



# Las Vegas Wash Vegetation Monitoring Report, 2018

November 2019



SOUTHERN NEVADA  
WATER AUTHORITY®

Las Vegas Wash  
Coordination  
Committee



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**Las Vegas Wash  
Vegetation Monitoring Report, 2018**

**SOUTHERN NEVADA WATER AUTHORITY  
Las Vegas Wash Project Coordination Team**

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**Las Vegas Wash Coordination Committee**

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## ABSTRACT

Revegetation projects have been conducted along the Las Vegas Wash for over 18 years to meet the goals of the Las Vegas Wash Coordination Committee. In late summer and early fall of 2018, when monitoring for this report took place, approximately 496 acres of revegetation across 134 sites were established. These sites were broken up into 233 monitoring areas. Sites ranging in age from 1 to 18 growing seasons had total cover, noxious species cover, species richness, and Wetland Prevalence Index documented. Three new sites were monitored in 2018. These include sites that were not previously monitored at the DU Wetlands No. 1 Weir, as well as newly planted sites at the Pabco Road Weir and the Tropicana Weir. Overall, most revegetation sites either increased in cover or remained the same as in 2017; approximately 11% of the sites decreased in cover. Most mature sites have stabilized and cover does not change much between growing seasons.

## ACKNOWLEDGEMENTS

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## 1.0 INTRODUCTION

### 1.1 Background

In 1997, the Southern Nevada Water Authority (SNWA) assembled a citizen’s advisory committee to evaluate water quality issues in the Las Vegas Wash (Wash), Las Vegas Bay, and Lake Mead. These efforts resulted in the establishment of the Las Vegas Wash Coordination Committee (LVWCC), now a 28-member multi-stakeholder group consisting of federal, state, and local agencies, the university, private businesses, environmental groups, and citizens. In 2000, the LVWCC drafted a long-term management plan, the Las Vegas Wash Comprehensive Adaptive Management Plan (CAMP), to facilitate stabilization and enhancement activities along the Wash (LVWCC 2000; Figure 1). On-the-ground activities have been carried out since then to implement the goals of the CAMP, including constructing erosion control structures (weirs) in the stream channel and armoring the banks with rock. After erosion control facilities are built, wetland, riparian, and upland vegetation is planted to help further protect the Wash from erosion, as well as to improve the functional attributes of the ecosystem.

