

Clark County 2020-2021 USFWS Refuge Survey Summary Reports  
Springs Stewardship Institute  
Volume 1 of 2

1. Big Spring, 12/06/21 .....	2
2. Cottonwood Spring, 12/06/21 .....	4
3. Lone Tree Spring, 12/06/21 .....	12
4. Moapa NWR Springs Complex, 10/29/20 .....	18
5. Moapa NWR, Apcar Springs A, 10/29/20.....	19
6. Moapa NWR, Apcar Springs B, 10/29/20.....	21
7. Moapa NWR, Apcar Springs C, 10/29/20.....	23
8. Moapa NWR, Apcar Springs D, 10/29/20.....	25
9. Moapa NWR, Apcar Springs E Pipe Outlet, 10/29/20.....	27
10. Moapa NWR, Pederson Springs A, 10/29/20.....	30
11. Moapa NWR, Pederson Springs B, 10/29/20.....	33
12. Moapa NWR, Pederson Springs C, 10/29/20.....	35
13. Moapa NWR, Pederson Springs D, 10/29/20.....	37
14. Moapa NWR, Pederson Springs E, 10/29/20.....	39
15. Moapa NWR, Pederson Springs F, 10/29/20.....	40
16. Moapa NWR, Pederson Springs H, 10/29/20.....	42
17. Moapa NWR, Pederson Springs I, 10/29/20.....	44
18. Moapa NWR, Pederson Springs J, 10/29/20.....	46
19. Plummer Pond, 10/29/20 .....	48
20. Plummer Springs A, 10/28/20.....	50

## 1. Big Spring, 12/06/21

### Survey Summary Report, Site ID 111676

Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Big Spring ecosystem is located in Lincoln County in the White Nevada 15010011 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Pahranaagat National Wildlife Refuge, in the Lower Pahranaagat Lake USGS Quad, at 37.20191, -115.05334 measured using a GPS (WGS84). The elevation is approximately 962 meters. Andrea Hazelton, Chantal Iosso, Erin Kaczmarowski, James Hada, and Nicole Collar verified the site on 12/06/21 at 15:56. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 1.1 Big Spring:** The reported spring location with dry soil and winter-dormant vegetation. The photographer is facing south.

**Physical Description:** Big Spring is a hypocrene/helocrene spring. As of 2021, this site is dry. The reported location is in a broad, dry valley about 350 meters west of Highway 93. The valley floor is flat with mountains to the south, east, and west. A raised, long-abandoned roadbed crosses the valley bottom about 100 meters south of the site.

**Access Directions:** From the Pahranaagat National Wildlife Refuge Visitor Center, turn south onto Highway 93 and drive for about 6.5 miles. Park on the side of the highway, and walk west about 350 meters to the spring.

**Survey Notes:** No water was found at the time of survey. The dominant vegetation is *Kochia*, *Juncus*, and *Anemopsis californica*, with scattered *Ericameria nauseosa*. One lone *Tamarix* was observed. Vegetation was winter-dormant at the time of the survey.



**Fig 1.2 Big Spring:** The valley bottom, as viewed from the old roadbed south of the reported springs location. The GPS point is about 50 meters beyond the surveyors.

2. Cottonwood Spring, 12/06/21  
Survey Summary Report, Site ID 111742  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Cottonwood Spring ecosystem is located in Lincoln County in the White Nevada 15010011 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Pahrnagat National Wildlife Refuge, in the Lower Pahrnagat Lake USGS Quad, at 37.24438, -115.11400 measured using a GPS (WGS84). The elevation is approximately 987 meters. Erin Kaczmarowski, Andrea Hazelton, James Hada, Chantal Iosso, and Nicole Collar surveyed the site on 12/06/21 for 02:55 hours, beginning at 9:15, and collected data in 10 of 10 categories. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 2 protocol.



**Fig 2.1 Cottonwood Spring:** The excavated pool, lined with cattails and sedges.

**Physical Description:** Cottonwood Spring is a limnocrene/anthropogenic spring. Seepage emerges into a 30 meter by 100 meter excavated pool in the broad Pahrnatag Valley. The pool flows out at the northern end, into a narrow channel with a weir and flow measurement station. The outflow channel flows through a broad cienega beginning about 20 meters downstream of the pond. The channel is very straight and appears to have been excavated. There is an elevated terrace around the pool that was also likely human-made to impound the spring. There is old infrastructure including metal beams and plastic tubing around the spring. There is a walking trail from Alamo Road to the spring. Calcium precipitate covers the terrace soil. The pool, margin, and cienega substrate is organic-rich. Some data for this spring were imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. The microhabitats associated with the spring cover 9175 sqm. The site has 5 microhabitats, including A -- a 2725 sqm pool, B -- a 675 sqm pool margin, C -- a 4950 sqm terrace, D -- a 175 sqm channel, E -- a 650 sqm low gradient cienega. The geomorphic diversity is 0.50, based on the Shannon-Weiner diversity index.

**Table 2.1 Cottonwood Spring Microhabitat characteristics.**

Code	A	B	C	D	E
Name	Pool	Pool perimeter	Upper terrace	Outflow channel	Low gradient cienega
Area sqm	2725	675	4950	175	650
Surface type	P	PM	TE	CH	LGC
Surface subtype	anthro		MRZ		
Slope variability	Low	Low	Low	Low	Low
Aspect TN				33	
Slope degrees					
Moisture (scale 1-10)	10	9	1	8	8
Water depth cm	102	6	0	6	3
Area % open water	100	50	0	40	40
<b>Substrate</b>					
1 - Clay %	0	15	40	20	15
2 - Silt %	0	25	20	20	25
3 - Sand %	0	0	40	34.9	0
4 - Fine gravel %	0	0	0	25	0
5 - Coarse gravel %	0	0	0	0	0
6 - Cobble %	0	0	0	0	0
7 - Boulder %	0	0	0	0	0
8 - Bedrock %	0	0	0	0	0
Organic %	100	60	0	0	60
Other % (anthropogenic)	0	0	0	0.1	0
Precipitate %	0	0	10	0	0
Litter %	1	90	70	70	90
Wood %	0	0.5	5	0	0
Litter Depth (cm)	0.05	20	15	25	25

**Geomorphology:** Cottonwood Spring emerges as a seepage or filtration spring from an unconsolidated rock layer. The emergence environment is subaerial, with a gravity flow force mechanism. The site receives approximately 97% of available solar radiation, with 9105 Mj annually.

**Access Directions:** From Highway 93, turn left (southwest) onto the HQ Entrance Road to Pahranaagat Visitor Center. Stay right past the Visitor Center to continue onto Alamo Road, an unpaved but well-graded road. Continue for 2 miles, and park at the gate/trailhead. Walk 300 meters past the gate to the spring.

**Survey Notes:** The pool impounds a large amount of water which exits the pond in an outflow channel at the north end before widening into broad cienega with standing water and damp ground after about 20 meters. Cattails and sedges line the pool and cienega, while the upper terrace is dominated by grasses and yerba mansa. There are many mature cottonwoods, as well as caged willow and cottonwood saplings on the terrace. Waterbirds like coots are abundant in the pool, and nests in the surrounding trees indicate other bird presence. The gauge station appears to be non-functional along with the weir. A trail leads to the spring and follows the perimeter of the pool.

**Flow:** Surveyors measured a flow of 1.4 liters/second, using a flume. Flow was adjusted for an estimate of 95% of site flow capture. Surveyors measured flow using a 1-inch flume in the outflow channel just upstream of the permanently installed weir. This spring is perennial.

**Water Quality:** Water quality was measured on the western edge of the pool, where surveyors suspected a source might be. Location 1: in a pool in standing water at 11:11.

**Table 2.2 Cottonwood Spring Water Quality Measurements.**

Characteristic Measured	Value	Location Number	Device
Dissolved Solids (field) (ppt)	0.429	1	Hanna Combo
pH (field)	7.3	1	Hanna Combo
Specific conductance (field) ( $\mu\text{S}/\text{cm}$ )	851	1	Hanna Combo
Temperature, air C	23.8	1	Handheld therm
Temperature, water C	12	1	Hanna Combo

**Flora:** Most plants were dormant for the winter. All identifiable plants were recorded, even if dead or dormant. Andrea Hazelton was the botanist for this survey. Surveyors identified 25 plant species at the site, with 0.0027 species/sqm. These included 24 native and 1 nonnative species.

