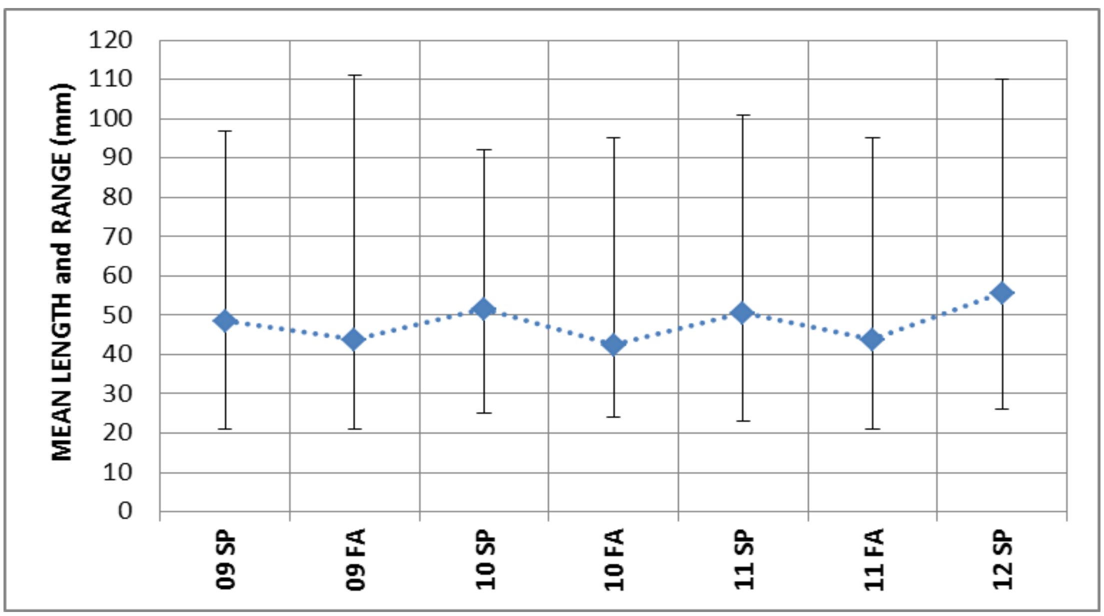
[1]Data were collected in spring 2011 within designated sample areas in Keegan Spring Complex North and Stonehouse Spring Complex. For fall 2011 and spring 2012 surveys, trapping efforts were extended to incorporate the majority of the spring complexes.

Figure D-1 Relict Dace Time Series Graphs: Keegan Spring Complex

Time series by year (09 = 2009) and season (SP = Spring, FA = Fall)
Data were collected in spring 2009-spring 2011 within the designated sample area at Keegan Spring Complex North. For fall 2011and spring 2012 surveys, trapping efforts were extended to incorporate the majority of the spring complex.



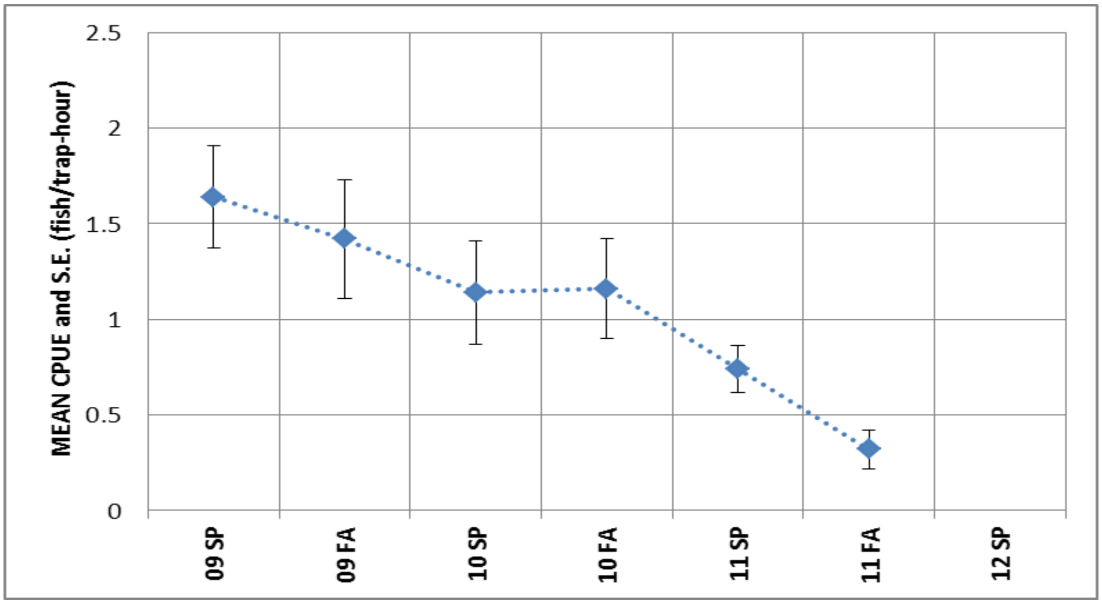
Mean catch per unit effort (fish/trap/hour), with standard error (SE)



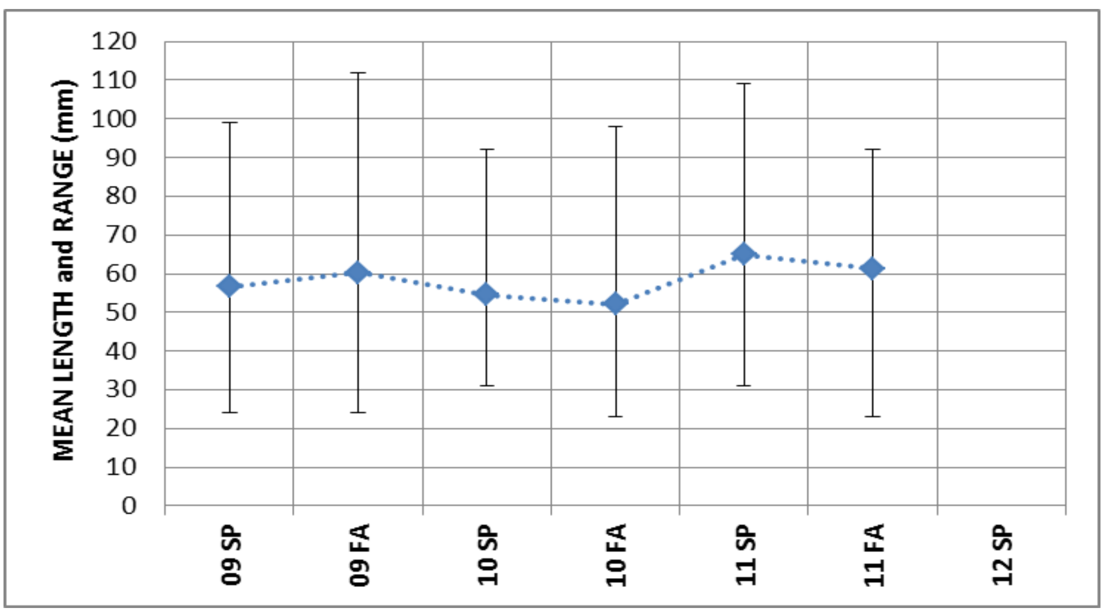
Mean fish length and range (minimum and maximum)

Figure D-2 Relict Dace Time Series Graphs: Stonehouse SpringComplex.

Time series by year (09 = 2009) and season (SP = Spring, FA = Fall)
Data were collected in spring 2009-spring 2011 within the designated sample area at Stonehouse Spring Complex. For the fall 2011 survey, trapping efforts were extended to incorporate the majority of the spring complex.



Mean catch per unit effort (fish/trap/hour), with standard error (SE)



Mean fish length and range (minimum and maximum)

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Appendix E

NDOW 2011 and 2012 Field Trip Reports for Shoshone Ponds

NEVADA DEPARTMENT OF WILDLIFE
NATIVE FISH AND AMPHIBIANS
FIELD TRIP REPORT

DATE(S): 17 and 24 August 2011
LOCATION(S): Shoshone Ponds, White Pine County, NV
PURPOSE(S): To assess the population of Pahrump poolfish and relict dace
PERSONNEL: Aaron Ambos (SNWA), Mark Beckstrand (NDOW), Ryan Drew (NDOW), Amanda Finger (UC Davis), Kevin Guadalupe, Kevin Netcher(NDOW)
PREPARED BY: Kevin Guadalupe

INTRODUCTION
In 1972, the Ely District of the BLM constructed warm water ponds in eastern Nevada with the intent of providing habitat for endangered species. On 13 August 1976, 50 Manse Ranch Pahrump poolfish (*Empetrichthys latos latos*) were transplanted into one of the ponds. Relict dace (*Relictus solitarius*) was introduced to one of the four ponds in December 1977. In 2010 Pahrump poolfish existed in three ponds (Stock, Middle, and North) and Relict dace existed in the most southern pond of the refuge (Figure 1). Annual surveys monitor population structure at this refuge.

METHODS
On 17 August, 19 standard Gee Minnow traps (0.64 cm mesh, 2.5 cm openings) and two exotic trap (0.32 cm mesh, 2.5 cm openings) dog food baited traps were set around the perimeter of the stock pond at 09:00 hours. Four standard traps and one exotic trap were set around the perimeter of each of the three ponds in the Shoshone Ponds enclosure at 09:15 hours. The traps were allowed to fish four hours before they were pulled. All fish in the exotic traps were measured and each fish greater than 30 millimeters (mm) was marked with an oblique clip of one corner of the caudal fin before release in the stock pond. All fish captured in North, Middle, and South ponds were measured and each fish greater than 30 mm was marked with an oblique clip to one corner of the caudal fin before release.

On 24 August, 21 standard baited traps were set in the stock pond at 09:00 hours. Five standard traps with bait were set along the perimeter of the three Shoshone Ponds at 09:15 hours. Traps were allowed to fish approximately three and a half hours before they were pulled. Each fish caught was examined for marks, tallied, and released. Water chemistry data was taken at one location in each of the Shoshone Ponds with a YSI 55 Dissolved Oxygen, Conductivity and Salinity meter (Table 2).

Population estimates were calculated using Peterson's estimator: MC/R. Where M=number of individuals marked, C=number of individuals captured and R=number of individuals recaptured. Approximate 95% confidence intervals were determined using a table appropriate to the Poisson distribution, after the method described in Ricker (1975).

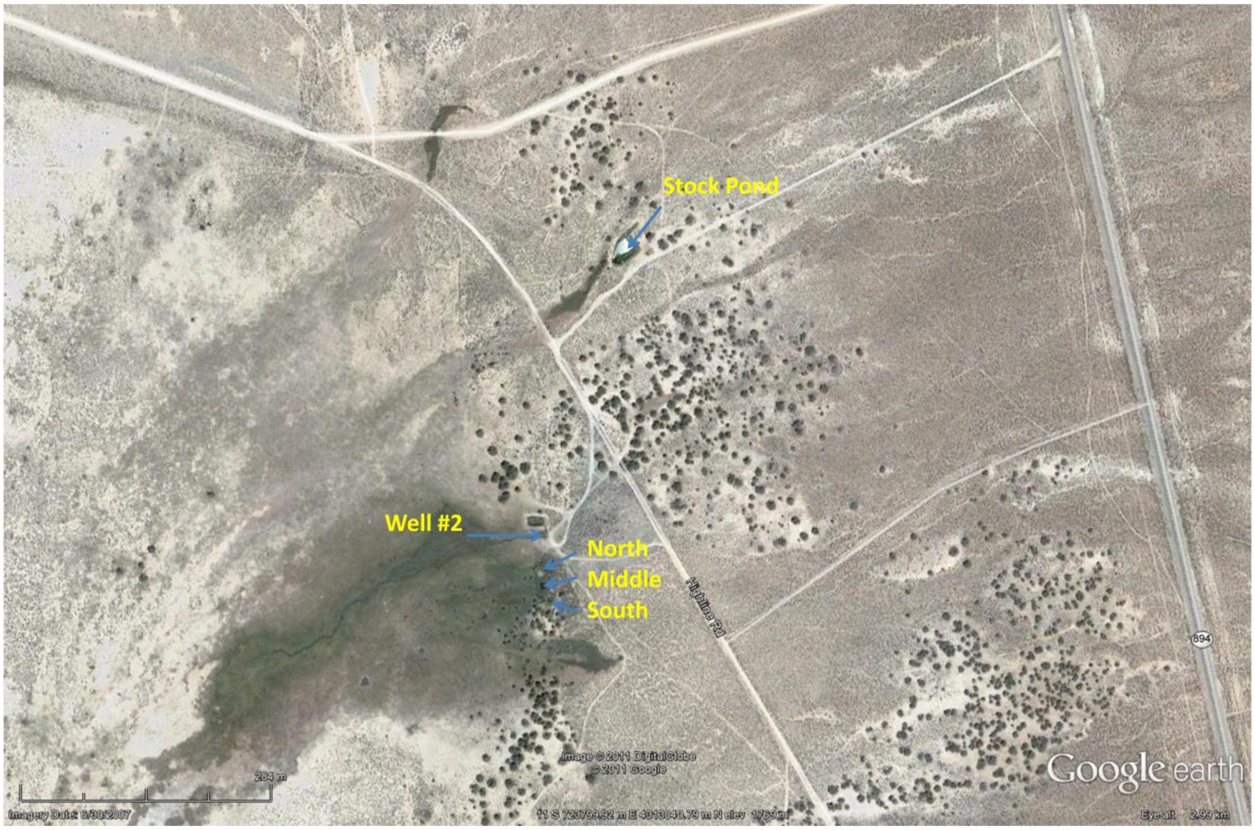


Figure 1. Aerial photograph showing surveyed habitats at Shoshone Ponds, 2011. Photograph taken May 30, 2007.