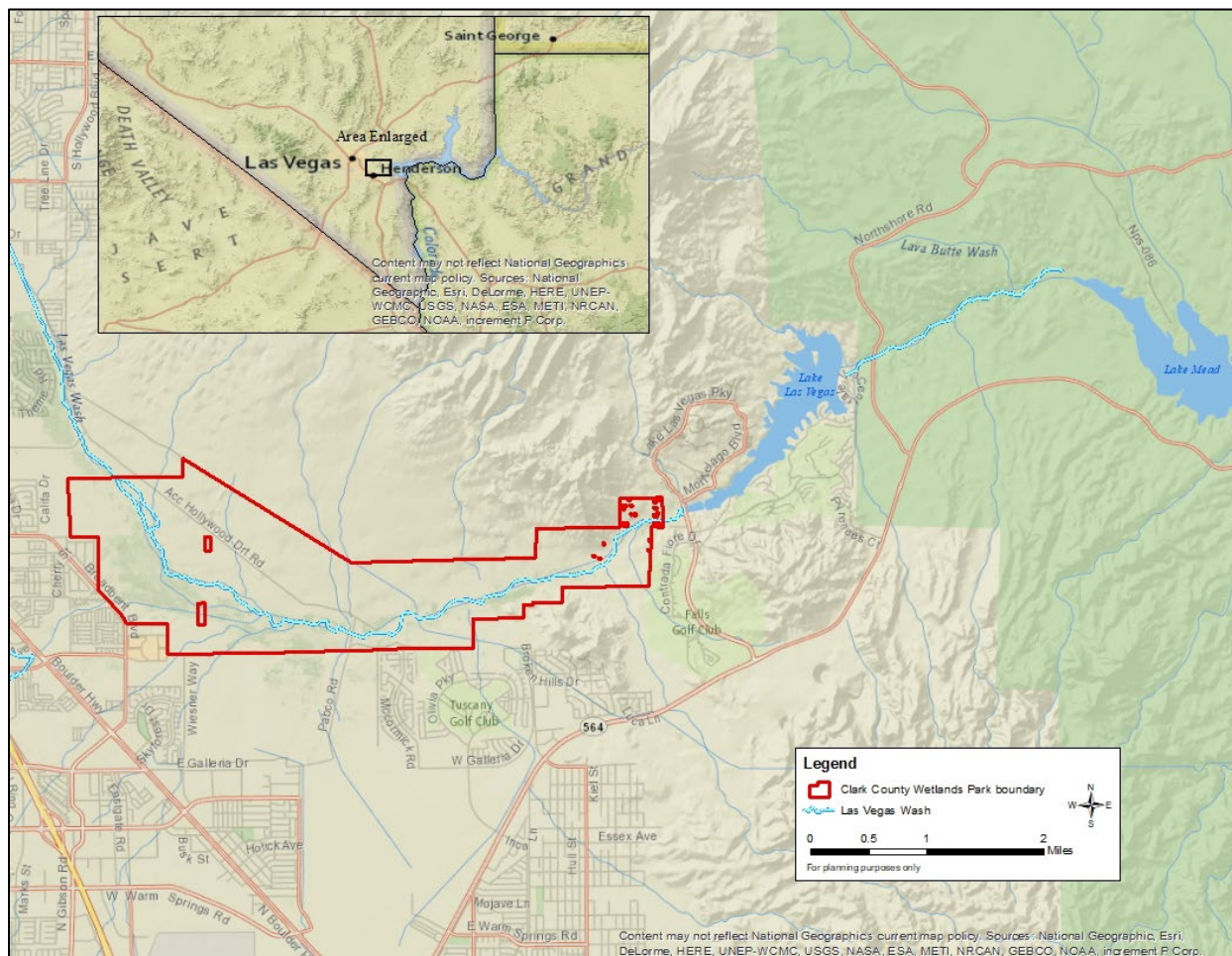


Figure 1. Las Vegas Wash location and general study area map.

A critical component of the overall plan to stabilize and enhance the Wash is the revegetation program. Erosion control is enhanced by plants binding their roots to loose soil particles on the surface, subsurface and in deep subsurface horizons, thereby acting as soil anchors during scouring events (i.e., floods). In addition, a variety of wildlife species benefit from revegetation efforts. These areas planted with native species also potentially provide habitat for species formerly found to reestablish there. At the time when the erosion control project began along the Wash, there were very few native plants found along its banks, especially wetland and riparian species. Moreover, from the time flows increased and began to incise the channel, exotic species such as salt cedar (*Tamarix ramosissima*) successfully established in the area and became the dominant species. As a result, the plants used to restore the Wash to a natural-type condition include a variety of species native to upland, wetland, and riparian areas in the region.

## **1.2 Purpose and Scope**

The primary purpose of this report is to document the status of SNWA's revegetation efforts along the Wash by reporting 2018 data as part of a comprehensive vegetation monitoring program. Vegetation monitoring results from 2002 through 2017 have been previously documented (SNWA 2005, Eckberg and Shanahan 2008, Eckberg 2019a); therefore, they are not described in detail in this report. Since 2003, monitoring activities have been conducted on progressively larger land areas. Approximately 38 acres were monitored in 2003 and approximately 496 acres were monitored in 2018. The majority of these activities have been conducted on revegetation project sites located within the boundaries of the Clark County Wetlands Park (CCWP; Figure 2). An additional revegetation area is located at the Clark County Water Reclamation District (CCWRD), which is located just north of the CCWP (Figure 2).

## **1.3 Need for Revegetation and Vegetation Monitoring**

Revegetation projects along the Wash are conducted for multiple reasons. Clean Water Act (CWA) Section 404 permits issued by the U.S. Army Corps of Engineers (Corps) to SNWA for erosion control projects occurring in jurisdictional waters of the U.S. require revegetation as compensatory mitigation for wetlands impacted. Section 404 of the CWA established a program to regulate the discharge of dredged or fill material into waters of the U.S. This includes wetlands associated with Wash erosion control projects. Section 404 permits require that revegetation projects are monitored for success; consequently, several performance indicators are monitored so performance criteria can be achieved. The primary criterion is that mitigation areas provide the functional attributes of a natural wetland system.

The Nevada Division of Environmental Protection (NDEP), which derives duties through state and federal implementing regulations (i.e., Chapter 445A of the Nevada Revised Statutes and Section 402 of the CWA), also requires revegetation to occur for Wash erosion control projects. NDEP issues general stormwater permits for Wash construction activities and permits require that final site stabilization is achieved. Vegetation cover serves as a form of final stabilization, defined by NDEP as "...perennial vegetative cover with a density of 70% of the native background vegetative cover...establishing at least 70% of the natural cover of the native vegetation...e.g., if the native vegetation covers 50% of the ground, 70% of 50% would require 35% total cover."