**Table 2.3 Cottonwood Spring Cover Type.**

Cover Type	Species Count	Wetland Species Count
Ground	16	11
Shrub	7	5
Mid-canopy	2	2
Tall canopy	2	2
Basal	0	0
Aquatic	0	0
Non-vascular	1	1

**Table 2.4 Cottonwood Spring Vegetation % Cover in Microhabitats.**

Plant Species	Cover Code	Native Status	Wetland Status	Comments	A	B	C	D	E
algae	NV	N?	A		80	0	0	0	0
Anemopsis californica	GC	N	W		0	2	25	0.1	0.5
Atriplex lentiformis	SC	N	R		0	0.1	10	0	0
Baccharis emoryi	SC	N	R		0	0	0.5	0	0
Cirsium mohavense	GC	N	F		0	0.1	0	0	0
Distichlis spicata	GC	N	WR		0	0	15	0	0
Eleocharis	GC	N	W		1	10	0	1	0
Elymus lanceolatus	GC	N	F		0	0.1	20	0	0
Epilobium ciliatum	GC	N	W		0	0.1	0	0	0
Ericameria nauseosa	SC	N	F		0	0	5	0	0
Juncus balticus	GC	N	W		0.1	10	3	0	0
Kochia scoparia	GC	I	F		0	0.5	2	0	0
Mentha arvensis	GC	N	WR		0	0.1	0.01	0	0
Muhlenbergia asperifolia	GC	N	WR		0	5	1	0.1	0
Nitrophila occidentalis	GC	N	F		0	0.1	1	0	0
Populus fremontii	MC	N	R		0	1	2	0	0
Populus fremontii	SC	N	R		0	1	2	0	1
Populus fremontii	TC	N	R		0	0	3	0.5	0
Salix exigua	SC	N	WR		0	3	0.5	0	0
Salix gooddingii	MC	N	R		0	0	1	0	0
Salix gooddingii	SC	N	R	cf.	0	4	1	0	0
Salix gooddingii	TC	N	R		0	0	0.5	0	0
Sarcobatus vermiculatus	SC	N	F		0	0	1	0	0
Schoenoplectus acutus	GC	N	W		2	20	0.01	0	60
Schoenoplectus americanus	GC	N	W		1	10	2	20	20
Solidago	GC	N	F		0	2	7	0.1	10
Sporobolus airoides	GC	N	WR		0	0.1	3	0	0
Typha	GC	N	W		7	25	0	75	5

**Fauna:** Invertebrates were collected on the edge of the pool and in the outflow channel. Erin Kaczmarowski served as wildlife biologist for this survey. Surveyors collected or observed 4 aquatic and 3 terrestrial invertebrate taxa and 3 vertebrate taxa.

**Table 2.5 Cottonwood Spring Invertebrates.**

Species	Lifestage	Habitat	Method	Rep#	Count	Species Detail
Amphipoda	Ad	A	Collected spot		1	
Araneae	Ad	T	Collected spot		1	
Coleoptera	Ad		Collected spot		1	
Ephemeroptera	L	A	Collected spot		5	
Hemiptera	Ad	T	Collected spot		1	
Hemiptera Corixidae	Ad	A	Collected spot		1	
Mollusca Gastropoda	Ad		Collected spot		16	
Odonata	L	A	Collected spot		7	
Odonata	Ad	T	Spot		1	

**Table 2.6 Cottonwood Spring Vertebrates.**

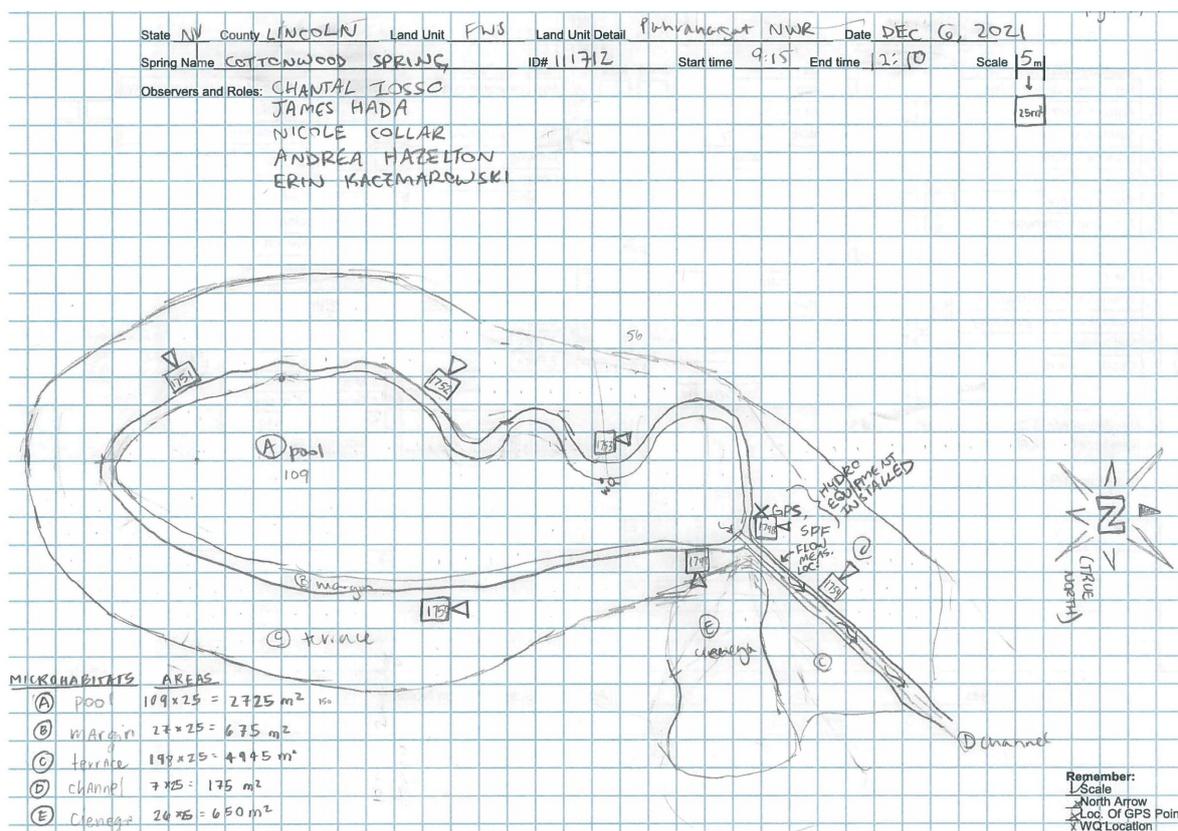
Vertebrate Species Common Name	Count	Detection	Comments
American Coot	10	obs	many in water
Osprey		sign	nest high in tree
Mountain Lion		sign	scat

**Assessment:** Assessment scores were compiled in 5 categories and 33 subcategories, with 9 null condition scores, and 9 null risk scores. Aquifer functionality and water quality are good with significant restoration potential (average condition score 4.3) and there is negligible risk (average risk score 1.8). Geomorphology condition is good with significant restoration potential (average condition score 4) and there is low risk (average risk score 2.2). Habitat condition is good with significant restoration potential (average condition score 4.6) and there is negligible risk (average risk score 1.6). Biotic integrity is good with significant restoration potential (average condition score 4.8) and there is low risk (average risk score 2.1). Human influence of site is very good with excellent restoration potential (average condition score 5) and there is negligible risk (average risk score 1.7). Overall, the site condition is good with significant restoration potential and there is low risk.

**Table 2.7 Cottonwood Spring Assessment Scores. Condition scores range from 0 (extremely poor condition) to 6 (pristine condition) and risk scores range from 0 (no risk to the site) to 6 (extreme risk to the site).**

Category	Condition	Risk
Aquifer Functionality & Water Quality	4.3	1.8
Geomorphology	4	2.2
Habitat	4.6	1.6
Biota	4.8	2.1
Human Influence	5	1.7
Overall Ecological Score	4.6	1.9

**Management Recommendations:** Remove old and non-functional piping. Monitor for bullfrogs during their active season; they were not observed during this survey but they have been recorded at this spring in the past.



**Fig 2.2 Cottonwood Spring Sketchmap.**



**Fig 2.3 Cottonwood Spring:** The gauge station, which is likely non-functional, located in the pond outflow channel. A permanent weir is installed less than a meter downstream of the gauge station. The photographer is facing south. The pond is out of view, right of the photo frame.



**Fig 2.4 Cottonwood Spring:** The outflow channel and low gradient cienega, both densely covered with winter-dormant vegetation and dried litter. The photographer is facing southeast.

3. Lone Tree Spring, 12/06/21  
Survey Summary Report, Site ID 111743  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Lone Tree Spring ecosystem is located in Lincoln County in the White Nevada 15010011 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Pahrnagat National Wildlife Refuge, in the Lower Pahrnagat Lake USGS Quad, at 37.20198, -115.06799 measured using a GPS (WGS84). The elevation is approximately 973 meters. Andrea Hazelton, James Hada, Chantal Iosso, Nicole Collar, and Erin Kaczmarowski surveyed the site on 12/06/21 for 01:00 hours, beginning at 14:15, and collected data in 9 of 10 categories. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 2 protocol.



**Fig 3.1 Lone Tree Spring:** Seepage emerges within a wet patch of cienega with shallow standing water, located within the grove of cottonwood trees. The photographer is on the low hill to the west of the spring, facing east.

**Physical Description:** Lone Tree Spring is a helocrene/hillslope spring. Seepage emerges from the base of a low hill at the western edge of the salt flat that fills the wide bottom of the Pahrnagat Valley. The seepage supports a low gradient cienega that extends down the western edge of the valley bottom for about 400 meters. At the base of the hill where the flow first emerges, the seepage fills two small pools and also forms a short springbrook channel. The soil surrounding the pools is covered in salt crust. The microhabitats associated with the spring cover 2012 sqm. The site has 3 microhabitats,

including A -- a 340 sqm low gradient cienega, B -- a 32 sqm channel, C -- a 1640 sqm terrace. The geomorphic diversity is 0.23, based on the Shannon-Weiner diversity index.

**Geomorphology:** Lone Tree Spring emerges as a seepage or filtration spring from an unconsolidated rock layer. The emergence environment is subaerial, with a gravity flow force mechanism. The site receives approximately 99% of available solar radiation, with 9321 Mj annually.

**Access Directions:** From the junction of Highway 15 and Highway 93, drive north on Highway 93 for roughly 60 miles. Park on the side of the road, east of the spring site. Walk approximately 0.5 miles west to the spring.