RESULTS

The population estimate for poolfish was 826 (448-986, p=0.95) in Middle Pond, and 5762 (4,180-7,944, p=0.95) in Stock Pond (Table 1, Figure 2,3,4). Poolfish were not captured in trapping efforts in North Pond.

Relict dace were estimated at 10 (2-10, p=0.95) in the South Pond (Figure 5). There were four relict dace marked in south pound (CPUE = 0.20). The four marked relict dace were not measured for length frequency before they were returned to the water. Only one relict dace was captured during recapture efforts in South pond on August 20.

Table 1. Mark-recapture data for Shoshone Ponds, White Pine County, NV, 2011.

Location	Species	M	C	R	CPUE M	CPUE C	Estimate
North Pond	*E. l. latos*	0	0	0	0	0	0
Middle Pond	*E. l. latos*	59	84	6	2.95	4.20	448<**826**<986
South Pond	*R. solitarius*	4	1	0	0.20	0.05	2<**10**<10
Stock Pond	*E. l. latos*	656	325	37	10.41	4.64	4180<**5762**<7944

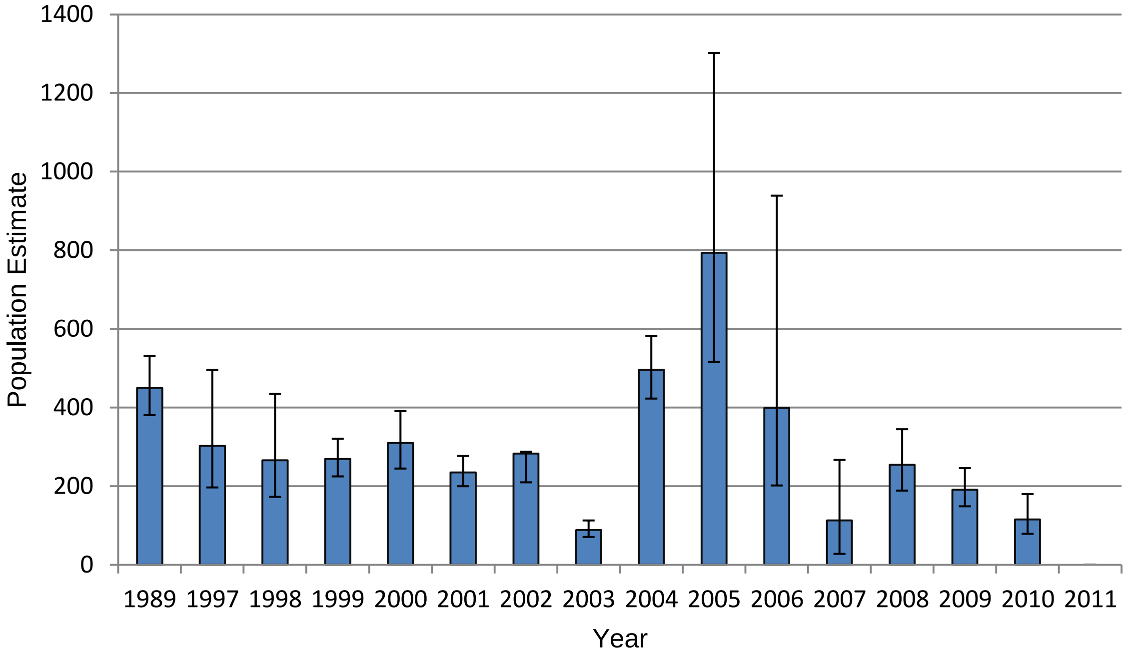


Figure 2. Population Estimates for Pahrump poolfish at Shoshone Ponds, North Pond 1989-Present. Fish were not captured in north pond in 2011 survey.

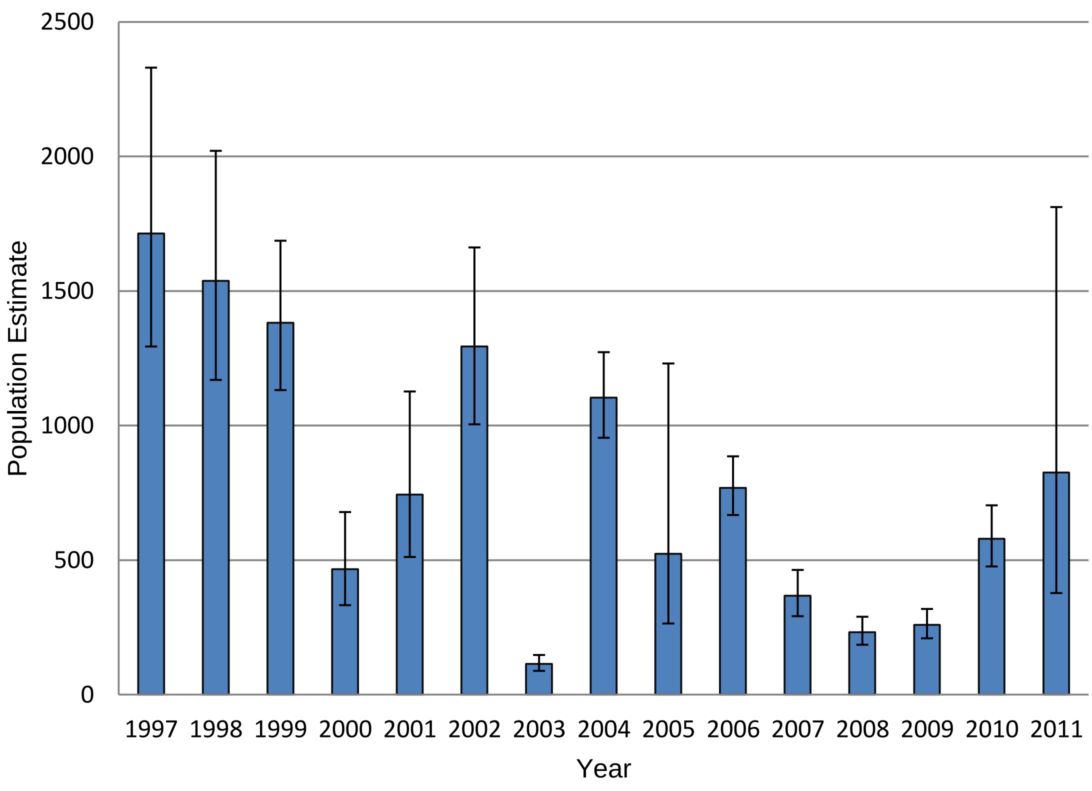


Figure 3. Population Estimates for Pahrump poolfish at Shoshone Ponds, Middle Pond 1997-Present.

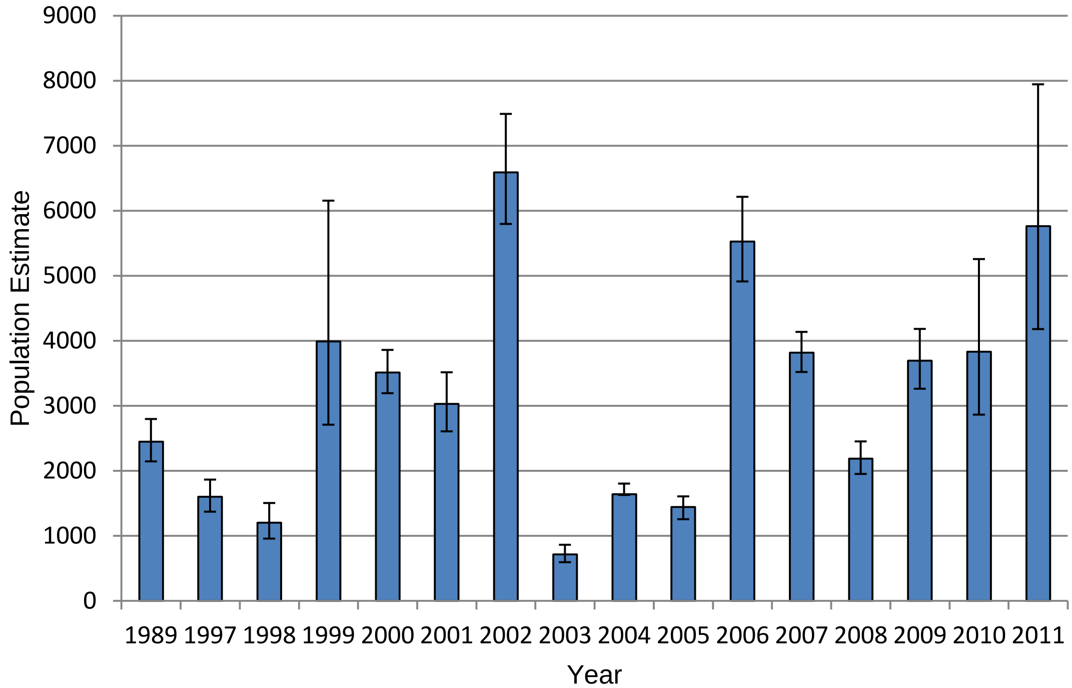


Figure 4. Population Estimate for Pahrump poolfish at Shoshone Ponds, Stock Pond 1989-Present.

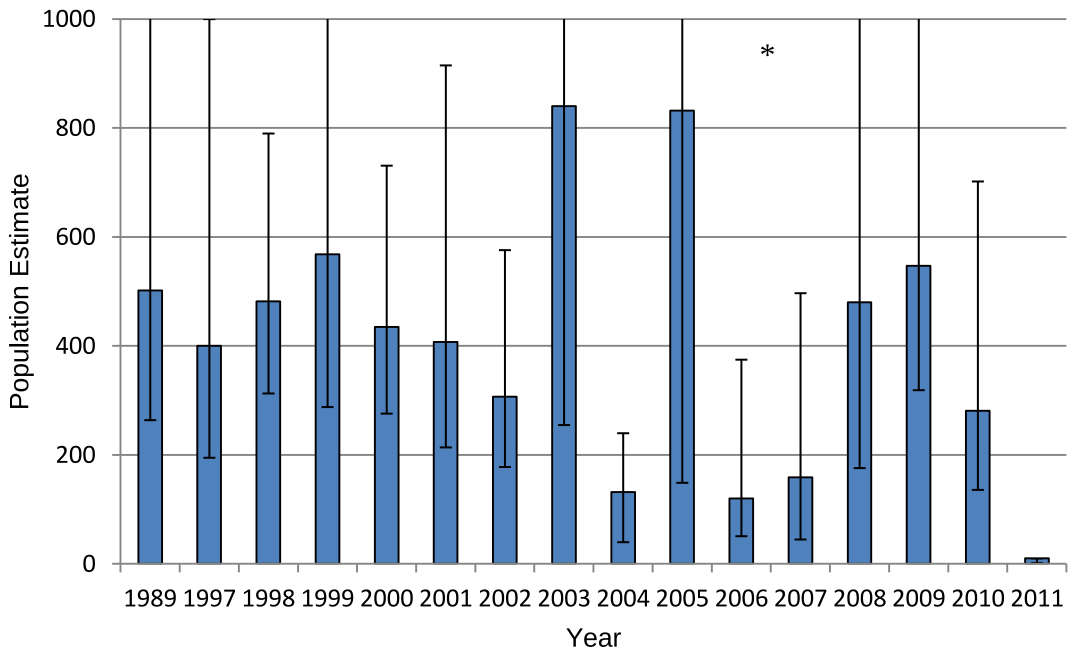


Figure 5. Population Estimates for Relict dace at the South Pond, Shoshone Ponds 1989-Present.
* Population estimate 2005 showed error bars >7000 due to low recapture rates typical with South Pond.

On 17 August, 59 Pahrump poolfish were trapped and marked (CPUE =2.95) in Middle Pond, ranging in length from 33 mm to 49 mm, averaging 42 mm (Table 2, Figure 6).

We captured and marked 656 poolfish in Stock Pond (CPUE = 10.41) ranging from 29 mm to 62 mm, averaging 39.3 mm (Figure 7).

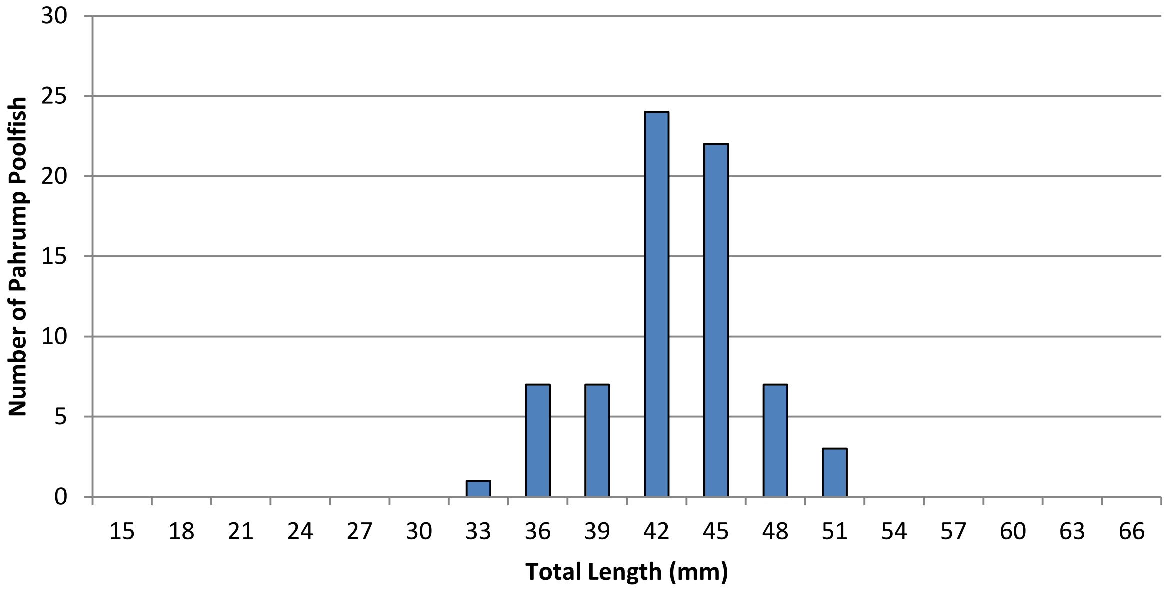


Figure 6. Length frequency distribution of Pahrump poolfish captured in Middle Pond, August 17, 2011. Poolfish averaged (±SD) 41.8 ± 3.6 mm (range 33-49; n =59).