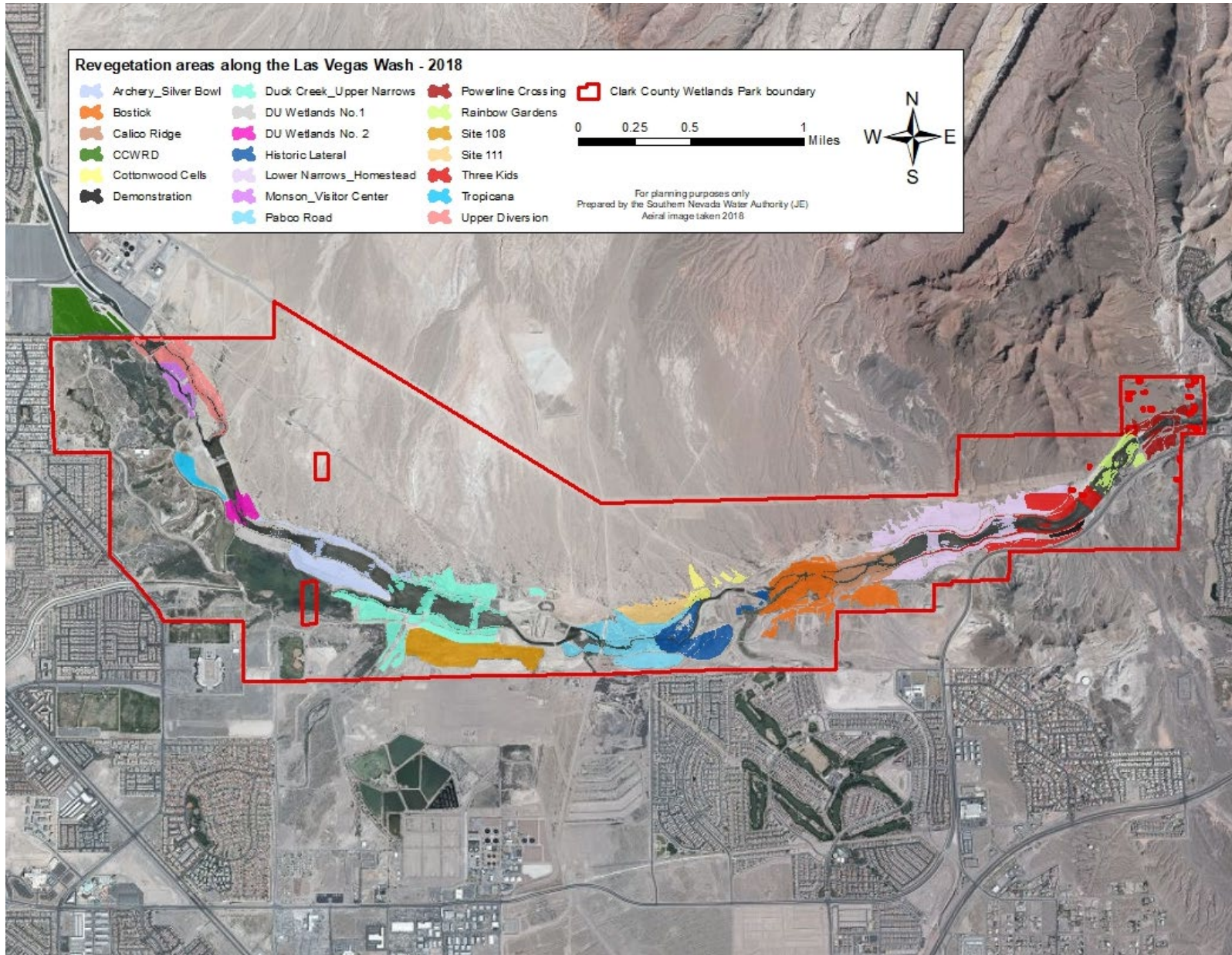


Figure 2. Location of the 2018 Las Vegas Wash revegetation sites.

In addition to permit-required revegetation, SNWA has received multiple federal, state, and local grants to help fund the erosion control program as well as ecological enhancement along the Wash. Granting agencies, such as the Bureau of Reclamation (BOR), require that revegetation projects are successful; therefore, specific criteria are measured during monitoring to ensure compliance with these requirements. For program consistency, all revegetation sites are monitored annually and with the same general methodology.

#### **1.4 Program Funding**

Major sources of funding for revegetation projects along the Wash are the Las Vegas Wash Capital Improvements Plan (Wash CIP), state and federal grants, Clark County (primarily for specific projects related to the CCWP), and the LVWCC operating budget. Wash CIP funds revegetation activities stipulated in federal or state permits obtained by SNWA as part of weir construction. Grant funds have been used to supplement the majority of revegetation projects implemented along the Wash, typically areas adjacent to but not directly influenced by weir construction. Grants have been obtained from a variety of sources for revegetation including the Clark County Multiple Species Habitat Conservation Plan, NDEP, Nevada Division of State Parks (NDSP), and three rounds of the Southern Nevada Public Land Management Act (SNPLMA IV, SNPLMA V, and SNPLMA VI). Once revegetation sites are established, funding for ensuring the success of these sites has been grants provided by the BOR and the LVWCC operating budget.

#### **1.5 Typical Revegetation Establishment Activities**

##### **1.5.1 Planning**

The majority of revegetation sites along the Wash are in association with the construction of erosion control structures. This results in most site revegetation efforts being planned in conjunction with those construction activities. Once designs are complete on the structures including temporary and permanent footprints, design of revegetation areas begins. This includes plant selection and irrigation design. Once substantial completion has been reached on the structures, on-site soil testing may alter final plant selection and layout. Included in the design of these structures are species and procedures for hydroseeding. Hydroseeding doubles as the final step in the construction process and the initial step in most revegetation projects.

##### **1.5.2 Plant Procurement**

After plant selection has been completed, procurement activities must take place in order to have material in time for planting at the sizes needed to have a successful restoration site. Plants are either ordered from government or commercial nurseries or grown by the Las Vegas Wash Project Coordination Team (Wash Team). Plants grown by the Wash Team involve collecting seed or cuttings, establishing the seedlings, transplanting into larger containers, irrigating, and delivery back to the Wash for final planting. With revegetation activities taking place along the Wash since 2000, there are now sufficient native species established to procure seeds and cuttings without looking to surrogate areas. Plant propagation for the Wash Team takes place at the SNWA owned and operated Warm Springs Natural Area propagation facility in Moapa, NV.