**Survey Notes:** The larger pool is surrounded by cottonwood trees and filled with bullrushes. The cienega immediately surrounding the pools and channel is covered yerba masa with *Juncus balticus*. The surrounding vegetation is primarily composed of rabbitbrush and saltbrush with interspersed saltgrass. Many signs of anthropogenic use are present including PVC pipe, holes dug around the perimeter of the site, rebar, and barbed wire.

**Flow:** There are shallow, segmented pools of standing water, but no outflow. Surveyors visually estimated flow at less than 0.01 L/s. This spring is perennial. Surveyors were unable to measure flow because there was no outflow.

**Water Quality:** Water quality was measured in the larger source pool. Location 1: in a pool in standing water at 14:14.

**Table 3.1 Lone Tree Spring Water Quality Measurements.**

Characteristic Measured	Value	Location Number	Device
Dissolved Solids (field) (ppt)	0.589	1	Hanna Combo
pH (field)	7.57	1	Hanna Combo
Specific conductance (field) ( $\mu\text{S}/\text{cm}$ )	1125	1	Hanna Combo
Temperature, air C	21.6	1	Handheld therm
Temperature, water C	13.9	1	Hanna Combo

**Flora:** The botany inventory was conducted out of season. All identifiable plants were recorded, even if dead or dormant. Andrea Hazelton was the botanist for this survey. Surveyors identified 13 plant species at the site, with 0.0065 species/sqm. These included 11 native and 2 nonnative species.

**Table 3.2 Lone Tree Spring Cover Type.**

Cover Type	Species Count	Wetland Species Count
Ground	9	6
Shrub	4	3
Mid-canopy	1	1
Tall canopy	1	1
Basal	0	0
Aquatic	0	0
Non-vascular	0	0

**Table 3.3 Lone Tree Spring Vegetation % Cover in Microhabitats.**

Plant Species	Cover Code	Native Status	Wetland Status	Comments	A	B	C
<i>Anemopsis californica</i>	GC	N	W		2	10	70
<i>Atriplex lentiformis</i>	SC	N	R		0.5	0.5	1
<i>Cynodon dactylon</i>	GC	I	F		0	0	2
<i>Ericameria nauseosa</i>	SC	N	F		0	1	1
<i>Heliotropium curassavicum</i>	GC	N	W		0	2	1
<i>Juncus balticus</i>	GC	N	W		1	0.1	20
<i>Lemna</i>	GC	N	A		0.5	0	0
<i>Nitrophila occidentalis</i>	GC	N	F		0	0	2
<i>Populus fremontii</i>	MC	N	R		20	0	10
<i>Populus fremontii</i>	SC	N	R		10	0	5
<i>Populus fremontii</i>	TC	N	R		30	0	10
<i>Schoenoplectus americanus</i>	GC	N	W		30	80	0
<i>Solidago</i>	GC	N	F		0.5	2	0
<i>Sporobolus airoides</i>	GC	N	WR		0	0	2
<i>Tamarix</i>	SC	I	WR		0	2	0.1

**Fauna:** Erin Kaczmarowski served as the wildlife biologist for this survey. Surveyors collected or observed 1 aquatic and 4 terrestrial invertebrate taxa and 2 vertebrate taxa.

**Table 3.4 Lone Tree Spring Invertebrates.**

Species	Lifestage	Habitat	Method	Rep#	Count	Species Detail
Araneae	Ad	T	Collected spot		2	
Coleoptera	L		Collected spot		9	
Coleoptera	Ad		Collected spot		1	
Coleoptera Coccinellidae	Ad	T	Spot		1	
Diptera	L		Collected spot		5	
Diptera	Ad		Collected spot		1	
Diptera Culicidae	Ad	T	Spot		20	
Isopoda	Ad	T	Collected spot		2	
Mollusca Gastropoda	Ad		Collected spot		3	
Zooplankton Ostracoda	Ad	A	Collected spot		2	

**Table 3.5 Lone Tree Spring Vertebrates.**

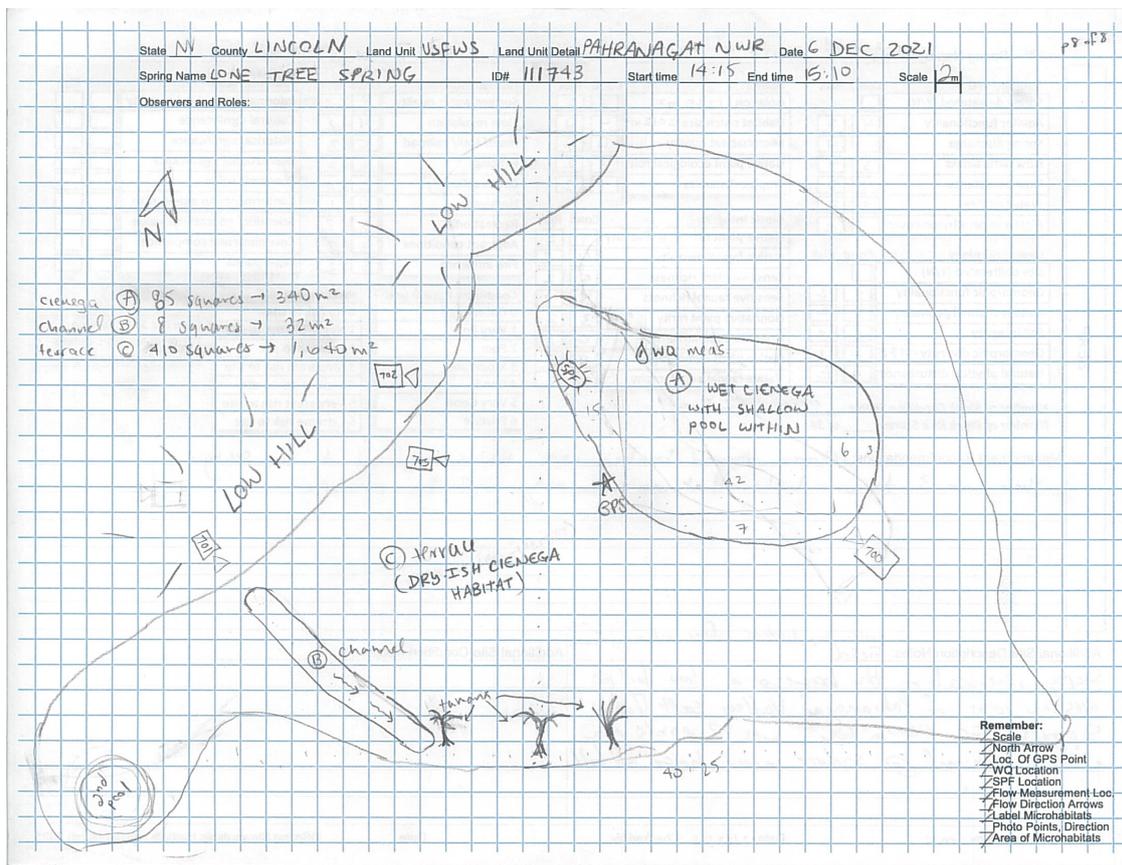
Vertebrate Species Common Name	Count	Detection	Comments
Mountain Lion		sign	scat
Elk		sign	scat

**Assessment:** Assessment scores were compiled in 5 categories and 33 subcategories, with 9 null condition scores, and 9 null risk scores. Aquifer functionality and water quality are moderate with some restoration potential (average condition score 3.6) and there is moderate risk (average risk score 3). Geomorphology condition is good with significant restoration potential (average condition score 4.2) and there is negligible risk (average risk score 1.8). Habitat condition is good with significant restoration potential (average condition score 4.2) and there is low risk (average risk score 2). Biotic integrity is good with significant restoration potential (average condition score 4.6) and there is low risk (average risk score 1.9). Human influence of site is very good with excellent restoration potential (average condition score 5.1) and there is negligible risk (average risk score 1.7). Overall, the site condition is good with significant restoration potential and there is low risk.

**Table 3.6 Lone Tree Spring Assessment Scores. Condition scores range from 0 (extremely poor condition) to 6 (pristine condition) and risk scores range from 0 (no risk to the site) to 6 (extreme risk to the site).**

Category	Condition	Risk
Aquifer Functionality & Water Quality	3.6	3
Geomorphology	4.2	1.8
Habitat	4.2	2
Biota	4.6	1.9
Human Influence	5.1	1.7
Overall Ecological Score	4.5	2

**Management Recommendations:** Remove the downed barbed wire that is adjacent to the spring. There are 3 tamarisk bushes that managers may wish to remove.



**Fig 3.2 Lone Tree Spring Sketchmap.**



**Fig 3.3 Lone Tree Spring:** Bullrushes and dense mats of yerba mansa fill the relatively dry cienega that surrounds the pools and channel.

4. Moapa NWR Springs Complex, 10/29/20  
Survey Summary Report, Site ID 111738  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR Springs Complex ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70987, -114.71566 (WGS84). The elevation is approximately 540 meters. Larry Stevens and Andrea Hazelton verified the site on 10/29/20 at 16:35. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.