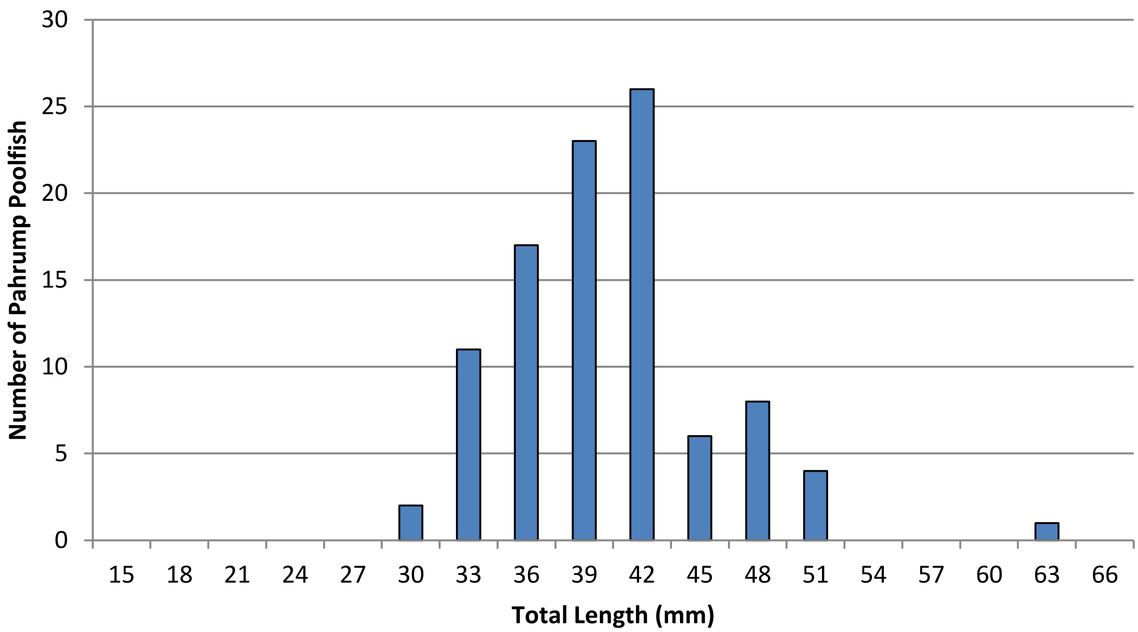


Figure 7. Length frequency distribution of Pahrump poolfish captured in Stock Pond, August 17, 2011. Poolfish averaged (±SD) 39.3 ± 5.2 mm (range 29-62; n = 98).

Table 2: Water Quality parameters 2011.					
Location	DO (mg/L)	DO (% Sat.)	Conductivity/ Specific (µS)	Salinity (ppt)	Temperature (°C)
Stock pond (source)	3.85	48.5	NA	0.1	20.6
North pond	4.88	57.0	NA	0.1	22.0
Middle pond	3.75	43.5	NA	0.1	23.0
South pond	2.95	40.0	NA	0.1	23.0

DISCUSSION

The poolfish population at Shoshone Ponds within the fence line is declining with deteriorating habitat in need of maintenance. Fish were not captured, or seen on either survey days in North Pond, but numerous leeches were caught in traps. Water level at North Pond remains low, overgrown with emergent, submergent, and floating aquatic vegetation (Figure 8). This increase of organic matter could create a decrease in pH and drastic diel variations in dissolved oxygen. Monitoring future diel variations of dissolved oxygen and pH levels at Shoshone ponds could help explain fish die-off in North Pond. Water leakage from the well head continues to puddle at the entrance of the fenced-in ponds (Figure 9, 10). This water leaks from a broken pipe feeding into the ponds, possibly lowering water levels creating unfavorable stagnant habitat conditions for poolfish in North Pond. The Stock Pond remains the most stable population estimated, showing the highest estimation since 2002. The relict dace population remains difficult to effectively sample due to trap avoidance during second trappings and low population numbers, resulting in high error in estimation.

In 2010, 1179 poolfish were salvaged from Well #2 outflow, placing 508 in Middle Pond and 671 in the North Pond. Poolfish were first observed here in 1999. Traps placed in Well #2 outflow in 2011 confirmed poolfish remain and continue to reproduce in Well #2 outflow (Figure 11).

Although the population was not estimated, adult northern leopard frogs, *Rana pipiens* were observed around the perimeter of middle Shoshone pond.

Plans to enlarge the enclosure and incorporate the flowing well pond immediately north are moving forward and should be completed within the next few years. This work should create additional habitat for the poolfish and further secure the habitat into the future. Population surveys will continue in August 2012.

LITERATURE CITED

Ricker WE. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bulletin of the Fisheries Research Board of Canada. 191: 382 pp.

Figure 8. North Shoshone Pond, August 17, 2011.

Figure 9. Water accumulating at entrence of Shoshone Ponds fenceline, August 17, 2011.

Figure 10. Water accumulating outside north-east Shoshone Ponds fenceline, August 17, 2011.

Figure 11. Well #2 outflow leading into marsh, facing west, August 17, 2011.

NEVADA DEPARTMENT OF WILDLIFE
NATIVE FISH AND AMPHIBIANS
FIELD TRIP REPORT

DATE(S): 8, 15, 22 and 23 August 2012
LOCATION(S): Shoshone Ponds, White Pine County, NV
PURPOSE(S): To assess the population of Pahrump poolfish and relict dace
PERSONNEL: Aaron Ambos (SNWA), Mark Beckstrand (NDOW), Adam Burnside(NDOW), Allen Cattal (SNWA), Ryan Drew (NDOW), Jacob Ferguson (BLM), Todd Gilmore(USFWS), Shawn Goodchild (NDSU), Kevin Guadalupe(NDOW), Nancy Herms (BLM), Simon Madill(NDOW), Raymond Saumure(SNWA), Andy Starostka (USFWS), Holly Weissenfluh(NDOW)
PREPARED BY: Kevin Guadalupe, Simon Madill, and Holly Weissenfluh

INTRODUCTION
In 1972, the Ely District of the BLM constructed warm water ponds in eastern Nevada with the intent of providing habitat for endangered species. On 13 August 1976, 50 Manse Ranch Pahrump poolfish (*Empetrichthys latos latos*) were initially transplanted into North Pond, making it one of three extant locations for the entire species, and the only outside of Clark County (Figure 1). Relict dace (*Relictus solitarius*) was introduced to South Pond in December 1977. Poolfish have transferred between ponds and associated surrounding surface water locations occasionally during high water events (Withers 1985). In 2012 Pahrump poolfish existed in Stock Pond, Middle Pond, and Well #2 outflow. Relict dace persist in the most southern pond of the refuge. Poolfish were not captured, or observed in North pond since 2010 due to habitat degradation. Habitat maintenance was enacted after failure of North Pond and depletion of poolfish captures in Middle Pond after survey efforts. Annual surveys monitor population structure at this refuge.

METHODS
On 8 August, 20 standard Gee Minnow traps (0.64 cm mesh, 2.5 cm openings) and two exotic traps (0.32 cm mesh, 2.5 cm openings) dog food baited traps were set around the perimeter of the stock pond at 09:00 hours (Figure 1). Four standard traps and one exotic trap were set around the perimeter of each of the three ponds in the Shoshone Ponds enclosure at 09:30 hours. The traps were allowed to fish three hours before they were pulled. All fish in the exotic traps were measured and each fish greater than 30 millimeters (mm) was marked with an oblique clip to one corner of the caudal fin before release in the stock pond. All fish captured in Middle Pond were measured and each fish greater than 30 mm was marked with an oblique clip to one corner of the caudal fin before release. South Pond relict dace were not measured during marking procedures.

On 8 August, six exotic mesh traps were set in Well #2 Outflow every five meters from the top to 40 meters downstream at 13:15 and allowed to fish two hours. All captured fish were measured, and fish greater than 30mm were marked with an oblique clip to the caudal fin before release. A block net was set 44 meters downstream from the spring box during mark-recapture surveys to limit immigration and emigration into the survey reach.

On 15 August, 22 standard baited traps were set in the stock pond at 09:00 hours. Five standard traps with bait were set along the perimeter of the three Shoshone Ponds at 09:30 hours. Traps were allowed to fish approximately three hours before they were pulled. Six exotic mesh traps were re-set every five meters in Well #2 Outflow and allowed to fish two hours. Each captured fish was examined for marks, tallied, and released. Unmarked fish ≥30 mm captured in Middle were marked and released back into Middle Pond. Water chemistry data was taken at one location in each of the Shoshone Ponds, Well #2 Outflow, and twice in Stock Pond with a YSI 55 Dissolved Oxygen, Conductivity and Salinity meter (Table 3).

On 22 August, five standard mesh minnow traps were set around the perimeter of Middle Pond and allowed to fish three hours. Each captured fish was examined or marks, tallied, and released.

Population estimates were calculated using Peterson's estimator: MC/R. Where M=number of individuals marked, C=number of individuals captured and R=number of individuals recaptured. Approximate 95% confidence intervals were determined using a table appropriate to the Poisson distribution, after the method described in Ricker (1975). Population estimates were calculated in Middle Pond using the Schnabel Method for estimating multiple day mark recapture days due to low captures on the first trapping day. Population estimates in South Pond were calculated using modified Petersen estimator for less than four recaptures.

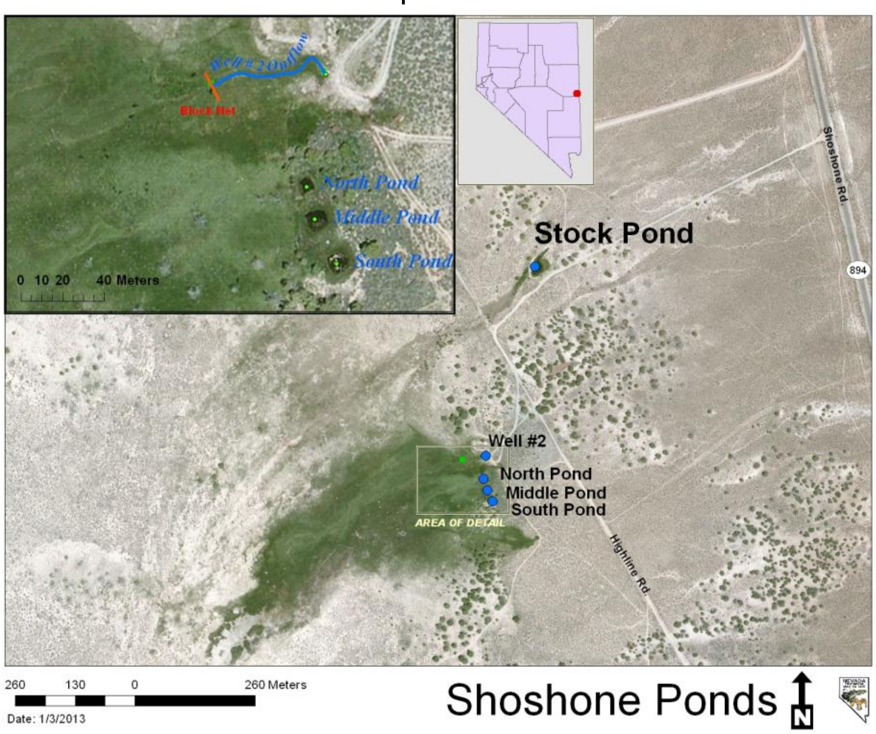


Figure 1. Pahrump poolfish survey locations at Shoshone Ponds, White Pine County, Nevada, 2012.

RESULTS

On 8 August, three poolfish were marked in Middle Pond (CPUE=0.20), nine on 15 August (CPUE C=0.60), and five were captured on 22 August (CPUE=0.33). One poolfish was recaptured, giving a population estimate of 44 (13-79, p=0.95) poolfish in Middle Pond (Table 1, Figure 2).

On 8 August, 1103 poolfish were captured (CPUE=16.71) and marked in Stock Pond, and 144 were captured (CPUE=8.00) and marked in Well#2 Outflow. On 15 August, 712 poolfish were captured (CPUE=10.79) in Stock Pond with 269 displaying marks, and 36 poolfish were captured (CPUE=2.00) in Well # 2 Outflow with ten showing marks. The population estimate was 2919 (2,590-3,290, p=0.95) for Stock Pond, and 518 (281-1103, p=0.95) in Well #2 Outflow. (Table 2, and Figure 3, 4). Poolfish were not captured or observed in trapping efforts in North Pond in 2012.

Relict dace population was estimated at 660 (140-660, p=0.95) in the South Pond (Figure 5). There were 65 relict dace marked in south pound (CPUE = 4.33). Relict dace were not measured for age-length frequency distribution before they were returned to the water. Nine unmarked relict dace were captured during recapture efforts in South pond on August 15.

Poolfish total length in Stock Pond ranged from 29 mm to 64 mm with an average of 40.60 mm (Figure 6). Well #2 Outflow poolfish ranged from 24 mm to 60 mm, averaging 36.2 mm (Figure 7). Poolfish captured during dip net surveys during pre and post habitat maintenance activities on 22 and 23 August averaged 44.5 mm, ranging from 18 mm to 59 mm in total length (Figure 8).

Table 1. Multiple day mark-recapture data for Middle Pond, White Pine County, NV, 2012. Estimates are based on the Schnabel method ($N=CtMt^2/RtMt$).