### **1.5.3 Invasive and Other Undesirable Species Removal**

The majority of the sites described in this report were previously covered in part or entirely by salt cedar, an invasive species that is prolific and spreads easily and can encroach on revegetation sites if removal does not take place. Some of the other invasive species that are found on sites and require constant monitoring are tall whitetop (*Lepidium latifolium*), silverleaf nightshade (*Solanum elaeagnifolium*), giant reed (*Arundo donax*), Malta starthistle (*Centaurea melitensis*) and Johnsongrass (*Sorghum halepense*). Without removal, the native species would not be able to grow, germinate, and become self-sustaining. Considerable effort, therefore, is given to continually surveying sites for encroachment, identifying the invasive species, and planning for their removal as soon as possible.

In addition to invasive species, there are other undesirable species that are closely monitored for their presence. Common reed (*Phragmites australis*) and quailbush (*Atriplex lentiformis*) can grow so vigorously that they outcompete native species that are trying to establish. The Wash has native and non-native common reed as well as hybrids of the two (Saltonstall et al. 2016). The goal with these is not to completely remove them but to selectively thin them so that other vegetation can have time to establish and create a species-rich environment.

### **1.5.4 Irrigation**

Non-wetland revegetation sites along the Wash require irrigation for the first 1-3 growing seasons in order to become established. Sites are irrigated with infrastructure components that are easily moved to new sites as they are planted. Irrigation water is pumped out of the Wash using gasoline or bio-diesel powered pumps to a single mainline and then to multiple lateral lines that are fitted with sprinkler heads and/or drip irrigation tubing.

The sizes of the sites that are irrigated have ranged from under 10 acres to almost 60 acres. Maintenance on irrigation system components is critical to ensure that plant material is given the proper amount of water. This is particularly true in Southern Nevada where the average rainfall is less than five inches of rainfall annually. Irrigation maintenance includes fixing leaks, tightening connections, and fixing or replacing broken pipes or heads.

### **1.5.5 Trash Removal**

Furniture, landscape waste, and many other types of trash have been found on revegetation sites. On newly created sites, successful establishment can be hindered by trash and other debris collecting on the site. The revegetation program is reducing the amount of illegal dumping that is observed by making the Wash a more scenic location, involving the public in its revegetation activities, and continually removing trash. Without large amounts of visible trash, people are not encouraged to dump there; however, some trash does get into the Wash from wind or water runoff.

### **1.5.6 Herbivore Control**

On revegetation sites, fences are installed to reduce the damage caused by rabbits and beavers to newly planted material. Some sites have had a single fence placed around the entire site while others have had smaller fences around the plants themselves. Both must be continually inspected

for damage, have repairs made, and have adjustments made to the spacing of the fences to reduce plant damage.

## **2.0 MATERIALS AND METHODS**

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Monitoring was conducted between August and September 2018, and the methods followed the same guidelines as previous years (Eckberg and Shanahan 2009). As of August 2018, there were 70 wetland and 64 non-wetland revegetation sites. Many of the non-wetland sites were broken up into multiple monitoring areas (Table 1). This marks the first year where wetland sites outnumber non-wetland sites. The primary reason was the increase in passive wetland sites that have developed on weirs.

ArcGIS was used to monitor 65 of the 134 total revegetation sites in 2018 for total cover; these sites did not have data collected regarding species richness, individual species cover, or Wetland Prevalence Index (WPI). Sites are only monitored using ArcGIS if they meet specific criteria as laid out in the 2008 Las Vegas Wash Vegetation Monitoring Report (Eckberg and Shanahan 2009).

## **3.0 RESULTS AND DISCUSSION**

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The following subsections describe monitoring results for each site and for groupings of sites. From 2017 to 2018, the number of areas monitored decreased by 51 and the acreage decreased by eight acres (Table 1). The total areas and acreage include sites monitored in the field as well as with ArcGIS. There was a decrease in acres despite new restoration plantings at the Tropicana Weir. This was primarily due to areas being removed in conjunction with the expansion of Historic Lateral Weir. Some of the older revegetation sites were removed permanently while others will be replaced with new plantings. The decrease in monitoring areas comes as a result of treating both Site 111 and CCWRD as a single site this year instead of breaking them up into multiple monitoring areas.

Cumulatively, there have been 81.01 acres of wetlands created above those required by mitigation permits (Table 2), including 3.14 acres associated with the Cottonwood Cells, which were fully funded by grants from the BOR, and the CCWRD, which had its permit held by the property owners. Federally funded projects are not eligible for use as mitigation of wetlands impacted in accordance with permits issued by the Corps.

### **3.1 Archery and Silver Bowl Weirs**

The Archery and Silver Bowl weirs were simultaneously completed in 2015 and their project boundaries are adjacent to each other (Figure 3). The revegetation for these weirs was also done simultaneously. In 2018, the six actively revegetated sites were in their third growing season (Table 3). The vegetation on the weirs was passively created.