**Physical Description:** This springs record represents a springs complex which has been alternately called Warm Springs, Moapa Warm Springs, and Pederson Springs. As of 2020, Pederson Springs was the preferred name used by Moapa NWR staff for this springs complex. Surveys by Don Sada (1991) associated with this springs record pre-date extensive restoration work done by the refuge. Sada re-surveyed this springs complex after the restoration work and mapped the complex as a series of sources named Pederson A through J. This springs record should be considered historic, representing the pre-restoration state. New springs surveys should be associated with the appropriate Pederson source, as mapped by Sada in 2016 and re-mapped by Stevens and Hazelton in 2020. The GPS coordinate of this springs record is located closest to Pederson D (SSI ID 235885) but this information should be interpreted with care because modern GPS technology was not available when the coordinate was recorded. Note also that there is a nearby springs record, Warm Springs Province (SSI ID 163242) which houses data that applies to the entire springs province, including several springs complexes within and surrounding the Moapa National Wildlife Refuge.

**Access Directions:** This complex is located at the Moapa National Wildlife Refuge, about 50 miles north of downtown Las Vegas. The Pederson Springs Complex is located about 50 m southeast of a workshop on the Moapa NWR property.

**Survey Notes:** The GPS coordinates associated with this springs record is in the middle of sparse arrowweed (*Pluchea sericea*) and screwbean mesquite (*Prosopis pubescens*). The adjacent landscape is woodland. This site is associated with the Pederson Springs Complex. It is closest to the Pederson D source (SSI ID 235885), as mapped by Don Sada in 2016.

5. Moapa NWR, Apcar Springs A, 10/29/20  
Survey Summary Report, Site ID 180908  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Apcar Springs A ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.71530, -114.71863 measured using a GPS (WGS84, estimated position error 3 meters). The elevation is approximately 555 meters. Larry Stevens verified the site on 10/29/20 at 14:05. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 5.1 Moapa NWR, Apcar Springs A:** The springs source, which is dominated by herbaceous wetland vegetation. The photographer is facing northwest.

**Physical Description:** Moapa NWR, Apcar Springs A is a helocrene spring. This spring and the 2008 survey were imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. The coordinates reported in 2017 by Dr. Sada for this site were significantly different from those previously

reported, and they were adjusted at that time. Coordinates were adjusted again based on a 2020 survey. This is the northern-most spring in the Apcar province. According to the 2020 surveyor, water at this source seeps to the surface in a shallow gradient helocrene and forms a narrow, rather incised channel, covered by vegetation. According to notes imported from a compilation of Don Sada's data, there are six springs in this province. All of these springs flow into a common springbrook that leaves MVNWR and flows onto SNWA property. This was the third piece of property purchased by the U.S. Fish and Wildlife Service for the MVNWR to conserve the endangered Moapa dace. These springs have also been altered for recreation, but never used as a resort. It now includes a pumping facility for the Moapa Valley Water District, which captures discharge from the largest spring in the province and delivers a portion of it to downstream agriculture. These springs were restored in 2007 and 2008, and the riparian community along all springbrooks remains in an early seral stage of recovery. The condition of all springs and springbrooks in the province was similar, with the exception of Spring-F, which was large, relatively steep and swift, and contains large substrates. Substrate composition in all other springs was dominated by fine sand and gravel. Riparian vegetation was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which was often dense. Dense vegetation prevented access to two spring sources, but the springbrook below their confluence was surveyed. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce. Albrecht et al. (2008) did not find *Pyrgulopsis* in these springs during 2008, which may be attributed to their sampling during the winter (when springsnails abundance is at its annual lows) and/or the immediate stress caused by construction during restoration. Mosquito fish and *M. tuberculata* were common in these springs during 2016 surveys.

**Access Directions:** The Apcar Springs Complex is located at the northwest end of the Moapa National Wildlife Refuge, just east of a pumphouse and a workshop.

**Survey Notes:** There is no sign of recent human activity. Vegetation cover is dominated by cattails (*Typha domingensis*), Fremont cottonwood (*Populus fremontii*), spikerush (*Eleocharis*), Yerba mansa (*Anemopsis californica*), goldenrod (*Solidago canadensis*), and common reed (*Phragmites australis*). There are also some seepwillows (*salicifolia*) and non-native palms (*Washingtonia filifera*). Screwbean mesquite (*Prosopis pubescens*) is dead or dying here.

**Fauna:** Surveyors collected or observed 1 terrestrial invertebrate taxon

**Table 5.1 Moapa NWR, Apcar Springs A Invertebrates.**

Species	Lifestage	Habitat	Method	Rep#	Count	Species Detail
Odonata Coenagrionidae <i>Argia immunda</i>	Ad	T	Collected spot		1	Male

6. Moapa NWR, Apcar Springs B, 10/29/20  
Survey Summary Report, Site ID 180909  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Apcar Springs B ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.71488, -114.71872 (WGS84). The elevation is approximately 555 meters. Larry Stevens verified the site on 10/29/20 at 14:30. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 6.1 Moapa NWR, Apcar Springs B:** The dense thicket of riparian vegetation at the source. The photographer is facing south.

**Physical Description:** Moapa NWR, Apcar Springs B is a hillslope spring. This spring's record and its 2008 survey were imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. Additional data were imported from the Sada 2017 data import. In 2020, surveyors described this spring as a minor hillslope source within the Apcar Springs Complex. Flow emerges within a dense stand of vegetation and flows down a narrow, 20 centimeter-wide channel through a dense riparian thicket. Notes from the 2017 data import state that there are six springs in this province. All of these springs flowed into a common springbrook that leaves MVNWR and flows onto SNWA property. This was the third piece of property purchased by the U.S. Fish and Wildlife Service for the MVNWR to conserve the endangered Moapa dace. These springs have also been altered for recreation, but it was never used as a resort. It now includes a pumping facility for the Moapa Valley Water District, which captures discharge from the largest spring in the province and delivers a portion of it to downstream agriculture. These springs were restored in 2007 and 2008, and the riparian community along all springbrooks remains in an early seral stage of recovery. The condition of all springs and springbrooks in the province was similar, with exception of Spring-F, which was large, relatively steep and swift, and contains large substrates. Substrate composition in all other springs was dominated by fine sand and gravel. Riparian vegetation was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which was often dense. Dense vegetation prevented access to two spring sources, but the springbrook below their confluence was surveyed. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce. Albrecht et al. (2008) did not find *Pyrgulopsis* in these springs during 2008, which may be attributed to their sampling during the winter (when springsnails abundance is at its annual lows) and/or the immediate stress cause by construction during restoration. Mosquitofish and *M. tuberculata* were common in these springs during 2016 surveys.

**Access Directions:** The Apcar Springs Complex is located at the northwest end of the Moapa National Wildlife Refuge, just east of a pumphouse and a workshop.

**Survey Notes:** The surveyor visually estimates the flow rate at approximately 0.5 L/sec. There is no recent sign of human alteration, but there also is no mature woody vegetation, indicating that it is a recovering landscape. The 20 centimeter-wide flowing stream is heavily overgrown and floored by roots. No invertebrates were detected. This site is overgrown with vegetation, including palms (*Washingtonia filifera*), goldenrod (*Solidago canadensis*), bullrush (*Schoenoplectus*), cattails (*Typha*), arrowweed (*Pluchea sericea*), and some yerba mansa (*Anemopsis californica*). There is some Fremont cottonwood (*Populus fremontii*) upstream and downstream of the source.

7. Moapa NWR, Apcar Springs C, 10/29/20  
Survey Summary Report, Site ID 251551  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Apcar Springs C ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.71482, -114.71880 (WGS84). The elevation is approximately 555 meters. Andrea Hazelton verified the site on 10/29/20 at 14:30. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 7.1 Moapa NWR, Apcar Springs C:** The dense thicket of arrowweed and cattail at the source.

**Physical Description:** Moapa NWR, Apcar Springs C is a hillslope spring. Flow emerges in the middle of a seepwillow, arrowweed, and cattail thicket. This source is part of the Apcar Springs Complex. This source was mapped and named in 2020 based on its location relative to the 2016 Sada record for Apcar D and for Apcar C and D confluence.

**Access Directions:** The Apcar Springs Complex is located at the northwest end of the Moapa National Wildlife Refuge, just east of a pumphouse and a workshop.

**Survey Notes:** This site is densely overgrown with vegetation.

8. Moapa NWR, Apcar Springs D, 10/29/20  
Survey Summary Report, Site ID 235884  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Apcar Springs D ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.71478, -114.71896 (NAD83). The elevation is approximately 542 meters. Andrea Hazelton verified the site on 10/29/20 at 14:15. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 8.1 Moapa NWR, Apcar Springs D:** The open, moist, precipitate-coated area that appears to serve as an outflow channel for this source when flows are higher.

**Physical Description:** Moapa NWR, Apcar Springs D is a hillslope spring. This springs record and its 2016 survey were imported in December 2017 from a compilation of Don Sada's 2016 research. The Land Manager ID number is from this dataset. Surveyors in 2020 described this site as a flowing hillslope source within the Apcar Springs Complex. It is located about 10 meters northeast of the most prominent source in this complex, the Apcar E Pipe Outlet. Flow from this source continues southeast and joins the outflow from the Apcar E Pipe Outlet within a short distance, about 10 meters. While flowing water is visible from this source, it is not possible to physically access the source through the dense seepwillow. There is another smaller source visible a few meters to the northeast that lacks outflow but shows evidence of an outflow channel leading east toward the coordinates for Apcar C and D Confluence. The area that appears to be the outflow channel for this small source is less vegetated than the surrounding thicket, and has moist soil coated with precipitates. Notes from the Sada 2017 dataset state that here are six springs in this province. All of these springs flowed into a common springbrook that leaves MVNWR and flows onto SNWA property. This was the third piece of property purchased by the U.S. Fish and Wildlife Service for the MVNWR to conserve the endangered Moapa dace. These springs have also been altered for recreation, but it was never used as a resort. It now includes a pumping facility for the Moapa Valley Water District, which captures discharge from the largest spring in the province and delivers a portion of it to downstream agriculture. These springs were restored in 2007 and 2008, and the riparian community along all springbrooks remains in an early seral stage of recovery. The condition of all springs and springbrooks in the province was similar, with exception of Spring-F, which was large, relatively steep and swift, and contains large substrates. Substrate composition in all other springs was dominated by fines, sand, and gravel. Riparian vegetation was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which was often dense. Dense vegetation prevented access to two spring sources, but the springbrook below their confluence was surveyed. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce. Albrecht et al. (2008) did not find *Pyrgulopsis* in these springs during 2008, which may be attributed to their sampling during the winter (when springsnails abundance is at its annual lows) and/or the immediate stress cause by construction during restoration. Mosquitofish and *M. tuberculata* were common in these springs during 2016 surveys.