Date	Day	M	Ct	R	Mt	CtMt	CPUE M	CPUE C	Estimate
8-Aug	1	3	0	0	0	0	0.20	NA	NA
15-Aug	2	9	9	0	3	27	NA	0.60	NA
22-Aug	3	0	5	1	0	60	NA	0.33	13<**44**<79

Table 2. Mark-recapture data for Shoshone Ponds, White Pine County, NV, 2012.
M=Marked, C=capture, R=recapture, CPUE= Catch per unit effort. South Pond was estimated using the equation N=[(M+1)(C+1)(C+1)]/(R+1)when recaptures are less than four.

Location	Species	M	C	R	CPUE M	CPUE C	Estimate
North Pond	*E. l. latos*	0	0	0	0	0	0
Stock Pond	*E. l. latos*	1103	712	269	16.71	10.79	2590<**2919**<3290
Well #2	*E. l. latos*	144	36	10	8.00	2.00	281>**518**>1103
South Pond	*R. solitaries*	65	9	0	4.33	0.60	140<**660**<660

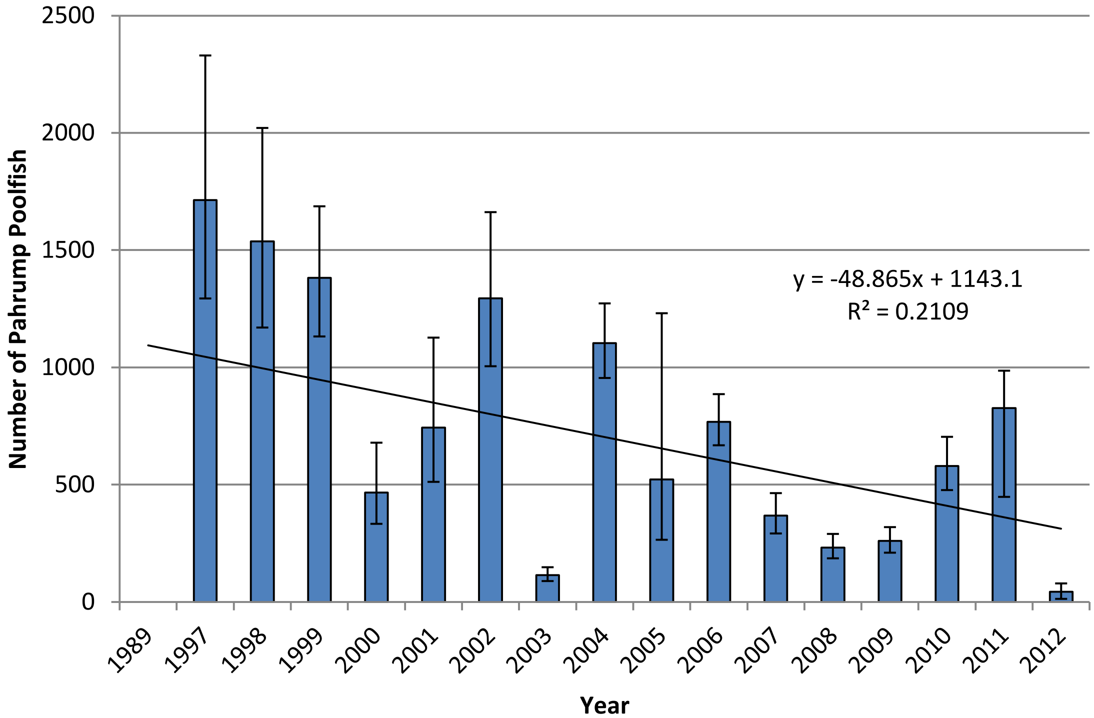


Figure 2. Relative abundance of Pahrump poolfish for Middle Pond at Shoshone Ponds, 1989 to present. Estimates in 2012 were calculated using the modified Schnabel method, marking multiple days.

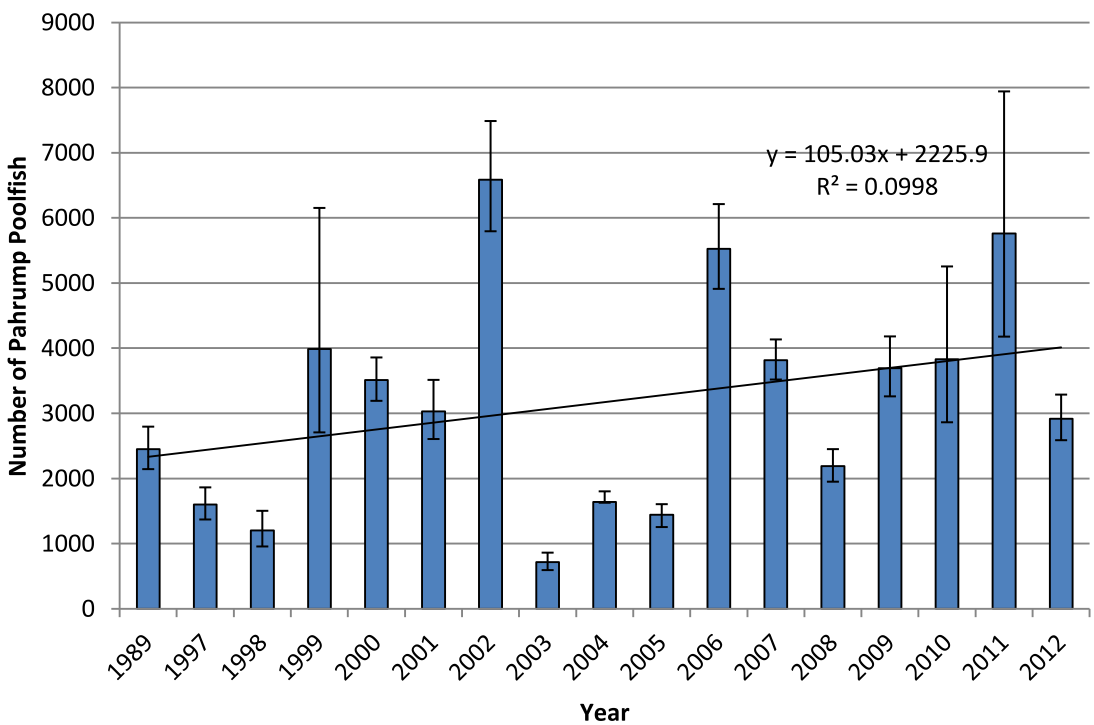


Figure 3. Population estimates for Stock Pond, Shoshone Ponds 1989 to present.

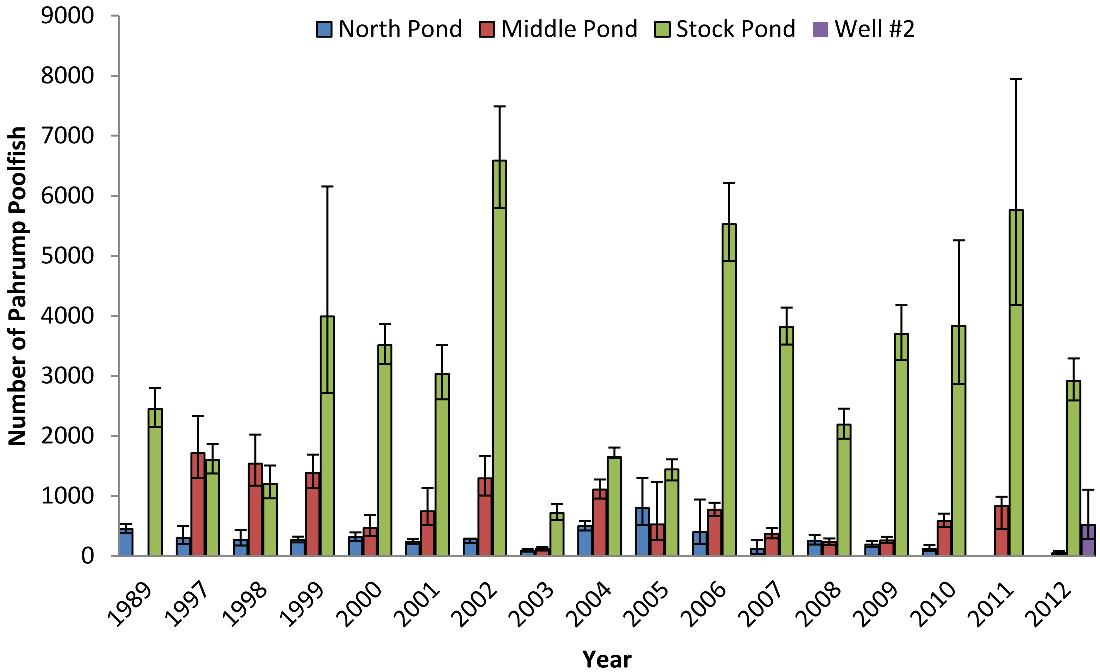


Figure 4. Population Estimates for Pahrump poolfish, Shoshone Ponds 1989 to present.

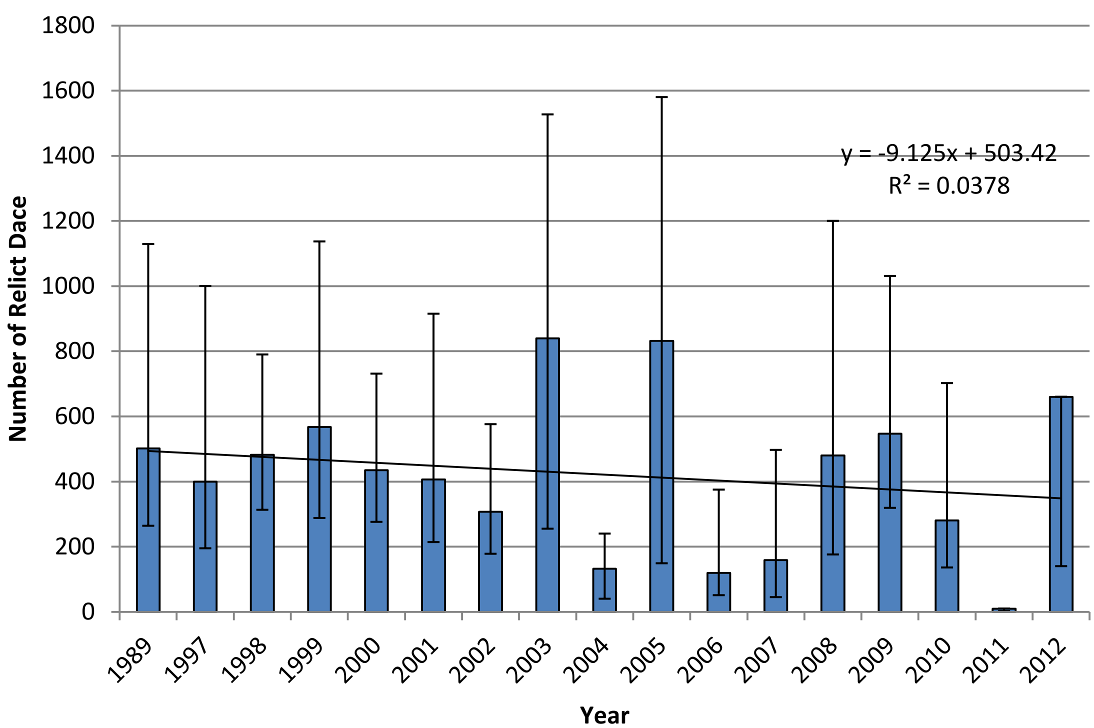


Figure 5. Population estimates for Relict dace at the South Pond, Shoshone Ponds 1989-Present. Population estimate 2012 showed large error due to low recapture rates, and no marked fish captured during surveys.

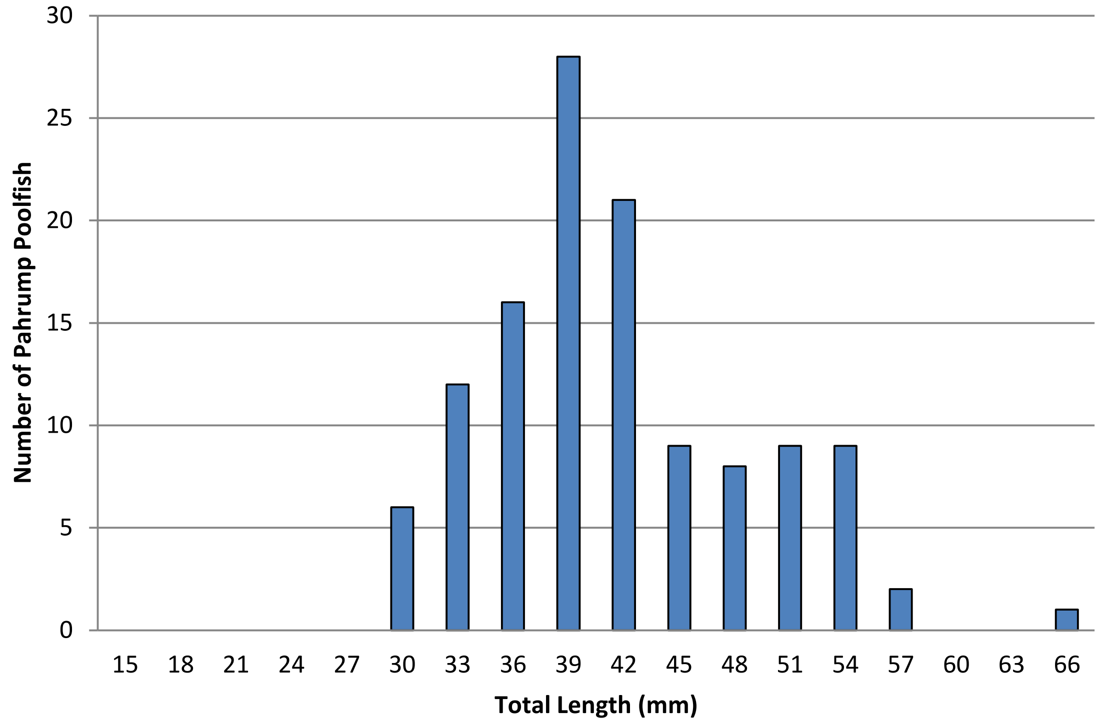


Figure 6. Length frequency distribution of Pahrump poolfish captured during mark-recapture surveys from Stock Pond, August 8, 2012. Poolfish averaged (±SD) 40.6 ± 6.9 mm (range 29-64; n = 121).