Major Site	Acreage		No. of Monitoring Areas	
	2017	2018	2017	2018
Archery and Silver Bowl Weirs	31.9	33.3	9	9
Bostick Weir	47.3	48.4	14	15
Calico Ridge Weir	16.8	17.0	10	9
CCWRD	27.4	27.4	29	1
Cottonwood Cells	10.4	8.1	10	9
Demonstration Weir	2.0	2.2	2	2
Duck Creek Confluence and Upper Narrows Weirs	59.5	62.3	13	13
DU Wetlands No. 1 Weir	10.6	12.2	4	5
DU Wetlands No. 2 Weir	7.3	7.5	5	5
Historic Lateral Weir	43.8	26.7	13	11
Lower Narrows and Homestead Weirs	66.7	67.4	9	9
Monson and Visitor Center Weirs	8.7	8.2	4	4
Pabco Road Weir	41.7	39.6	18	19
Powerline Crossing Weir	13.9	13.6	17	17
Rainbow Gardens Weir	9.3	9.9	8	8
Site 108	40.9	38.0	61	63
Site 111	14.9	14.9	26	1
Three Kids Weir	28.1	28.7	8	8
Tropicana Weir	-	7.3	-	1
Upper Diversion Weir	22.8	23.3	24	24
<b>TOTAL</b>	<b>504.0</b>	<b>496.0</b>	<b>284</b>	<b>233</b>

**Table 1. Change in cumulative acreage monitored and number of monitoring areas from 2017 to 2018.**

None of the revegetation sites at the Archery and Silver Bowl Weirs were irrigated during 2018. Soon after monitoring concluded, additional trees were planted at Archery Silver Bowl South 1 (ASBS1) and Archery Silver Bowl South 2 (ASBS2) and new irrigation was installed. The success and impact of these additional plantings will be reflected in next year's monitoring. In the current year's monitoring, ASBS1 decreased in total cover from 75-100% to 50-75% while ASBS2 remained constant at 50-75%. The decrease on ASBS1 was due to the equal decline in cover from desert saltbush (*Atriplex polycarpa*; Figure 4). When irrigated the native plants have fast growth rates that decline once the supplemental water is removed. Also, individual plants that are in microclimates that cannot support the plant without supplemental irrigation die off. This is expected, and the likely cause of the cover decline on this site. There may be additional declines in future years depending on natural rainfall levels, and this should not be considered unexpected.



<b>Mitigation Project</b>	<b>Mitigation Permit Number</b>	<b>Mitigation Required (acres)</b>	<b>Wetland Area Created (acres)</b>
Archery and Silver Bowl Weirs	SPK-2011-00796-SG	0 <sup>c</sup>	4.17
Bostick Weir	200125114	7.88	19.91
Calico Ridge Weir	200450004	3.80	9.34
Clark County Water Reclamation District	SPK-2009-00227-SG	6.79	5.99 <sup>a</sup>
Cottonwood Cells	N/A	—	3.14 <sup>b</sup>
Demonstration Weir	199825148	0.90	0.50
Duck Creek Confluence and Upper Narrows Weirs	SPK-2009-00042	1.33	14.70
DU Wetlands No. 1 Weir	SPK-2010-00285-SG	1.22	3.18
DU Wetlands No. 2 Weir	2007-1961-SG	0.05	2.94
Historic Lateral Weir	199825148	4.90	7.25
Lower Narrows and Homestead Weirs	SPK-2008-01417-SG	6.25	10.46
Monson and Visitor Center Weirs	200250111	4.81	1.6
Pabco Road Weir	199725375	2.20	12.17
Powerline Crossing Weir	200450454	4.87	2.91
Rainbow Gardens Weir	200250054	1.00	6.95
Three Kids Weir	SPK-2012-01138-SG	0 <sup>c</sup>	14.14
Tropicana Weir		0 <sup>c</sup>	7.28
Upper Diversion Weir	200550514	0.01	7.45
Bank Protection Projects	—	7.06	—
<b>TOTAL</b>		<b>53.07</b>	<b>134.08</b>

<sup>a</sup> Permit held by Clark County Water Reclamation District and not eligible for Wash wetland mitigation

<sup>b</sup> Federally funded revegetation not eligible for wetland mitigation

<sup>c</sup> Permits authorized under nationwide Permit Number #27 after 2012 have no mitigation requirement

**Table 2. Mitigation requirements and wetland areas established as of October 2018.**

The two wetland sites that were actively planted, Archery Silver Bowl North Bank (ASBNB) and Archery Silver Bowl South Bank (ASBSB), have both had the maximum cover value of 75-100% for the past two growing seasons. Combined, these two sites increased in size by 0.97 acres since 2017. ASBNB had 26 species in 2018 which was one less than in 2017. The dominant species was southern cattail (*Typha domingensis*) which passively established on the site and had a cover value of 25-50%. The second most dominant plant was sandbar willow (*Salix exigua*) which was planted as pole plantings on the site and had a cover of 5-25%. The species richness at ASBSB increased from 18 to 21. The codominant species were southern cattail and common reed both passively established and both with 25-50% cover.