**Access Directions:** The Apcar Springs Complex is located at the northwest end of the Moapa National Wildlife Refuge, just east of a pumphouse and a workshop.

**Survey Notes:** Extremely dense riparian vegetation, including juvenile palms (*Washingtonia*), arrowweed (*Pluchea sericea*), seepwillow (*Baccharis salicifolia*), and cattail (*Typha*) obscures the visibility of flow paths and site geomorphology. The open, precipitate-coated area to the east of the sources is vegetated with yerba mansa (*Anemopsis californica*) and bullrush (*Schoenoplectus*).

## 9. Moapa NWR, Apcar Springs E Pipe Outlet, 10/29/20

### Survey Summary Report, Site ID 180911

Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Apcar Springs E Pipe Outlet ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.71468, -114.71907 (WGS84). The elevation is approximately 555 meters. Andrea Hazelton and Larry Stevens verified the site on 10/29/20 at 14:00. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 9.1 Moapa NWR, Apcar Springs E Pipe Outlet:** The outflow pipe, which releases a constant 1 cfs of the groundwater pumped by the adjacent well. Note that the pipe cover and the rocks within the spray zone are coated with precipitates.

**Physical Description:** Moapa NWR, Apcar Springs E Pipe Outlet is an anthropogenic spring. This springs record and its 2008 survey were imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. This was a big cluster, and there were no coordinates in the original dataset, so it was placed near the others. The site ID was matched to the record labeled as Apcar Springs F in the 2017 Sada import, which was clearly described as the pipe outlet source, with coordinates to match. According to surveyors in 2020, flow emerges from a 30 centimeter- diameter pipe into a cattail-filled channel. The outlet is just below a bladed

area with two buildings associated with the springs development. One of the buildings is a pumphouse with a well; the developer (City of Glendale) is required to discharge a constant 1 cfs through the pipe that forms this springs source, as mitigation for the groundwater withdrawal. According to notes from the 2017 Sada import, this is the southernmost spring in the province, and the largest. All of its discharge comes from a pipe that captures the spring in a pump house. Its springbrook flows onto SNWA property and into a channelized ditch. There are six springs in this province. All of these springs flow into a common springbrook that leaves MVNWR and flows onto SNWA property. This was the third piece of property purchased by the U.S. Fish and Wildlife Service for the MVNWR to conserve the endangered Moapa dace. These springs have also been altered for recreation, but were never used as a resort. It now includes a pumping facility for the Moapa Valley Water District, which captures discharge from the largest spring in the province and delivers a portion of it to downstream agriculture. These springs were restored in 2007 and 2008, and, as of 2020, the riparian community along all springbrooks remains in an early seral stage of recovery. The condition of all springs and springbrooks in the province was similar, with exception of Spring-F, which was large, relatively steep and swift, and contains large substrates. Substrate composition in all other springs was dominated by fines, sand, and gravel. Riparian vegetation was dominated by shrub willow (*Salix* sp.) and arrow weed (*Pluchea* sp.), which was often dense. Dense vegetation prevented access to two spring sources, but the springbrook below their confluence was surveyed. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce. Albrecht et al. (2008) did not find *Pyrgulopsis* in these springs during 2008, which may be attributed to their sampling during the winter (when springsnails abundance is at its annual lows) and/or the immediate stress cause by construction during restoration. Mosquitofish and *M. tuberculata* were common in these springs during 2016 surveys.

**Geomorphology:** Moapa NWR, Apcar Springs E Pipe Outlet emerges as a tubular or conduit spring. The emergence environment is subaerial, with an anthropogenic flow force mechanism.

**Access Directions:** The Apcar Springs Complex is located at the northwest end of the Moapa National Wildlife Refuge, just east of a pumphouse and a workshop.

**Survey Notes:** The piped outflow is 1 cubic foot per second, with all other pumped water abstracted by the City of Glendale. There is abundant calcium-based precipitate coating the rocks that surround the outflow.

**Flow:** The Refuge biologist assured the surveyors that the pipe releases a constant flow of 1 cubic foot per second (28.3 L/sec). This spring is perennial.

**Water Quality:** The surveyor measured the water chemistry one meter downstream of the pipe outlet. Location 1: down-gradient from the spring source in flowing water at 15:15.

**Table 9.1 Moapa NWR, Apcar Springs E Pipe Outlet Water Quality Measurements.**

Characteristic Measured	Value	Location Number	Device
Dissolved Solids (field) (ppt)	0.475	1	Hanna Multi 98194
pH (field)	7.52	1	Hanna Multi 98194
Specific conductance (field) ( $\mu\text{S}/\text{cm}$ )	951	1	Hanna Multi 98194
Temperature, air C	30.5	1	Handheld therm
Temperature, water C	31.88	1	Hanna Multi 98194

**Fauna:** Surveyors collected or observed 1 terrestrial invertebrate taxon

**Table 9.2 Moapa NWR, Apcar Springs E Pipe Outlet Invertebrates.**

Species	Lifestage	Habitat	Method	Rep#	Count	Species Detail
Coleoptera	Ad		Collected spot		9	
Coleoptera	L		Collected spot		1	
Mollusca Gastropoda	Ad		Collected spot		23	
Odonata Coenagrionidae Argia sedula	Ad	T	Collected spot		1	Male



**Fig 9.2 Moapa NWR, Apcar Springs E Pipe Outlet:** The cobble and boulder-bed outflow channel, which is filled with cattails (*Typha*). The piped source is at the lower right-hand corner of the photo.

## 10. Moapa NWR, Pederson Springs A, 10/29/20

### Survey Summary Report, Site ID 181208

Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs A ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70933, -114.71568 (WGS84). The elevation is approximately 561 meters. Andrea Hazelton verified the site on 10/29/20 at 15:40. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 10.1 Moapa NWR, Pederson Springs A:** The small hillslope source, visible as a patch of cattails at the center of the photo, and the USGS gauge a few meters downslope of the source. The surrounding dense shrubby vegetation is mostly arrowweed associated with the springs complex. Note the juvenile palm just downslope of the gauge, and the burned mature palm tree in the background.

**Physical Description:** Moapa NWR, Pederson Springs A is a hillslope spring. This spring is part of the Pederson Springs Complex. The flow passes through a USGS weir gauge before entering a cobble-bed channel. About 8 meters downstream of the gauge, the flow is augmented by discharge from Pederson J source, which enters from creek right. This springs record was imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. All Pedersen springs are tributaries to this springbrook. Discharge is continuously measured by the USGS weir, located near the spring source. Approximately 400 meters of this springbrook lies

on the MVNWR (including 419.2 m<sup>2</sup> of *Pyrgulopsis* habitat) before crossing Warm Springs Road and entering SNWA property. *Pyrgulopsis* extended downstream from MVNWR for approximately 210 meters (occupying an additional 353.4 m<sup>2</sup> of habitat) on SNWA property. There are eight springs in this province. This was the first property purchased by the U.S. Fish and Wildlife Service in 1979 to create the MVNWR and conserve the endangered Moapa dace (*Moapa coriacea*). Prior to this purchase, it was managed as a warm springs resort that included an olympic-size swimming pool and bathhouses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallenseria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallenseria* was eradicated, artificial pools were removed, and native fish (Moapa dace and Moapa White River springfish [*Crenichthys baileyi moapa*]) (e.g., Scoppettone et al. 1992, Scoppettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs remains in early seral stage of recovery following restoration. In 2016, it was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which were often dense, and it restricted access to some portions of springbrook and to all of one spring and its springbrook. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** The source area is vegetated with cattails. The source and outflow channel are densely vegetated with herbaceous wetland vegetation. There are palms present and there is evidence that the Refuge palm removal effort is ongoing.



**Fig 10.2 Moapa NWR, Pederson Springs A: The USGS weir gauge, located a few meters downslope from the source.**

11. Moapa NWR, Pederson Springs B, 10/29/20  
Survey Summary Report, Site ID 181209  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs B ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70945, -114.71576 (WGS84). The elevation is approximately 561 meters. Andrea Hazelton verified the site on 10/29/20 at 17:00. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 11.1 Moapa NWR, Pederson Springs B:** Herbaceous wetland vegetation on the left bank of the springbrook. The flowing springbrook is just outside the photo frame, to the right.