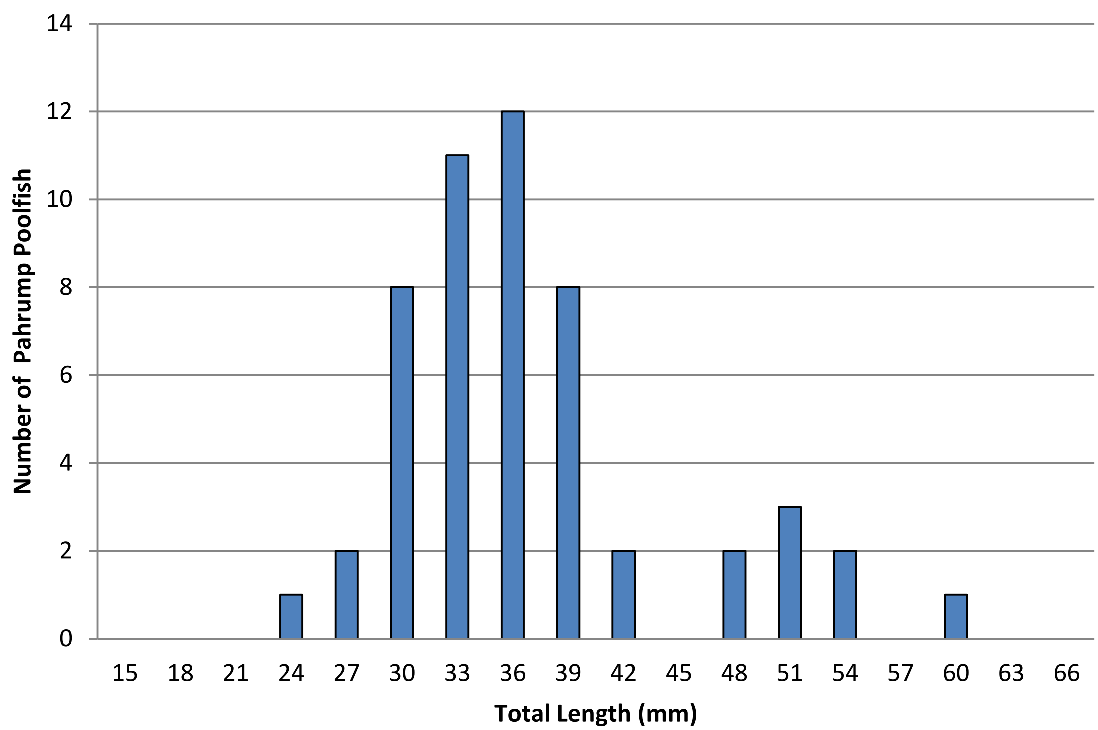


Figure 7. Length frequency distribution of Pahrump poolfish captured during mark-recapture surveys from Well #2 Outflow, August 8, 2012. Poolfish averaged (±SD) 36.2 ± 7.7 mm (range 24-60; n = 52).

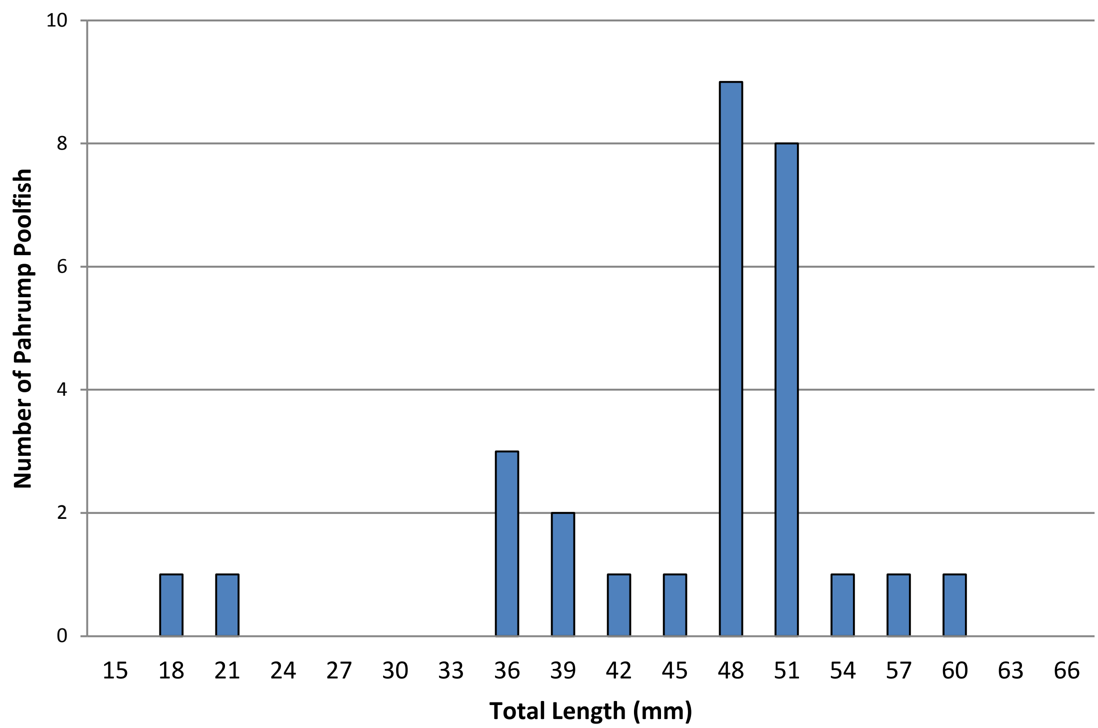


Figure 8. Length frequency distribution of Pahrump poolfish captured while dip netting from Middle Pond, August 23, 2012. Poolfish averaged (±SD) 44.5 ± 9.2 mm (range 18-59; n = 29). Captured fish were not used to estimate population in mark-recapture surveys.

DISCUSSION

The poolfish population at Shoshone Ponds within the fence line is declining with deteriorating habitat in need of maintenance. Poor water quality and potentially lethal dissolved oxygen levels were measured at Middle Pond, indicating a lack of flow into the pond (Table 3). Catching just three poolfish on August 8 enacted habitat maintenance by NDOW field personnel. On 23 August encroaching submerged root masses were cut and removed by hand, doubling the available surface water for Pahrump poolfish. Fish were not captured, or seen during survey days in North Pond. Water level at North Pond remained low with an apparent lack of inflowing water and overgrown with aquatic vegetation. Lack of flow into both North and Middle Pond remains the primary factor contributing to loss of North Pond poolfish, and low numbers at Middle Pond. Stock Pond remains the most stable population estimated. The second highest population at Shoshone ponds exists in the Well #2 outflow (Figure 9, and 10). The relict dace population remains difficult to effectively sample due to trap avoidance during successive trappings and low population numbers, resulting in high error in estimation.

Poolfish were never intentionally stocked into Middle Pond and escaped into it during a high water event (Withers 1985). In the 80's middle pond was considered a "sacrifice pond" since it was believed to never have sealed properly. Despite poor habitat conditions poolfish remain in Middle Pond while efforts are continuing to improve habitat.

Table 3: Water quality measurement data collected on a YSI 55 IN# 055225 at an altitude of 1757 meters on August 15, 2012.

Location	DO (mg/L)	DO (% Sat.)	Conductivity/ Specific (µS)	Salinity (ppt)	Temperature (°C)	Time of day
Stock pond (source)	1.59	17.8	NA	0.1	19.6	12:35
Stock pond (south bank)	5.61	65.9	NA	0.1	24.4	12:21
Middle pond	1.46	16.1	NA	0.1	20.3	12:55
South pond	5.10	62.2	NA	0.1	26.5	12:44
Well# 2 Outflow	8.55	104.9	NA	0.1	25.8	13:10

Multiple day trapping methods were used at Middle Pond due to difficulties trapping fish during survey dates. On 8 August there were over 15 people in and around Middle pond that could have possibly interrupted trapping. In addition, traps were thrown into Middle pond without consideration of placement. Middle Pond surface water was inundated with emergent bulrush and submergent roots. A thick layer of benthic anaerobic detritus covered approximately one foot, potentially covering the opening of traps on the bottom during the first sampling day.

Poolfish were first observed in Well #2 Outflow in 1999. In 2010, 1179 poolfish were salvaged from Well #2 Outflow, placing 508 in Middle Pond and 671 in the North Pond. Traps placed in Well #2 Outflow in 2011 confirmed poolfish remain and continue to reproduce in Well #2 outflow.

On September 6, 2012 a meeting was held at Shoshone ponds to coordinate pond rehabilitation between NDOW, BLM, and USFWS. By October all of valves were replaced, leaks were found and repaired. Water levels were returned to full flow in North, Middle, and South Pond. Water quality monitoring is ongoing to start preparations to repatriate North Pond with poolfish in 2013 after consultation with BLM and USFWS.

Poolfish were collected by Shawn Goodchild from Stock Pond for an ongoing reproduction and life history study at North Dakota State University. Tidbit Hobo temperature loggers were placed in each pond to monitor yearly temperature fluctuation. Scientific collections and studies will continue at Shoshone ponds in 2013.

Water quality assessment conducted 6 and 7 August for 24 hours on site by Southern Nevada Water Authority found that dissolved oxygen fell below potentially lethal ranges of 1.00 mg/L in North Pond, and just below 2.00 mg/L in Middle Pond during nighttime hours (Cattell 2012). While dissolved oxygen was above 10 mg/L for an entire 24 hour period in Stock Pond. In South Pond dissolved oxygen levels were about three times higher than in Middle Pond. Lack of flow into North Pond and Middle Pond is believed to have created these unfavorable poolfish conditions.

Plans to enlarge the enclosure and incorporate the flowing well pond immediately north are moving forward and should be completed within the next few years. This work should create additional habitat for the poolfish and further secure the habitat into the future. Additional population sites in Clark County are currently under investigation. Population surveys will continue in August 2013.

REFERENCES

Cattell A. 2012. Southern Nevada Water Authority; Shoshone Ponds Water Quality Field Report. August 6-7, 2012.

Ricker WE. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bulletin of the Fisheries Research Board of Canada. 191: 382 pp.

Withers D. 1985. Nevada Department of Wildlife, Memorandum; Shoshone Ponds File. September 23, 1985.

Figure 9. Well #2 Outflow facing downstream (West) on August 8,2012. A block net was placed 44 meters downstream during population estimates.

Figure 10. Well #2 Outflow facing upstream (East) on August 8, 2012.

Appendix F

Big Springs/Lake Creek Native Fish Community Data

Table F-1 Catch per Unit Effort (CPUE, Fish per Second), Total Fish Reach Estimates (Linear Regression with R-Squared (RSQ) and Fish Length with Standard Error (S.E.)

Reach	Species[1]	Total Fish Captured	CPUE (fish/sec)	Total Fish Reach Estimates (RSQ)	# Fish Measured	Mean Fish Length in mm (SE)	Fish Length Range in mm
1	Redside Shiner	104	0.025	126 (0.95)	54	68.5 (1.2)	40 - 85
	Speckled Dace	518	0.12	721 (0.86)	50	58.6 (1.4)	35 - 80
	Utah Chub	0	0	0	0	NA	NA
	Utah Sucker	0	0	0	0	NA	NA
	Mottled Sculpin	0	0	0	0	NA	NA
	Sacramento Perch	0	0	0	0	NA	NA
	Carp	0	0	0	0	NA	NA
	Combined Total	622	0.3	843 (0.94)			
4	Redside Shiner	54	0.007	85 (0.99)	51	72.2 (1.5)	35 - 97
	Speckled Dace	422	0.056	629 (0.76)	85	59.0 (1.4)	33 - 79
	Utah Chub	21	0.003	24 (1.00)	21	107.4 (5.3)	75 - 180
	Utah Sucker	6	0.001	insufficient data	6	147.3 (29.2)	73 - 265
	Mottled Sculpin	766	0.102	1098 (1.00)	78	52.1 (1.8)	29 - 88
	Sacramento Perch	0	0	0	0	NA	NA
	Carp	0	0	0	0	NA	NA
	Combined Total	1269	0.168	1858 (0.98)			
5	Redside Shiner	0	0	0	0	NA	NA
	Speckled Dace	0	0	0	0	NA	NA
	Utah Chub	8	0.002	insufficient data	8	44.0 (1.0)	38 - 48
	Utah Sucker	318	0.075	578 (0.93)	45	42.2 (1.3)	32 - 95
	Mottled Sculpin	0	0	0	0	NA	NA
	Sacramento Perch	249	0.059	338 (1.00)	35	35.2 (1.7)	16 - 100
	Carp	24	0.006	25 (0.98)	24	59.9 (1.4)	38 - 70
	Combined Total	599	0.141	902 (0.99)			
6	Redside Shiner	88	0.026	115 (0.96)	43	66.5 (3.7)	34 - 135
	Speckled Dace	71	0.021	84 (1.00)	39	69.3 (1.4)	44 - 89
	Utah Chub	6	0.002	6 (1.00)	6	165.5 (22.3)	91 - 225
	Utah Sucker	8	0.002	insufficient data	8	153.6 (27.5)	65 - 260
	Mottled Sculpin	0	0	0	0	NA	NA
	Sacramento Perch	0	0	0	0	NA	NA
	Carp	0	0	0	0	NA	NA
	Combined Total	173	0.052	217 (1.00)			

[1]The native fish community includes Redside Shiner, Speckled Dace, Utah Chub, Utah Sucker, and Mottled Sculpin. Sacramento Perch and Common Carp are non-native fish species.