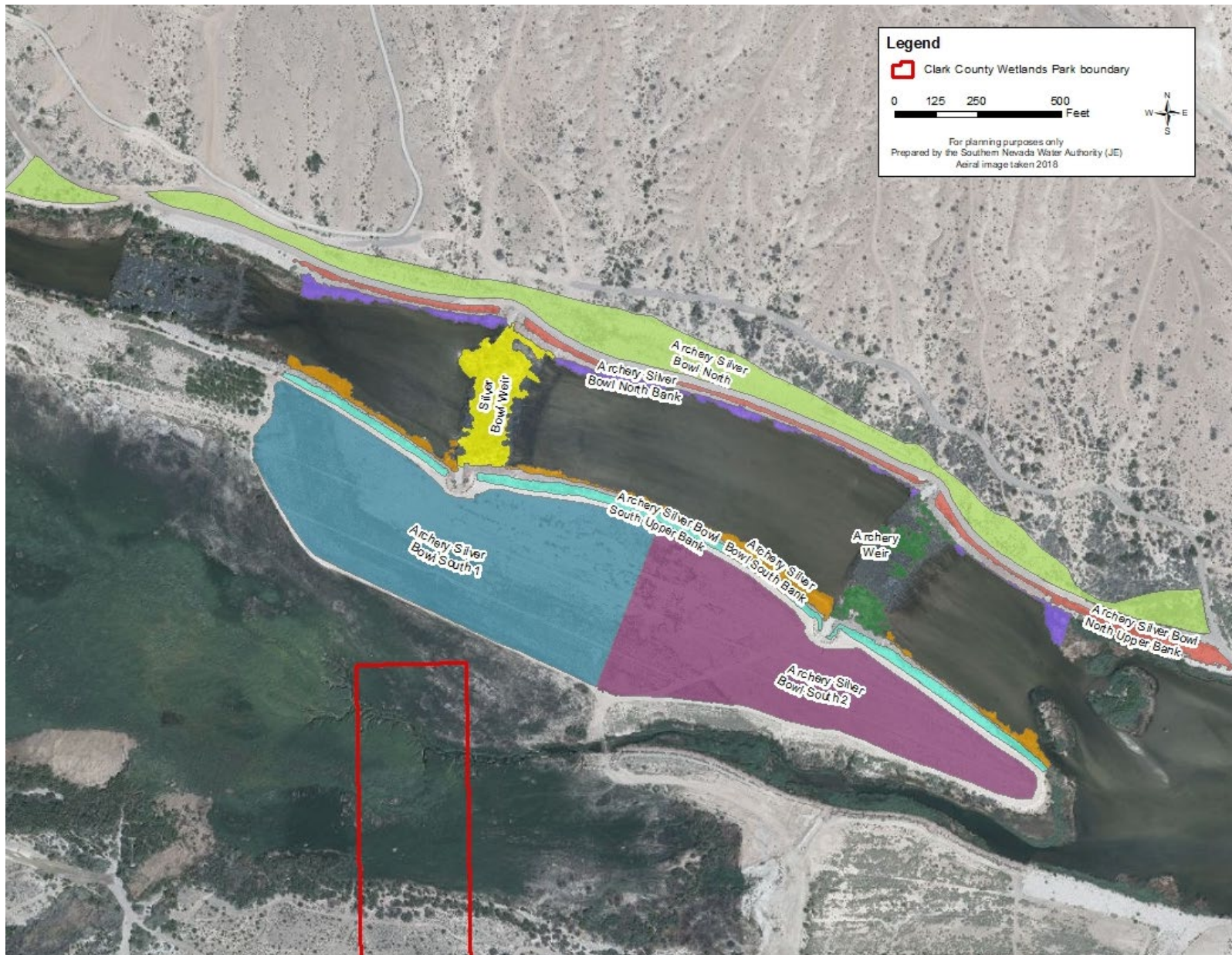


Figure 3. Aerial photograph of 2018 delineated Archery and Silver Bowl Weirs revegetation sites.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
ASBN	3	6.33	non-wet	50-75%	2.5%	17	3.87
ASBNB	3	0.97	wet	75-100%	0.2%	26	1.55
ASBNUB	3	1.37	non-wet	50-75%	5.0%	8	3.95
ASBS1	3	11.40	non-wet	50-75%	0.5%	8	3.98
ASBS2	3	8.60	non-wet	50-75%	0.5%	5	3.99
ASBSB	3	0.63	wet	75-100%	2.6%	21	1.56
ASBSUB	3	1.45	non-wet	50-75%	0.0%	6	3.98
AW	3	0.71	wet	75-100%	nm	nm	nm
SBW	3	1.40	wet	75-100%	nm	nm	nm

<sup>1</sup>ASBN= Archery Silver Bowl North, ASBNB= Archery Silver Bowl North Bank, ASBNUB= Archery Silver Bowl North Upper Bank, ASBS-1= Archery Silver Bowl South 1, ASBS-2= Archery Silver Bowl South 2, ASBSB= Archery Silver Bowl South Bank, ASBSUB= Archery Silver Bowl South Upper Bank, AW=Archery Weir, SBW=Silver Bowl Weir

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 3. Vegetation monitoring results for Archery and Silver Bowl Weirs revegetation sites in 2018.**



**Figure 4. Desert saltbush is the dominant plant on both non-wetland revegetation sites on the south side of Archery and Silver Bowl Weirs.**