**Physical Description:** Moapa NWR, Pederson Springs B is a hillslope/rheocrene spring. This springs record and the data from the 2008 survey were imported in February 2016 from a compilation of Don Sada's research. In 2020, this spring was barely distinguishable as such; just downstream of the confluence of the springbrooks associated with Pederson A and Pederson I, the left bank of the springbrook was seeping. The location of the seeping bank corresponded with the GPS coordinate for this springs record.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** There is a patch of herbaceous wetland vegetation on the lightly seeping left bank of the Pederson A and Pederson I combined outflow channel.

12. Moapa NWR, Pederson Springs C, 10/29/20  
Survey Summary Report, Site ID 235879  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs C ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70960, -114.71599 (WGS84). The elevation is approximately 554 meters. Andrea Hazelton verified the site on 10/29/20 at 15:50. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 12.1 Moapa NWR, Pederson Springs C:** The spring source, which is visible as a patch of cattails just to the right of the USGS gauge. The outflow channel for this springs complex is visible as a line of riparian vegetation crossing the desert in the photo-left mid-ground.

**Physical Description:** Moapa NWR, Pederson Springs C is a hillslope spring. The spring is in the Pederson Springs Complex. This source is instrumented with a USGS stream gauge. Outflow from this source joins flow from Pederson A. According to the Don Sada datasets imported in 2016 and 2017, this springbrook is 65 meters long and flows into the west side of the Pederson A springbrook. The source of this spring has been dredged into a circular pool, which is probably not characteristic of its natural form. It is a stable system that has naturalized from restoration and it is still recovering. There are eight springs in this province. All of them flow into a common springbrook that leaves the MVNWR and flows onto SNWA property. This was the first property purchased by the U.S. Fish and Wildlife Service in 1979 to create the MVNWR and conserve the endangered Moapa dace (*Moapa coriacea*). Prior to this purchase, it was managed as a

warm springs resort that included an olympic-sized swimming pool and bathhouses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallisneria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallisneria* was eradicated, artificial pools were removed, and native fish (Moapa dace and Moapa White River springfish [*Crenichthys baileyi moapa*]) (e.g., Scoppettone et al. 1992, Scoppettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs remains in early seral stage of recovery following restoration. During 2016 it was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which were often dense, and it restricted access to some portions of springbrook and to all of one spring and its springbrook. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** There are seedlings and juvenile palms throughout the springs ecosystem. Removal of adult palm trees is ongoing.

13. Moapa NWR, Pederson Springs D, 10/29/20  
Survey Summary Report, Site ID 235885  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs D ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70980, -114.71577 (NAD83). The elevation is approximately 550 meters. Larry Stevens verified the site on 10/29/20 at 15:50. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.

**Physical Description:** Moapa NWR, Pederson Springs D is a hillslope spring. This springs record was imported in December 2017 from a compilation of Don Sada's 2016 research. The Land Manager ID number is from this dataset. In 2016 and in 2020, dense vegetation prevented sampling access to the source of this spring. In 2020, flow emerged from dense brush consisting of arrowweed and palms. The following text was imported from the Sada dataset: Its springbrook was 52 m long, relatively wide, and with swift current. There are eight springs in this province. All of them flowed into a common springbrook that leaves the MVNWR and flows onto SNWA property. This was the first property purchased by the U.S. Fish and Wildlife Service in 1979 to create the MVNWR and conserve the endangered Moapa dace (*Moapa coriacea*). Prior to this purchase, it was managed as a warm springs resort that included an olympic-sized swimming pool and bathhouses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallisneria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallisneria* was eradicated, artificial pools were removed, and native fish (Moapa dace and Moapa White River springfish [*Crenichthys baileyi moapa*]) (e.g., Scoppettone et al. 1992, Scoppettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs remains in early seral stage of recovery following restoration. During 2016 it was dominated by shrub willow (*Salix* sp.) and arrow weed (*Pluchea* sp.), which were often dense, and it restricted access to some portions of springbrook, and to all of one spring and its springbrook. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** Flow emerges from the dense brush at an estimated rate of 5 L/sec. Several large palms have been cut. There is evidence of fire in the last approximately 15 years, with burned palm trunks remaining on site. Pyrgulopsis are abundant and some Turbellaria are present.

**Fauna:** Surveyors collected or observed 2 aquatic invertebrate taxa

**Table 13.1 Moapa NWR, Pederson Springs D Invertebrates.**

Species	Lifestage	Habitat	Method	Rep#	Count	Species Detail
Neotaenioglossa Hydrobiidae Pyrgulopsis	Ad	A	Spot		1	abundant
Turbellaria		A	Spot		1	some

14. Moapa NWR, Pederson Springs E, 10/29/20  
Survey Summary Report, Site ID 181210  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs E ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70976, -114.71583 (WGS84). The elevation is approximately 561 meters. Larry Stevens verified the site on 10/29/20 at 16:15. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.

**Physical Description:** This springs record was imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. This spring is part of the Pederson Springs Complex. The 2008 survey from the Sada dataset noted that this springs record corresponded with several small sources. A surveyor in 2020 noted that the coordinate is located in the middle of a dense stand of arrowweed associated with the Pederson Springs Complex, but that the closest springs source was Pederson D (SSI ID 235885).

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** The coordinates for this site are located within a dense stand of arrowweed (*Pluchea sericea*), but do not correspond with a springs source.

15. Moapa NWR, Pederson Springs F, 10/29/20  
Survey Summary Report, Site ID 181211  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs F ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70994, -114.71563 (WGS84). The elevation is approximately 561 meters. Larry Stevens verified the site on 10/29/20 at 16:43. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 15.1 Moapa NWR, Pederson Springs F:** The old staff gauge at this hillslope source. The photographer is facing south across much of this densely vegetated springs complex.

**Physical Description:** Moapa NWR, Pederson Springs F is a hillslope spring. This springs record was imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. This springs source is part of the Pederson Springs Complex. In 2020, a surveyor noted that flow emerged from a dense stand of riparian vegetation. There is an old staff gauge on site, mostly buried in vegetation. The Sada dataset noted that this spring and its springbrook were densely covered by woody riparian vegetation, which limited access. There are eight springs in this province. All of them flow into a common springbrook that leaves the MVNWR and flows onto SNWA property. This was the first property purchased by the U.S. Fish and Wildlife Service in 1979 to create the MVNWR and conserve the endangered Moapa dace (*Moapa coriacea*). Prior to this purchase, it was managed as a warm springs resort that included an olympic-sized swimming pool and bathhouses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallisneria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallisneria* was eradicated, artificial pools were removed, and native fish (Moapa dace and Moapa White River springfish [*Crenichthys baileyi moapa*]) (e.g., Scoppettone et al. 1992, Scoppettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs remains in early seral stage of recovery following restoration. During 2016 it was dominated by shrub willow (*Salix* sp.) and arrow weed (*Pluchea* sp.), which were often dense and it restricted access to some portions of springbrook and to all of one spring and its springbrook. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** The surveyor visually estimated the flow rate at 1.5 L/sec. The source is within a dense thicket of cattail (*Typha*), arrowweed (*Pluchea sericea*), bluestem grass (*Andropogon glomeratus*), and loosestrife (*Lythrum californicum*). A flume would work to measure flow here, but it would be necessary to bring a machete and a shovel.

16. Moapa NWR, Pederson Springs H, 10/29/20  
Survey Summary Report, Site ID 181213  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs H ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70999, -114.71515 (WGS84). The elevation is approximately 561 meters. Larry Stevens verified the site on 10/29/20 at 17:00. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 16.1 Moapa NWR, Pederson Springs H:** The arrowweed thicket surrounding the springs source. The photographer is facing south.

**Physical Description:** Moapa NWR, Pederson Springs H is a hillslope spring. This springs record was imported in February 2016 from a compilation of Don Sada's research. The Land Manager ID number is from this dataset. Vegetation is extremely dense at this spring source and all along its 35 meter- long springbrook, and sampling was not possible without removing vegetation. The proximity to other Pedersen springs and its connection with the Spring A springbrook suggests that it also supports a *Pyrgulopsis* population that is similar in abundance to other springs in the province. Habitat metrics and *Pyrgulopsis* abundance were not evaluated in this spring. There are eight springs in this province. All of them flow into a common springbrook that leaves the MVNWR and flows onto SNWA property. This was the first property purchased by the U.S. Fish and Wildlife Service in 1979 to create the MVNWR and conserve the endangered Moapa dace (*Moapa coriacea*). Prior to this purchase, it was managed as a warm springs resort that included an olympic-sized swimming pool and bathhouses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallenseria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallenseria* was eradicated, artificial pools were removed, and native fish (Moapa dace and Moapa White River springfish [*Crenichthys baileyi moapa*]) (e.g., Scopettone et al. 1992, Scopettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs remains in early seral stage of recovery following restoration. During 2016, it was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which were often dense, and it restricted access to some portions of springbrook and to all of one spring and its springbrook. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** The flow emerges within a dense stand of arrowweed and continues through dense vegetation. There is little evidence of macroinvertebrates and no evidence of human visitation. The surveyor visually estimated flow at approximately 1-2 L/sec.

17. Moapa NWR, Pederson Springs I, 10/29/20  
Survey Summary Report, Site ID 235886  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs I ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70944, -114.71577 (NAD83). The elevation is approximately 552 meters. Andrea Hazelton verified the site on 10/29/20 at 16:45. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 17.1 Moapa NWR, Pederson Springs I:** The springs source, with a juvenile palm in the middle. The Pederson A source and its USGS gauge are visible in the background. Outflow channels from these two sources merge at the left edge of the photo.