Figure F-1 Big Springs/Lake Creek Native Fish Community Time Series Graph: Total Fish Reach Estimate by Reach

Time series by year (09 = 2009) and season (SP = Spring, FA = Fall)

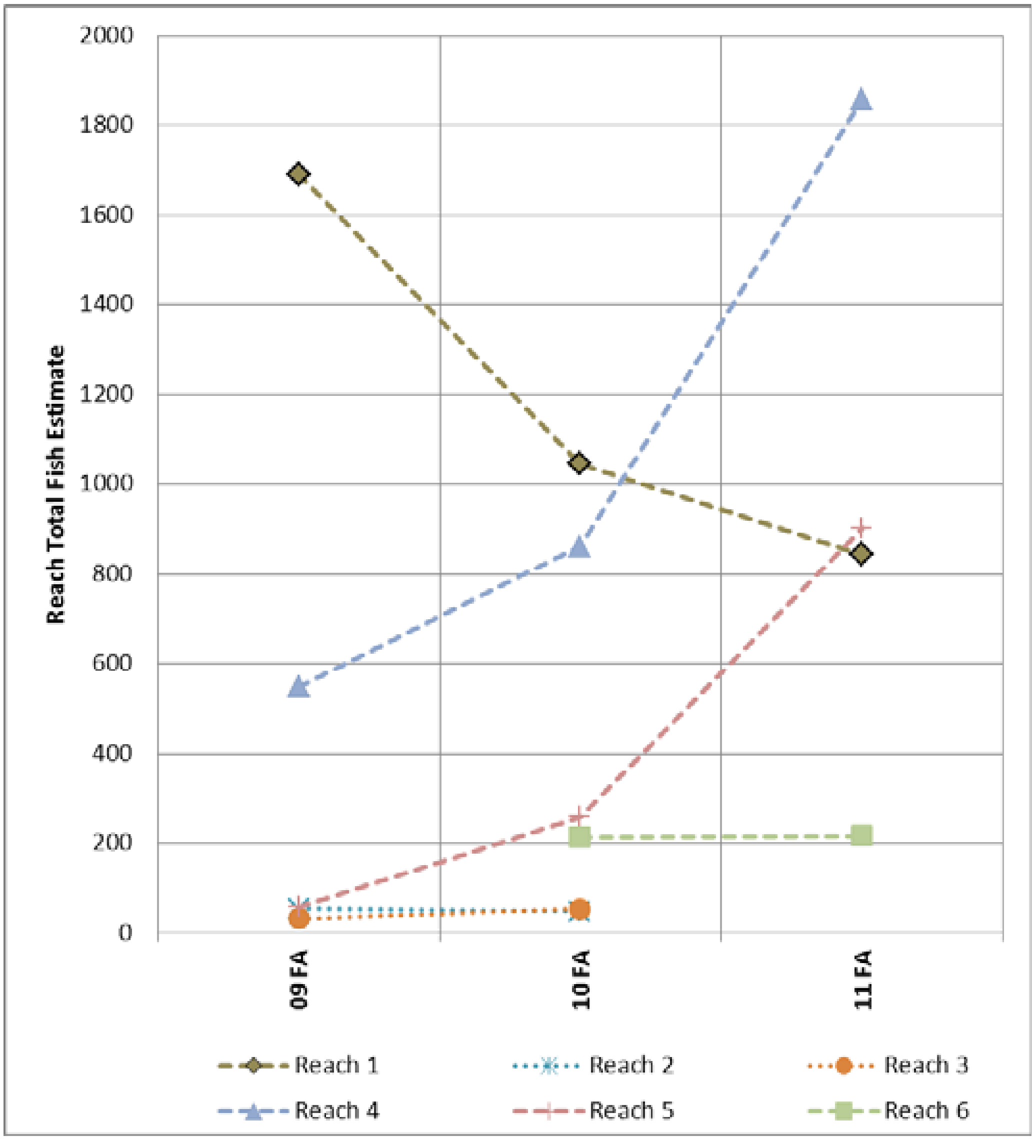
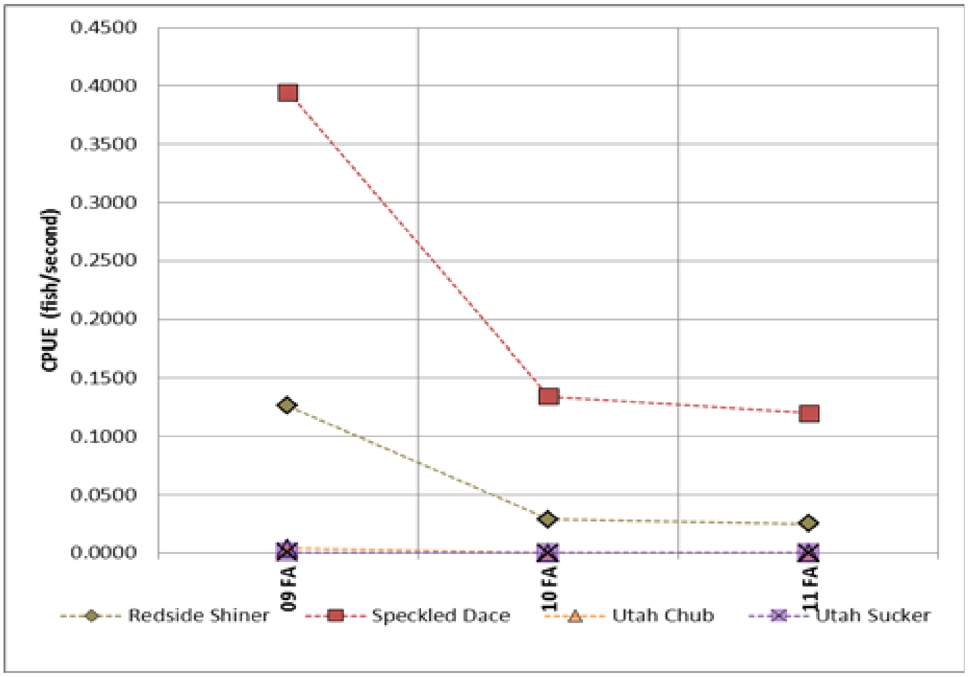
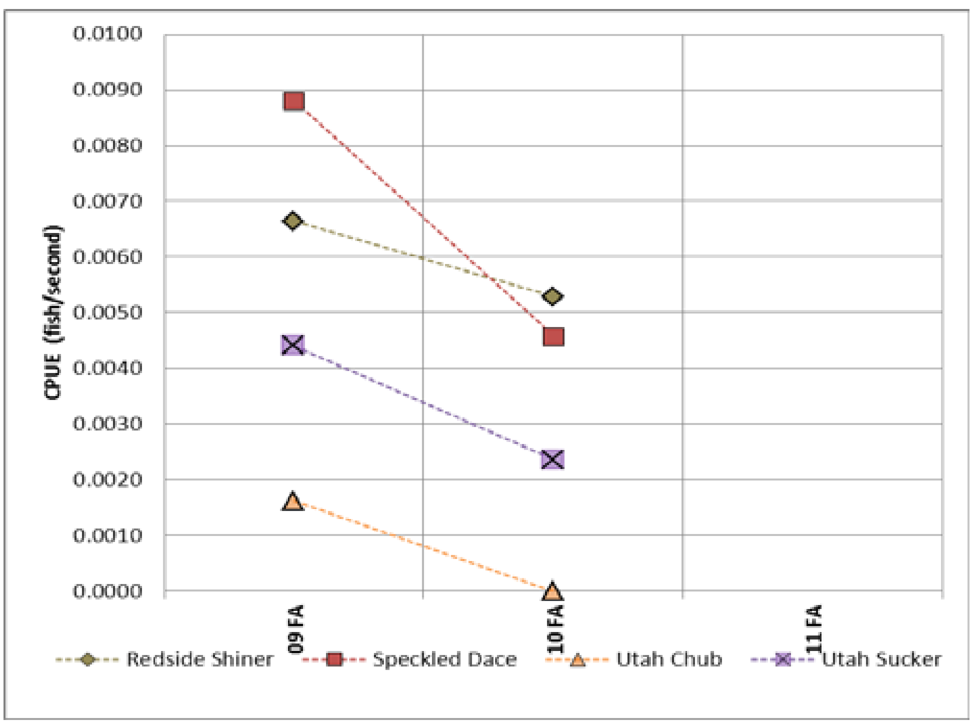


Figure F-2 Big Springs/Lake Creek Native Fish Community Time Series Graphs: Species Relative Abundance (Catch per Unit Effort, CPUE) by Reach.

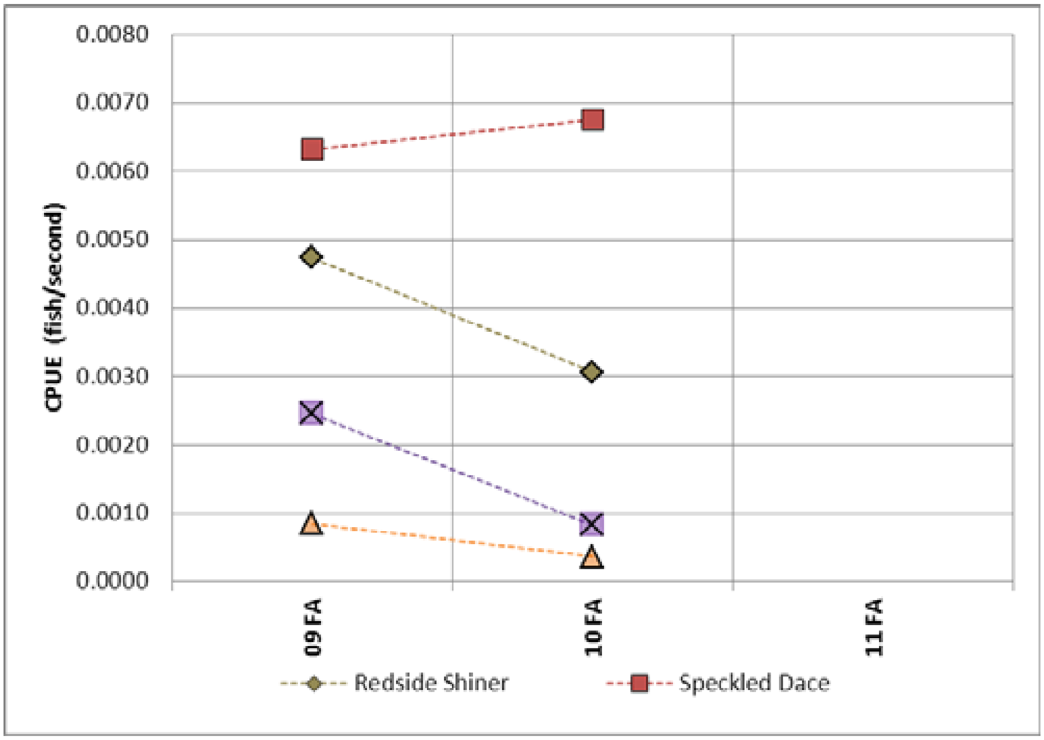
Time series by year (09 = 2009) and season (SP = Spring, FA = Fall)