### 3.2 Bostick Weir

There are 14 revegetation sites near the Bostick Weir (Table 4; Figure 5). Many of the sites have mature vegetation in their 14<sup>th</sup> or 15<sup>th</sup> growing season. Bostick Islands (BI) was monitored in the field for the first time since 2013. Being in the center of the Wash channel, this site is difficult to access as well as time consuming when compared to other sites. An effort was made this year to get field data on BI rather than ArcGIS total cover data which had been collected the four previous years. In 2018, the total cover of BI was 75-100%, the same that has been measured every monitoring year since it was first monitored in 2008. There were six species identified on the site with the codominant species being Goodding’s willow (*Salix gooddingii*) and common reed both with 25-50% cover.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
B	15	8.19	wet	75-100%	0.0%	17	2.17
BI	15	5.01	wet	75-100%	0.0%	6	1.86
BN	15	0.84	non-wet	25-50%	nm	nm	nm
BS	14	1.20	non-wet	75-100%	nm	nm	nm
BST	3	21.03	non-wet	50-75%	0.5%	34	3.99
DBN	15	0.49	non-wet	50-75%	nm	nm	nm
DBS	14	0.22	non-wet	50-75%	nm	nm	nm
DBSE	14	0.79	wet	75-100%	0.5%	10	2.32
UBN	15	0.54	non-wet	75-100%	0.0%	8	3.19
UBNB	14	2.03	wet	75-100%	15.0%	5	2.19
UBNE	14	1.82	wet	75-100%	nm	nm	nm
UBS	15	2.50	non-wet	75-100%	nm	nm	nm
UBS	15	2.07	wet	75-100%	nm	nm	nm
UBSB	14	1.71	non-wet	75-100%	nm	nm	nm

<sup>1</sup>B=Bostick, BI=Bostick Islands, BN=Bostick North, BS=Bostick South, BST=Bostick South Tamarisk, DBN=Downstream Bostick North, DBS=Downstream Bostick South, DBSE=Downstream Bostick South Emergent, UBN=Upstream Bostick North, UBNB=Upstream Bostick North Bank, UBNE=Upstream Bostick North Emergent, UBS=Upstream Bostick South, UBSB=Upstream Bostick South Bank

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps’ 1987 Wetland Delineation Manual. “wet” = wetland and “non-wet” = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 4. Vegetation monitoring results for Bostick Weir revegetation sites in 2018.**

The youngest revegetation site at the Bostick Weir is Bostick South Tamarisk (BST) which was in its third growing season in 2018 (Figure 6). This site was primarily a monocultural stand of tamarisk prior to restoration and was not part of the original Bostick Weir construction footprint like the other sites. The total cover for BST in 2018 increased from 25-50% to 50-75% despite decreasing in species richness from 49 species in 2017 to 34 species in 2018. This is common and expected as irrigation frequency has decreased in 2018 causing many annual forbs and grasses to die off.



Figure 5. Aerial photograph of 2018 delineated Bostick Weir revegetation sites.



**Figure 6. Vegetation at Bostick South Tamarisk lines the Clark County Wetlands Park bike trail.**

### **3.3 Calico Ridge Weir**

All but one of the nine revegetation sites at the Calico Ridge Weir were field monitored in 2018 (Figure 7, Table 5). Downstream Calico North (DCN) was monitored for total cover using ArcGIS. Three of the nine sites had a change in the total plant cover from 2017. DCN and Downstream Calico South – Non-wetland (DCS-N) both increased in cover (Figure 8). DCN returned to the cover found in 2016, which was 25-50%. However, it is difficult to determine total cover for this site in the field due to the majority of vegetation being located in the southern part of the site and the rest of the site being sparsely vegetated. DCS-N increased from 25-50% total cover to 50-75% in 2018. The main species that increased in cover to result in this increase in total cover was wheelscale (*Atriplex elegans*) which increased from 0.5% to 5-25%. In addition, the species richness increased from six species in 2016 to 17 species in 2018. The one site to decrease in cover was Upstream Calico North – Non-wetland (UCN-N). The total cover on this site decreased from 50-75% to 25-50%. The species richness also decreased from 13 to 11.