**Physical Description:** Moapa NWR, Pederson Springs I is a hillslope spring. This small source is part of the Pederson Springs Complex and located about 10 meters northwest of Pederson A, which is instrumented with a USGS gauge. Flow from this source joins the outflow from Pederson A on creek left about 8 meters downstream from the gauge. The record for this spring was imported in December 2017 from a compilation of Don Sada's 2016 research. The Land Manager ID number is from this dataset. According to the 2016 dataset, this small spring flows into its east side of the Spring-A springbrook, and approximately 10 meters downstream from the Spring-A source. Its springbrook is

5 meters long. There are eight springs in this province. All of them flow into a common springbrook that leaves the MVNWR and flows onto SNWA property. This was the first property purchased by the U.S. Fish and Wildlife Service in 1979 to create the MVNWR and conserve the endangered Moapa dace (*Moapa coriacea*). Prior to this purchase, it was managed as a warm springs resort that included an olympic-sized swimming pool and bathhouses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallisneria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallisneria* was eradicated, artificial pools were removed, and native fish (Moapa dace and Moapa White River springfish [*Crenichthys baileyi moapa*]) (e.g., Scoppettone et al. 1992, Scoppettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs remains in early seral stage of recovery following restoration. During 2016, it was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which were often dense, and it restricted access to some portions of springbrook and to all of one spring and its springbrook. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m southeast of a garage/ workshop associated with refuge operations.

**Survey Notes:** The source area is vegetated with spikerush (*Eleocharis*), young palms (*Washingtonia*), and cattails (*Typha*).

18. Moapa NWR, Pederson Springs J, 10/29/20  
Survey Summary Report, Site ID 235887  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Moapa NWR, Pederson Springs J ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.70942, -114.71563 measured using a GPS (WGS84). The elevation is approximately 552 meters. Andrea Hazelton verified the site on 10/29/20 at 16:15. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 18.1 Moapa NWR, Pederson Springs J:** The spring source, filled with cattails and spikerush; photographer is facing upstream (south).

**Physical Description:** Moapa NWR, Pederson Springs J is a hillslope spring. This small source is part of the Pederson Springs Complex. Flow emerges from a hillslope source and travels less than 10 meters down a marshy channel before merging with the

outflow channel from the Pederson A source. This springs record was imported in December 2017 from a compilation of Don Sada's 2016 research. The Land Manager ID number is from this dataset. According to the 2017 data import, this small spring flowed into its west side of the Spring A springbrook, approximately 9 meters downstream from the Spring A source. Its springbrook was 8 meters long. There are eight springs in this province. All of them flowed into a common springbrook that leaves the MVNWR and flows onto SNWA property. This was the first property purchased by the U.S. Fish and Wildlife Service in 1979 to create the MVNWR and conserve the endangered Moapa dace (*Moapa coriacea*). Prior to this purchase, it was managed as a warm springs resort that included an olympic-size swimming pool and bathhouses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallisneria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallisneria* was eradicated, artificial pools were removed, and native fish (Moapa dace and Moapa White River springfish [*Crenichthys baileyi moapa*]) (e.g., Scopettone et al. 1992, Scopettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs remains in early seral stage of recovery following restoration. During 2016, it was dominated by shrub willow (*Salix* sp.) and arrowweed (*Pluchea* sp.), which were often dense, and it restricted access to some portions of springbrook and to all of one spring and its springbrook. Native mesquite (*Prosopis* spp.) and ash trees (*Fraxinus* sp.) were scarce.

**Access Directions:** The Pederson Springs Complex is located at the Moapa National Wildlife Refuge, about 50 m SE of a garage/ workshop associated with refuge operations.

**Survey Notes:** The source is vegetated with herbaceous wetland plants, ash (*Fraxinus*), arrowweed (*Pluchea sericea*), and palms (*Washingtonia filifera*). There are pieces of dead palm which were cut down by land managers.

19. Plummer Pond, 10/29/20  
Survey Summary Report, Site ID 251552  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Plummer Pond ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.71021, -114.71179 measured using a GPS (WGS84). The elevation is approximately 543 meters. Larry Stevens and Andrea Hazelton verified the site on 10/29/20 at 8:40. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 1 protocol.



**Fig 19.1 Plummer Pond:** Dense wetland vegetation obscures the pool formed by this spring's hillslope source. The visitor parking lot and a building are visible in the background. The photographer is facing north (downslope).

**Physical Description:** Plummer Pond is a hillslope/limnocrone spring. Seepage emerges from a hillslope source and collects in a small (4 meters by 10 meters) pool which is filled with wetland vegetation, primarily cattails (*Typha*). The spring is about 10 meters upslope (south) of the Moapa National Wildlife Refuge visitor parking lot and brick walking path. It is about 10 meters east of the building housing the pit toilets.

**Access Directions:** This spring is adjacent to the visitor parking lot at the Moapa National Wildlife Refuge, about 50 miles north of downtown Las Vegas.

**Survey Notes:** The pond is filled with cattails (*Typha*) and sedges (*Eleocharis* and *Carex*), such that little open water is visible. The site is surrounded by mature palm trees (*Washingtonia filifera*). No flow exits the pond.

20. Plummer Springs A, 10/28/20  
Survey Summary Report, Site ID 181248  
Submitted 2/03/22 by Springs Stewardship Institute

**Location:** The Plummer Springs A ecosystem is located in Clark County in the Muddy Nevada 15010012 HUC, managed by the US Fish and Wildlife Service. The spring is located in the Moapa Valley National Wildlife Refuge, in the Moapa West USGS Quad, at 36.71003, -114.71240 measured using a GPS (WGS84, estimated position error 1 meters). The elevation is approximately 555 meters. Andrea Hazelton and Larry Stevens surveyed the site on 10/28/20 for 02:20 hours, beginning at 15:10, and collected data in 10 of 10 categories. This survey was conducted under the Clark County SSI USFWS Refuges project using the Stevens et al. Level 2 protocol.



**Fig 20.1 Plummer Springs A:** The confluence of outflow channels from the two sources. Biologist Larry Stevens sorts invertebrates on the right bank of the combined outflow channel. The interpretive fish display is in the background.

**Physical Description:** Plummer Springs A is a hillslope spring. This spring and its 2008 survey were imported in February 2016 from a compilation of research from Don Sada. The Land Manager ID number is from this dataset. According to a 2020 SSI survey crew, flow emerges from two distinct sources about 25 meters apart on a gravelly slope. At each source, seepage forms a small (less than 20 square meters) patch of marshy cienega habitat before picking up flow and becoming channelized. The channels associated with the two sources flow together, forming a Y shape and continue north for

about 15 meters before reaching an interpretive display with a plexiglass wall that allows visitors to view the aquatic biota. At this point, flow combines with the outflow from Plummer Springs B (Site ID 181249) and the combined channel flows east and north out of the refuge. According to notes from the Sada dataset, this is the smallest spring in this province. It discharges above the viewing chamber and flows beneath it into a naturalized springbrook. There are four springs in this complex. All of them flow into a common springbrook that leaves the Moapa Valley National Wildlife Refuge (MVNWR) and flows onto Southern Nevada Wildlife Authority (SNWA) property. There is no confluence of this springbrook with the springbrook leaving the Pedersen springs. This was the second property purchased for the MVNWR. Similar to the Pedersen Springs province, it was managed as a warm-springs resort that included swimming pools and bath houses. Some springs were impounded within concrete walls and springbrooks were lined with pea-size gravel. Palm trees were the only riparian vegetation, aquatic vegetation was dominated by an invasive plant (*Vallisneria* sp.), and the gastropod assemblage was dominated by *M. tuberculata*. Native fish were scarce and the springs exhibited little resemblance to natural conditions. A Moapa dace restoration program was initiated, *Vallisneria* was eradicated, artificial pools were removed, and the Moapa dace and Moapa White River springfish (e.g., Scoppettone et al. 1992, Scoppettone 1993), and a native benthic macroinvertebrate community returned (e.g., Sada and Herbst 1999). The riparian community at these springs differed demonstrably from the Pedersen Springs province. Arrowweed and willow were sparse, and springbrooks were bordered mostly by mesquite (*Prosopis* spp.), cottonwood trees (*Populus fremontii*), *Juncus*, and *Scirpus*. This vegetation appeared to be in a later seral stage of ecological change than vegetation on either the Pedersen or Apcar spring provinces. These springs provide an interpretive focus for MVNWR, with a visitor parking area, walking trails through the riparian area, bridges over springbrooks, and a flow-through viewing chamber where a springbrook is diverted to allow the public to observe fish and invertebrates in a quasi-natural setting. This facility appears to have no discernible negative affect on *Pyrgulopsis* abundance. The microhabitats associated with the spring cover 66 sqm. The site has 4 microhabitats, including A -- a 7 sqm low gradient cienega, B -- a 27 sqm low gradient cienega, C -- a 7 sqm channel, D -- a 25 sqm terrace. The geomorphic diversity is 0.53, based on the Shannon-Weiner diversity index.

**Geomorphology:** Plummer Springs A emerges from a sedimentary, unconsolidated rock layer. The site receives approximately 99% of available solar radiation, with 6711 Mj annually.

**Access Directions:** The Plummer Springs Complex is the springs complex closest to the visitor parking area at the Moapa National Wildlife Refuge. Plummer A can be reached by following the interpretive path west from the visitor parking area and walking south to leave the path and cross the springbrook just before reaching the interpretive fish display.