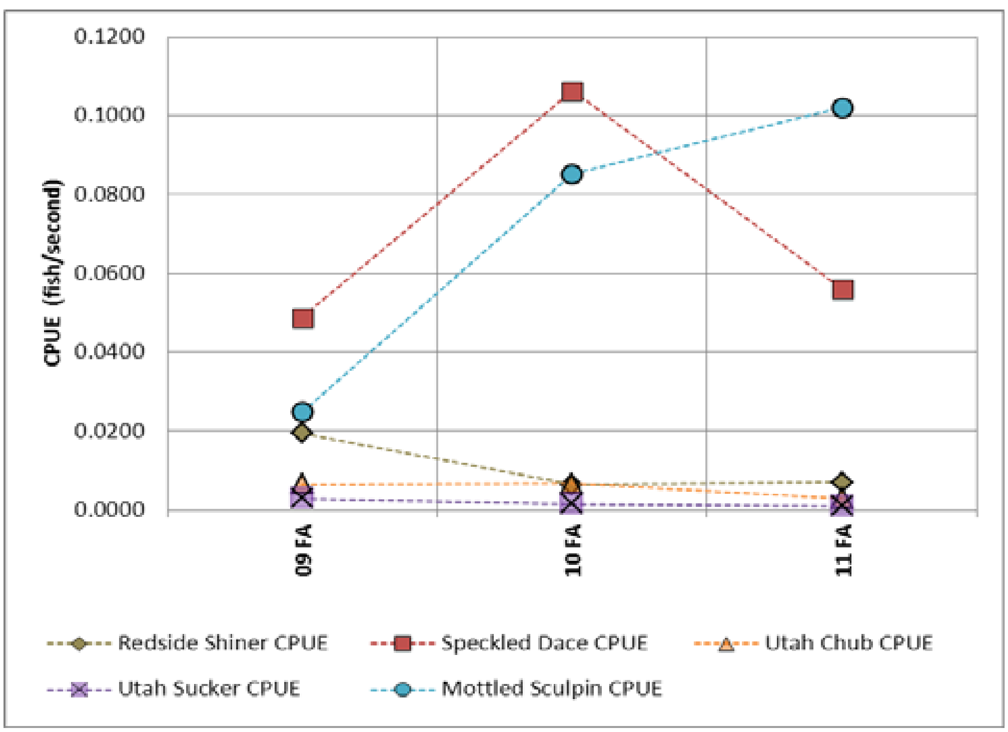
Reach 1



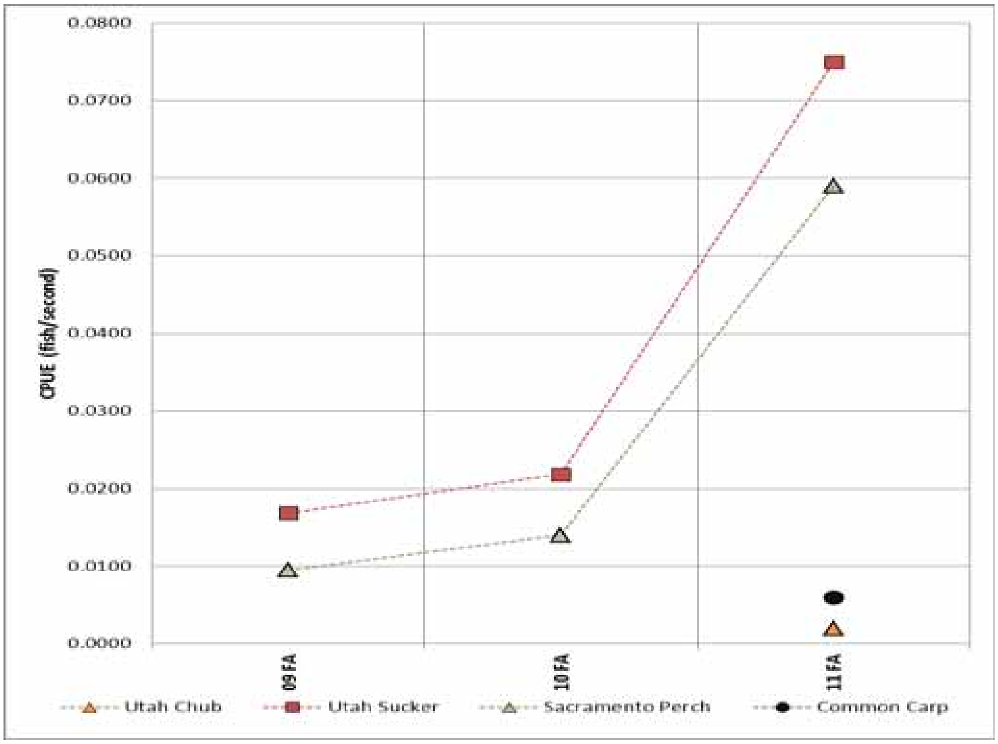
Reach 2 (Not Surveyed in 2011)



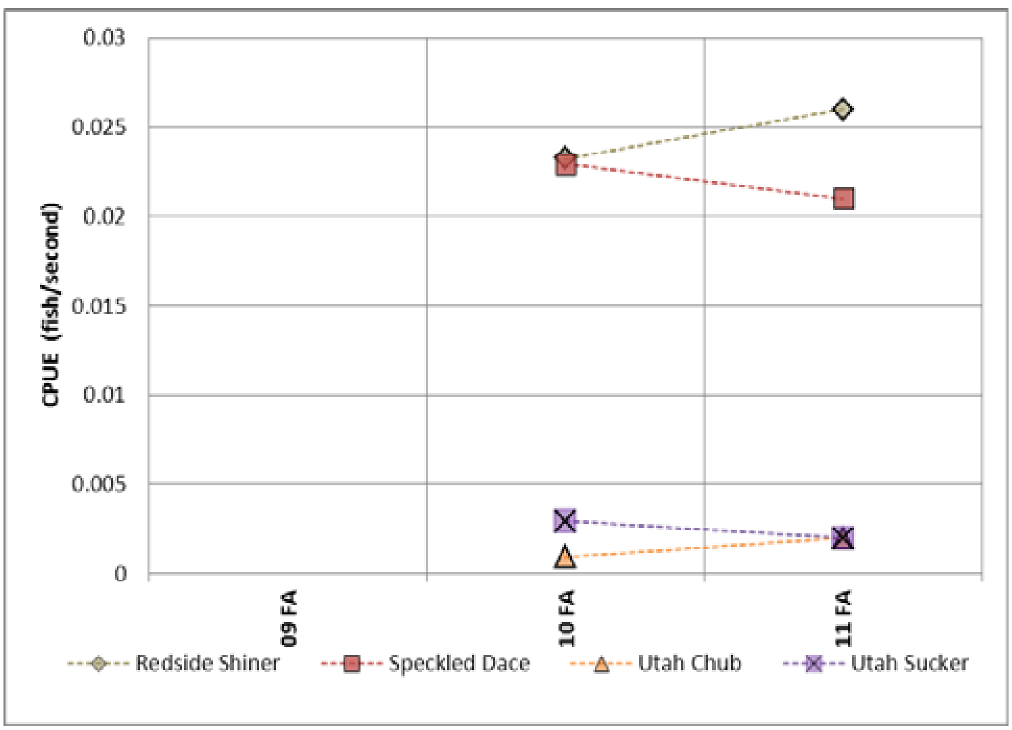
Reach 3 (not surveyed in 2011)



Reach 4



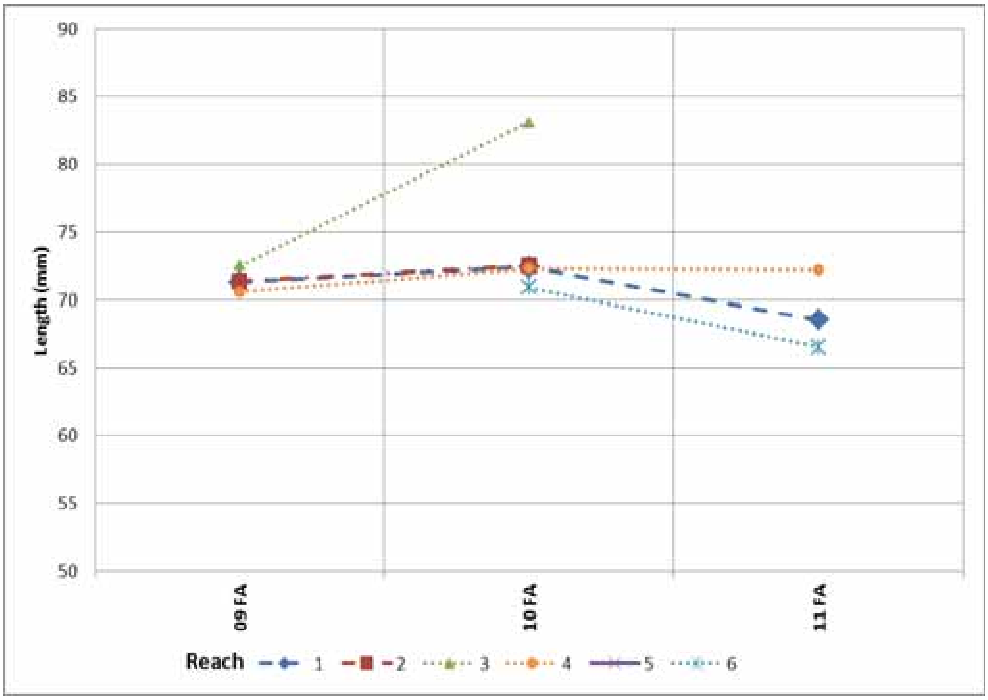
Reach 5 (Sacramento Perch and Common Carp are Non-Native Fish Species)



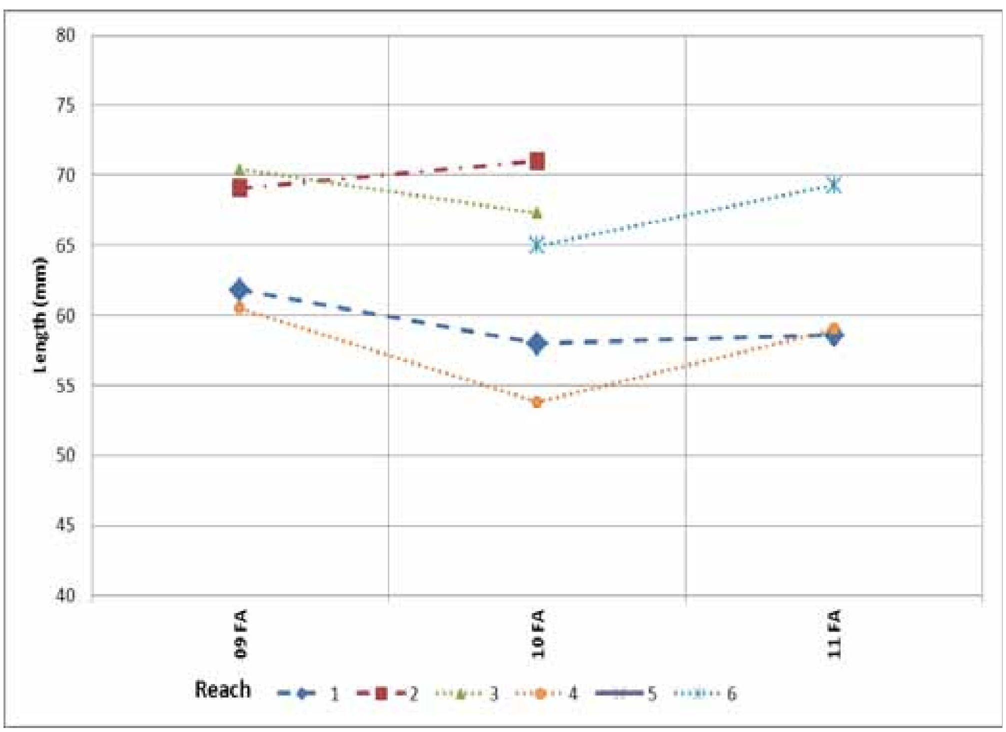
Reach 6 (Reach Established in 2010)

Figure F-3 Big Springs/Lake Creek Native Fish Community Time Series Graphs: Mean Fish Length (Denoting Age Class Structure) by Species by Reach

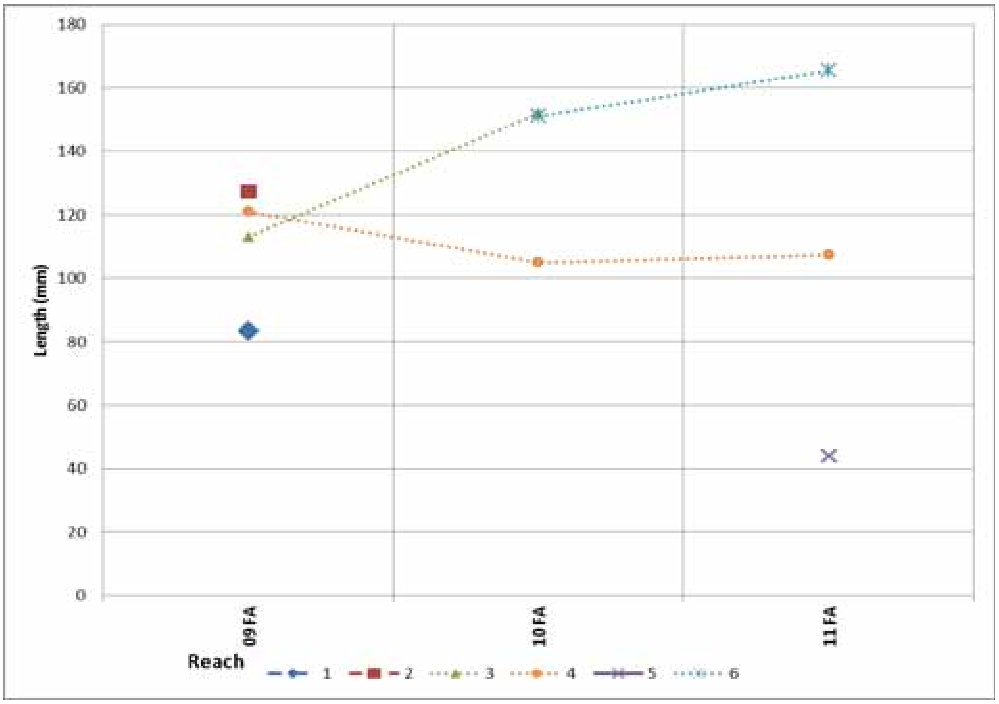
Time series by year (09 = 2009) and season (SP = Spring, FA = Fall)