**Survey Notes:** Despite the long history of human use and adjacent construction, this spring is in excellent condition. The sources and springbrooks appear geomorphically unaltered and the vegetation is mostly native. There is a variety of invertebrate life, including springsnails. The interpretive display does not seem to be negatively impacting the ecosystem and trails are designed to prevent visitors from stepping in the streams.

**Flow:** Surveyors measured a flow of 2.6 liters/second, using a timed flow volume capture method. Surveyors measured flow 5.5 m downstream of the confluence of outflow from the two sources. This spring is perennial.

**Water Quality:** Sampling site 1 was in the left springbrook, just before it joins the right springbrook. Sampling site 2 was in the left springbrook where flow exits the low gradient cienega and enters the channel. Location 1: down-gradient from the spring source in flowing water at 16:16. Location 2: down-gradient from the spring source in flowing water at 16:16.

**Table 20.1 Plummer Springs A Water Quality Measurements.**

Characteristic Measured	Value	Location Number	Device
Alkalinity, Total (mg/L)	200	1	LaMotte
Dissolved oxygen (field) (mg/L)	3	1	CHEMets DO kit
Dissolved Solids (field) (ppt)	0.522	1	Hanna Multi 98194
pH (field)	7.43	1	Hanna Multi 98194
Specific conductance (field) ( $\mu$ S/cm)	1045	1	Hanna Multi 98194
Temperature, air C	31	1	Handheld therm
Temperature, water C	31.72	1	Hanna Multi 98194
Dissolved Solids (field) (ppt)	0.498	2	Hanna Multi 98194
pH (field)	7.36	2	Hanna Multi 98194
Specific conductance (field) ( $\mu$ S/cm)	995	2	Hanna Multi 98194
Temperature, water C	31.5	2	Hanna Multi 98194

**Flora:** Andrea Hazelton was the botanist. Surveyors identified 9 plant species at the site, with 0.1364 species/sqm. These included 9 native and 0 nonnative species.

**Table 20.2 Plummer Springs A Cover Type.**

Cover Type	Species Count	Wetland Species Count
Ground	6	4
Shrub	3	2
Mid-canopy	0	0
Tall canopy	1	0
Basal	0	0
Aquatic	0	0
Non-vascular	0	0

**Table 20.3 Plummer Springs A Vegetation % Cover in Microhabitats.**

Plant Species	Cover Code	Native Status	Wetland Status	Comments	A	B	C	D
<i>Andropogon glomeratus</i>	GC	N	F		0	0	2	1
<i>Eleocharis geniculata</i>	GC	N	W		20	0.5	0	0
<i>Muhlenbergia asperifolia</i>	GC	N	WR		20	1	0.1	1
<i>Pluchea sericea</i>	SC	N	WR		10	15	0	5
<i>Prosopis pubescens</i>	SC	N	WR		0	0	1	2
<i>Samolus ebracteatus</i>	GC	N	W		20	5	60	5
<i>Typha angustifolia</i>	GC	N	W		15	45	7	0
<i>Washingtonia filifera</i>	GC	N	F	seedlings	3	1	0.1	0.1
<i>Washingtonia filifera</i>	SC	N	F		7	30	0	3
<i>Washingtonia filifera</i>	TC	N	F		5	0	2	2

**Fauna:** Larry Stevens was the wildlife biologist at this site. Surveyors collected or observed 9 aquatic and 4 terrestrial invertebrate taxa and 6 vertebrate taxa.

**Table 20.4 Plummer Springs A Invertebrates.**

Species	Lifestage	Habitat	Method	Rep#	Count	Species Detail
Amphipoda	Ad	A	Collected spot		4	
Araneae	Ad	T	Collected spot		3	
Coleoptera	Ad		Collected spot		11	
Coleoptera Elmidae Microcyloepus	Ad	A	Spot		1	
Coleoptera Elmidae Stenelmis moapa	Ad	A	Spot		1	other; abundant
Diptera	Ad		Collected spot		10	
Diptera Chironomidae	L	A	Spot		1	uncommon
Hemiptera	Ad	T	Collected spot		1	
Hemiptera Naucoridae Limnocoris moapensis	Ad		Collected spot		3	
Hemiptera Naucoridae Limnocoris moapensis	M	A	Spot		2	uncommon, 1- 2 per net sample
Homoptera	Ad	T	Collected spot		5	
Mollusca	Ad		Collected spot		3	
Mollusca Gastropoda	Ad		Collected spot		16	
Neotaenioglossa Cochliopidae Tryonia clathrata	Ad	A	Spot		1	rare - 2 dead shells
Neotaenioglossa Hydrobiidae Pyrgulopsis avernalis	M	A	Spot		1	
Thysanoptera	Ad	T	Collected spot		4	
Trichoptera	L	A	Collected spot		8	
Trichoptera Helicopsychidae	L	A	Spot		1	uncommon

**Table 20.5 Plummer Springs A Vertebrates.**

Vertebrate Species Common Name	Count	Detection	Comments
Northern Flicker	1	obs	
White-crowned Sparrow	4	obs	
Ringtail		sign	scat in parking lot nearby
Pocket Gopher		sign	burrow
House Finch	1	obs	
Fox Sparrow		obs	?

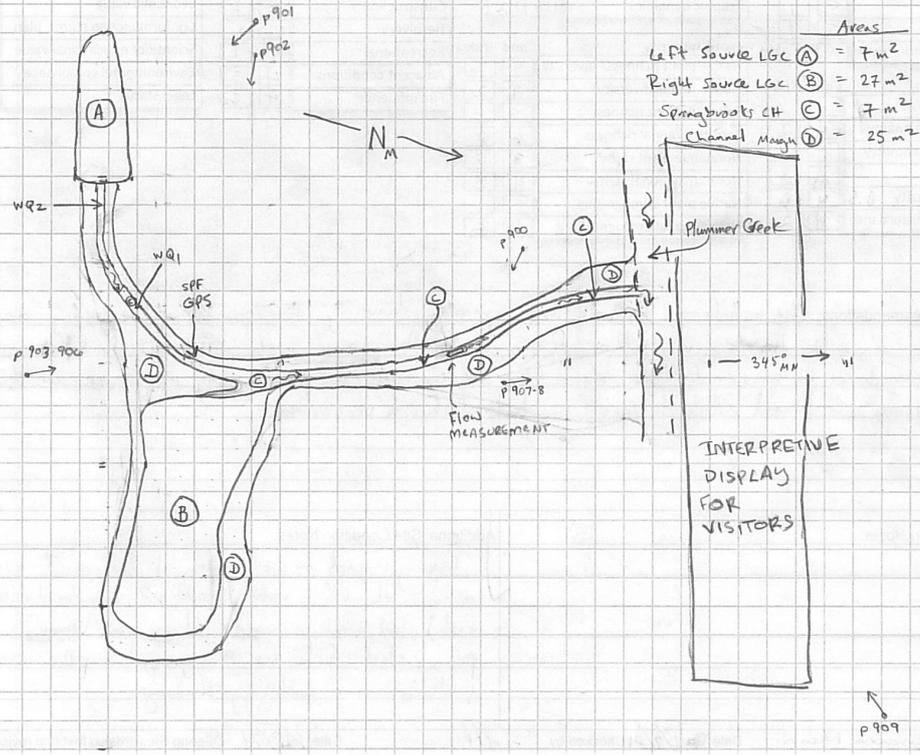
**Assessment:** Assessment scores were compiled in 5 categories and 33 subcategories, with 9 null condition scores, and 9 null risk scores. Aquifer functionality and water quality are good with significant restoration potential (average condition score 4.7) and there is negligible risk (average risk score 1.7). Geomorphology condition is good with significant restoration potential (average condition score 4) and there is low risk (average risk score 2.2). Habitat condition is moderate with some restoration potential (average condition score 3.4) and there is low risk (average risk score 2). Biotic integrity is very good with excellent restoration potential (average condition score 4.9) and there is low risk (average risk score 2.1). Human influence of site is very good with excellent restoration potential (average condition score 5) and there is low risk (average risk score 1.9). Overall, the site condition is good with significant restoration potential and there is low risk.

**Table 20.6 Plummer Springs A Assessment Scores. Condition scores range from 0 (extremely poor condition) to 6 (pristine condition) and risk scores range from 0 (no risk to the site) to 6 (extreme risk to the site).**

Category	Condition	Risk
Aquifer Functionality & Water Quality	4.7	1.7
Geomorphology	4	2.2
Habitat	3.4	2
Biota	4.9	2.1
Human Influence	5	1.9
Overall Ecological Score	4.5	2

**Management Recommendations:** The aquifer is at risk from groundwater abstraction from the nearby housing development. The refuge appears to be well-managed with limited visitation from the public, with well-designed visitor trails and outreach. Surveyors recommend researching springsnail-algae relationships and clarifying the referencing of sources. Continued efforts to remove non-native fish are warranted.

State NV County CLARK Land Unit USFWS Land Unit Detail MOAPA VALLEY NWR Spring Name PLUMMER A SPRING ID# 181248  
 Date 28 OCT 2020 Start time 15:10 End time 17:30 Observers and Roles: LE Stearns X, J; A Houghton P1, J 1m



**Fig 20.2 Plummer Springs A Sketchmap.**



**Fig 20.3 Plummer Springs A:** The flow measurement location (black pipe at center), 5.5 m downstream of the confluence of flow from the two sources.



**Fig 20.4 Plummer Springs A:** Outflow (entering from lower left) joins Plummer Creek at the interpretive display.



Fig 20.5 Plummer Springs A: Overview map showing the Plummer Springs Complex.