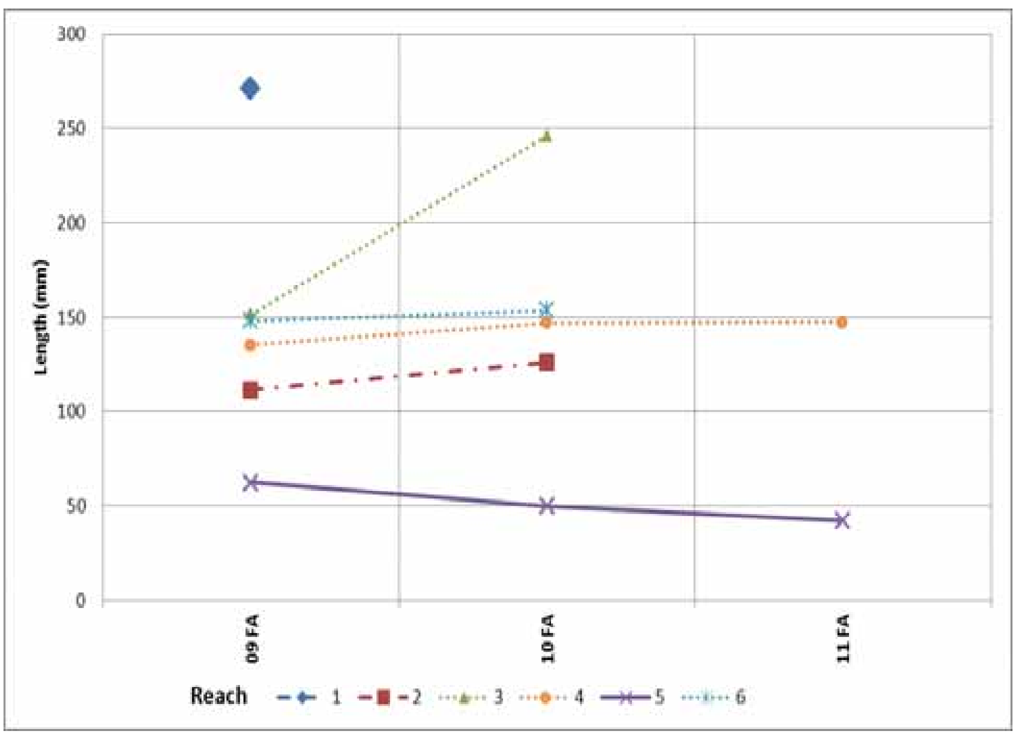
Redside Shiner



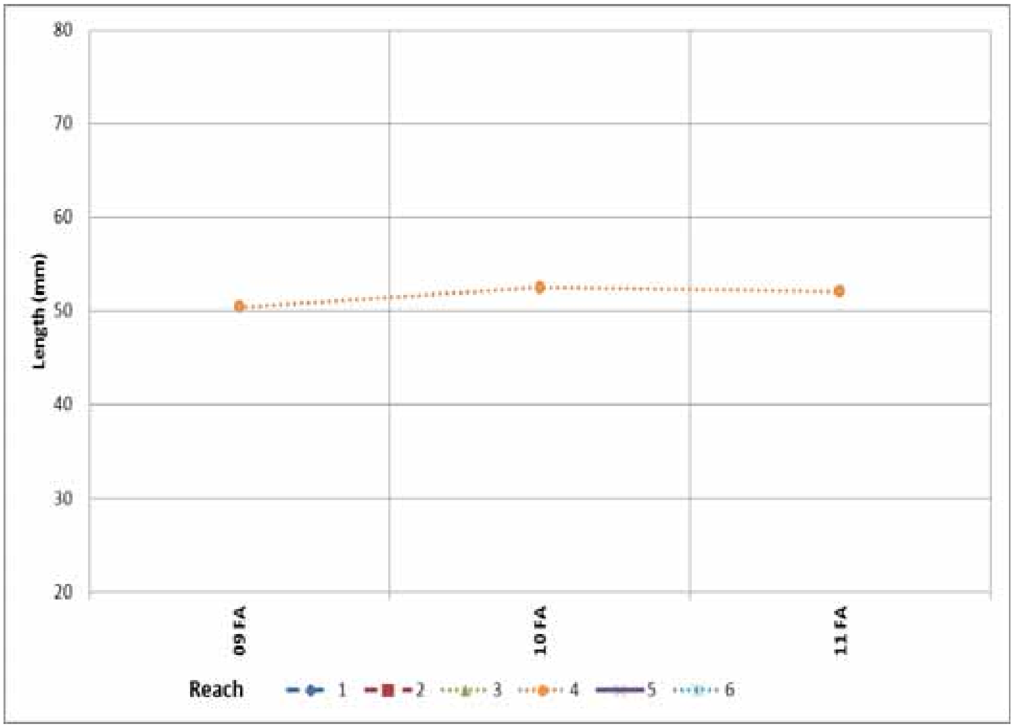
Speckled Dace



Utah Chub



Utah Sucker



Mottled Sculpin

Appendix G

Rocky Mountain Juniper Data

Table G-1 Rocky Mountain Juniper Tree Count, Height, and Stem Elongation, 2011

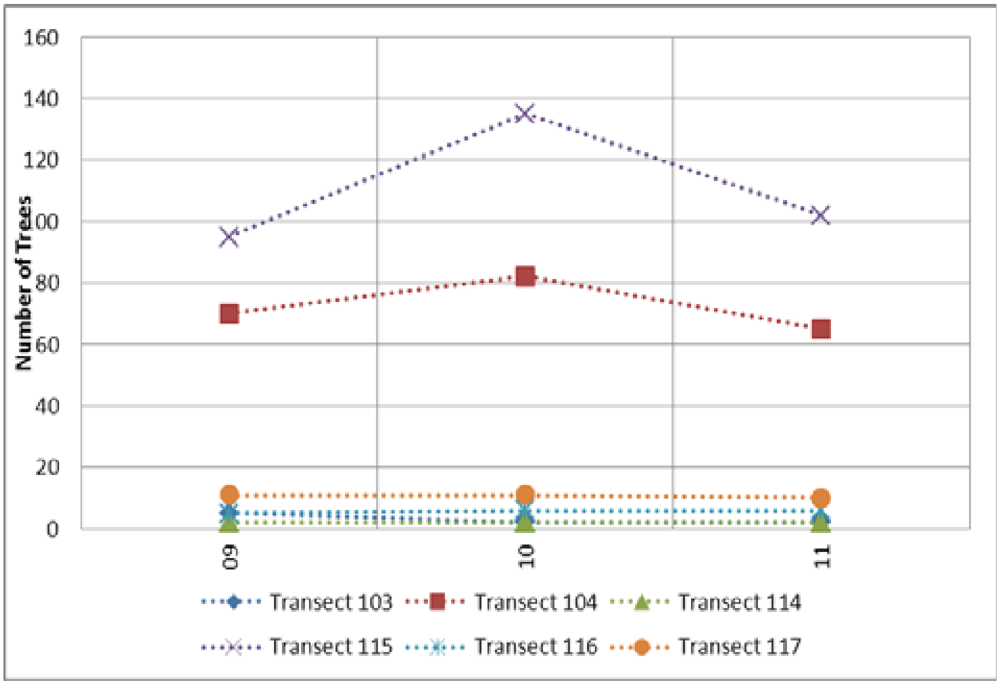
Site	Transect Number	Juvenile Tree Count[1]	Mature Tree Count[1]	Mean Juvenile Tree Height (m)	Mean Mature Tree Height (m)	Mean Stem Elongation (cm)
Swamp Cedar North	103	77	2	6.9	720.0	9.9
Swamp Cedar North	104	7	65	81.1	212.7	25.2
Swamp Cedar South	114	0	2	0	732.5	5.2
Swamp Cedar South	115	274	102	37.8	318.5	11.5
Swamp Cedar South[2]	116	2	6	23	421.2	6.4
Swamp Cedar South	117	92	10	17.3	425.1	9

[1]Juvenile trees are < 1m in height, Mature trees are ≥1m in height

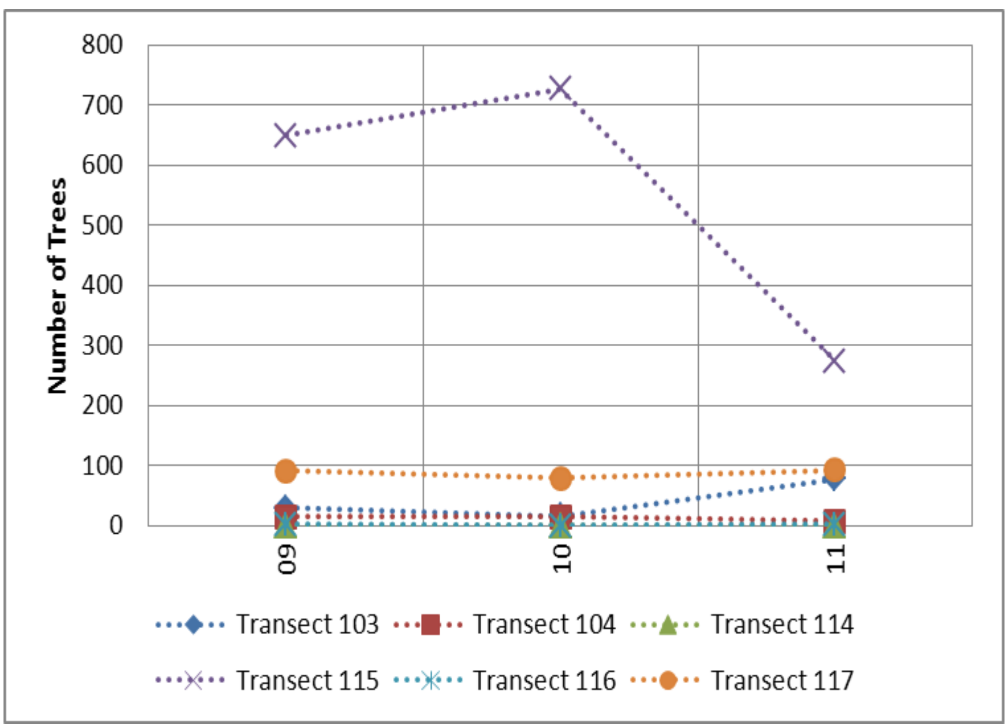
[2]All trees within Transect 116 were verified in 2011 to be *Juniperus osteosperma* (Utah Juniper), not *Juniperus scopulorum* (Rocky Mountain Juniper).

Figure G-1 Rocky Mountain Juniper Time Series Graphs: Mature and Juvenile Tree Counts

Time series by year (09-10 = growth from 2009 to 2010) previous data collected for other transects see SNWA (2011a). All trees are *J. scopulorum* (Rocky Mountain Juniper), with the exception of transect 116 where all trees are *J. osteosperma* (Utah Juniper)



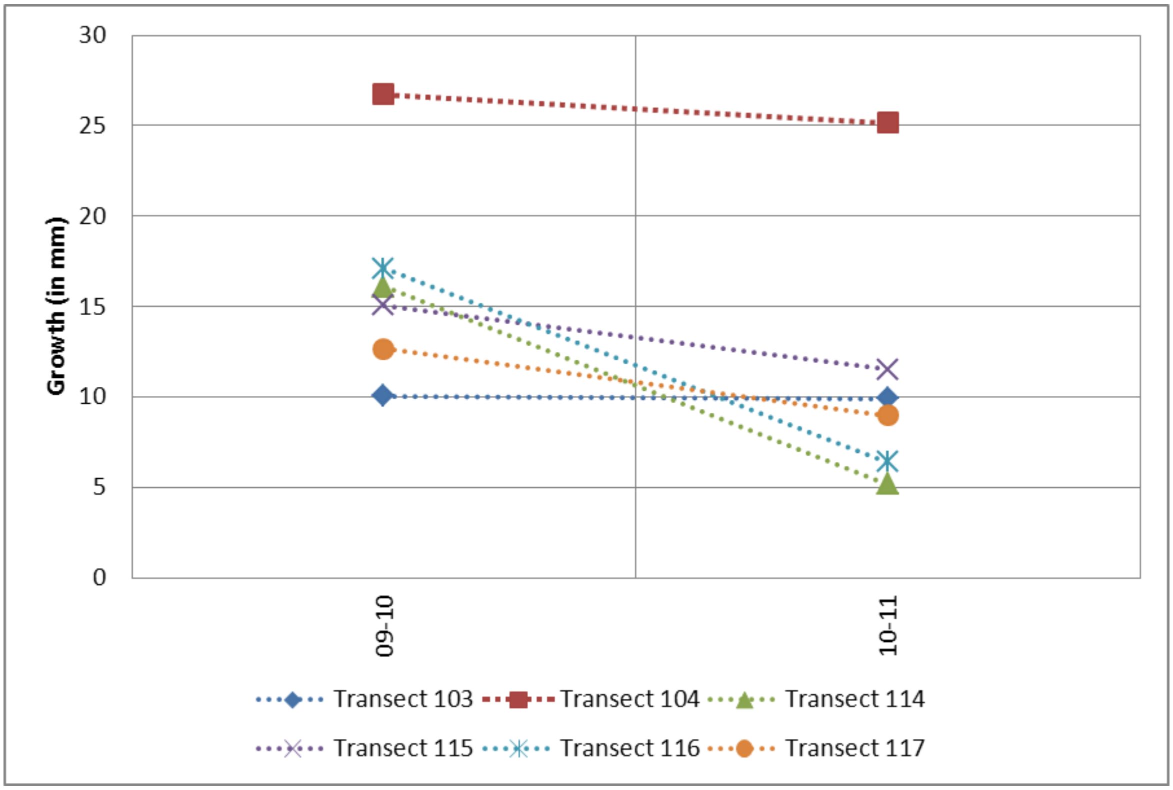
Mature Tree Count



Juvenile Tree Count

Figure G-2 Rocky Mountain Juniper Time Series Graphs: Stem Elongation

Time series by year (09-10 = growth from 2009 to 2010). Previous data collected for other transects see SNWA (2011a). All trees are *J. scopulorum* (Rocky Mountain Juniper), with the exception of transect 116 where all trees are *J. osteosperma* (Utah Juniper)



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Appendix H

Fixed Station Photography Data

Table H-1 List of Fixed Station Photographs*, 2011

Site	Date	Photography Station Number	Compass Bearing
Four Wheel Drive Spring	20110908	Photo_049	102
Four Wheel Drive Spring	20110908	Photo_050	240
Keegan Spring Complex North	20110908	Photo_010	005
Keegan Spring Complex North	20110908	Photo_010	043
Keegan Spring Complex North	20110908	Photo_010	089
Keegan Spring Complex North	20110908	Photo_010	130
Minerva Spring Complex North	20110906	Photo_035	255
Minerva Spring Complex North	20110906	Photo_037	029
Minerva Spring Complex North	20110906	Photo_037	054
Minerva Spring Complex North	20110906	Photo_037	102
Minerva Spring Complex North	20110906	Photo_038	007
Minerva Spring Complex North	20110906	Photo_039	082
Unnamed 5 Spring	20110906	Photo_001	236
Unnamed 5 Spring	20110906	Photo_002	074
Unnamed 5 Spring	20110906	Photo_003	150
West Spring Valley Complex 1	20110907	Photo_058	038
West Spring Valley Complex 1	20110907	Photo_059	131
West Spring Valley Complex 1	20110907	Photo_063	244
West Spring Valley Complex 1	20110907	Photo_064	075
West Spring Valley Complex 1	20110907	Photo_065	060
Willard Spring	20110906	Photo_077	269
Willow-NV Spring	20110907	Photo_056	010
Willow-NV Spring	20110907	Photo_057	110

*Photographs available upon request.

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