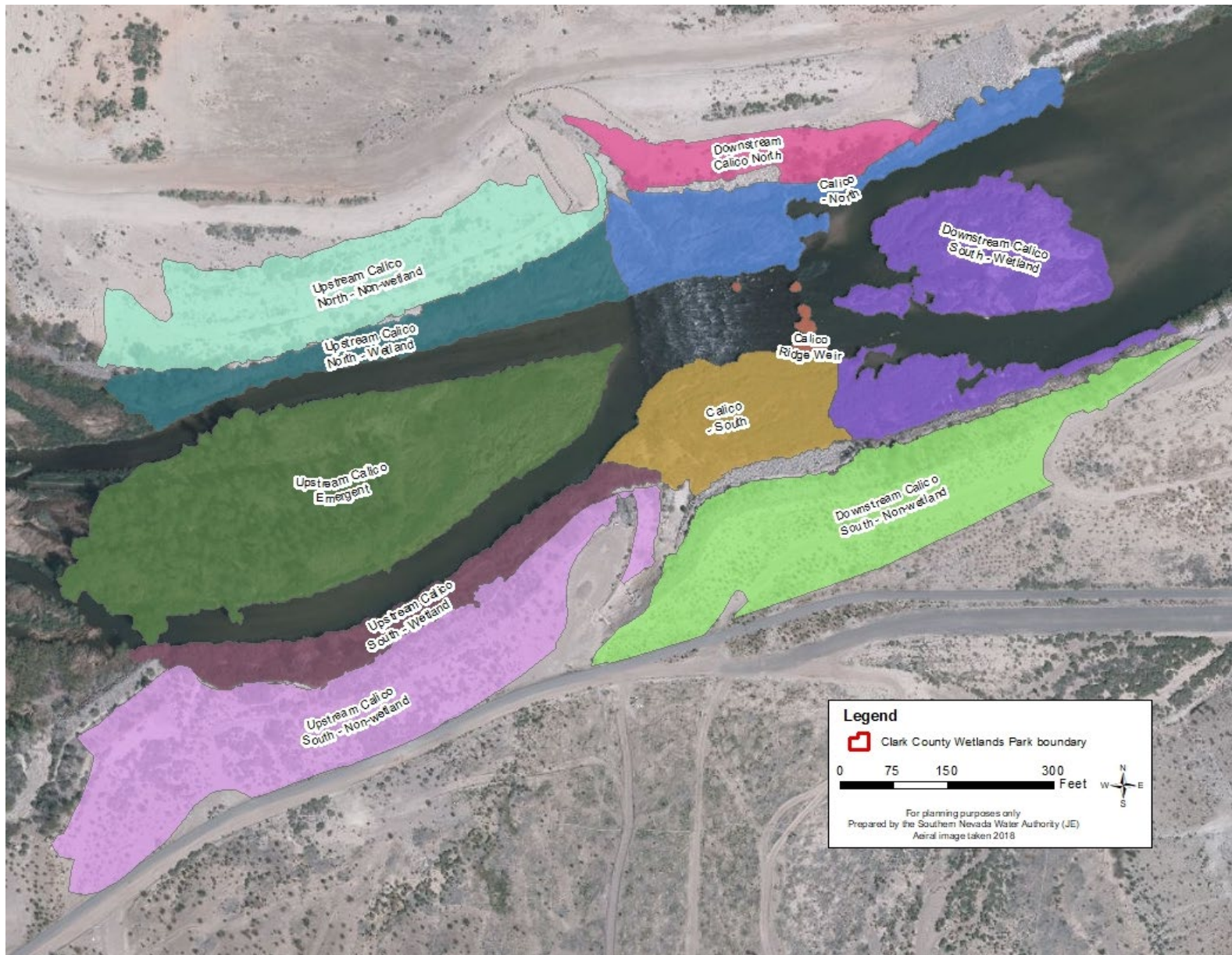


Figure 7. Aerial photograph of 2018 delineated Calico Ridge Weir revegetation sites.

Site Code <sup>1</sup>	Growing Season	Acreeage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
C	14	2.11	wet	75-100%	0.3%	4	2.00
DCN	14	0.65	non-wet	25-50%	nm	nm	nm
DCS	14	2.27	non-wet	50-75%	0.1%	17	4.71
DCS	14	1.76	wet	75-100%	2.5%	14	1.83
UCE	14	3.63	wet	75-100%	1.0%	7	1.89
UCN	14	1.89	non-wet	25-50%	0.0%	11	4.56
UCN	14	1.00	wet	75-100%	2.5%	4	2.03
UCS	14	2.86	non-wet	50-75%	0.0%	12	4.28
UCS	14	0.84	wet	75-100%	0.5%	9	2.15

<sup>1</sup>C=Calico, DCN=Downstream Calico North, DCS=Downstream Calico South, UCE=Upstream Calico Emergent, UCN=Upstream Calico North, UCS=Upstream Calico South

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 5. Vegetation monitoring results for Calico Ridge Weir revegetation sites in 2018.**



**Figure 8. Downstream Calico South – Non-wetland increased in total cover from 2017 to 2018.**



### 3.4 Clark County Water Reclamation District

The CCWRD revegetation site was monitored in the field in 2018 after not being field monitored since 2015 (Table 6, Figure 9). There were multiple construction projects at the CCWRD facility that limited accessibility to the site until this year. The vegetation on the site was so dense during 2018 monitoring that extensive visual observation of all species and the site as a whole was not possible. Instead the perimeter of the site was monitored, as well as various entry points around the site that allowed for some interior access. There is still a high level of confidence that the data collected represents the site as a whole based on the previous year’s data and knowledge of the site. What is primarily missing are small forbs and shrubs that were likely obscured by other vegetation and did not get included in the species richness data. Figure 9 shows the delineations of wetland and non-wetland areas within the site which were used for permit compliance. However, the site was monitored as a single site in 2018.

The total cover of the CCWRD site in 2018 was 75-100%. In the last field monitoring of the site, the total cover was determined by taking the weighted average of the 29 monitoring areas and equaled 73.4%, just below the range of this year’s monitoring result. There were 23 species recorded this year compared to 24 species in 2015. The co-dominant species were the same in both 2015 and 2018: honey mesquite (*Prosopis glandulosa* var. *torreyana*) and quailbush (Figure 10). In 2018, these species both had a cover of 25-50%. In 2015, their cover was also calculated using a weighted average of cover found on each of the monitoring areas and was 19.0% for quailbush and 19.4% for honey mesquite. So, despite three years of changes on the site and plant growth, much of the site remains the same in terms of species and plant cover.

Site Code	Growing Season	Acreage	Wetland Status <sup>1</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>2</sup>
CCWRD	9	27.44	both	75-100%	6.0%	23	3.30

<sup>1</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps’ 1987 Wetland Delineation Manual. “wet” = wetland and “non-wet”= non-wetland

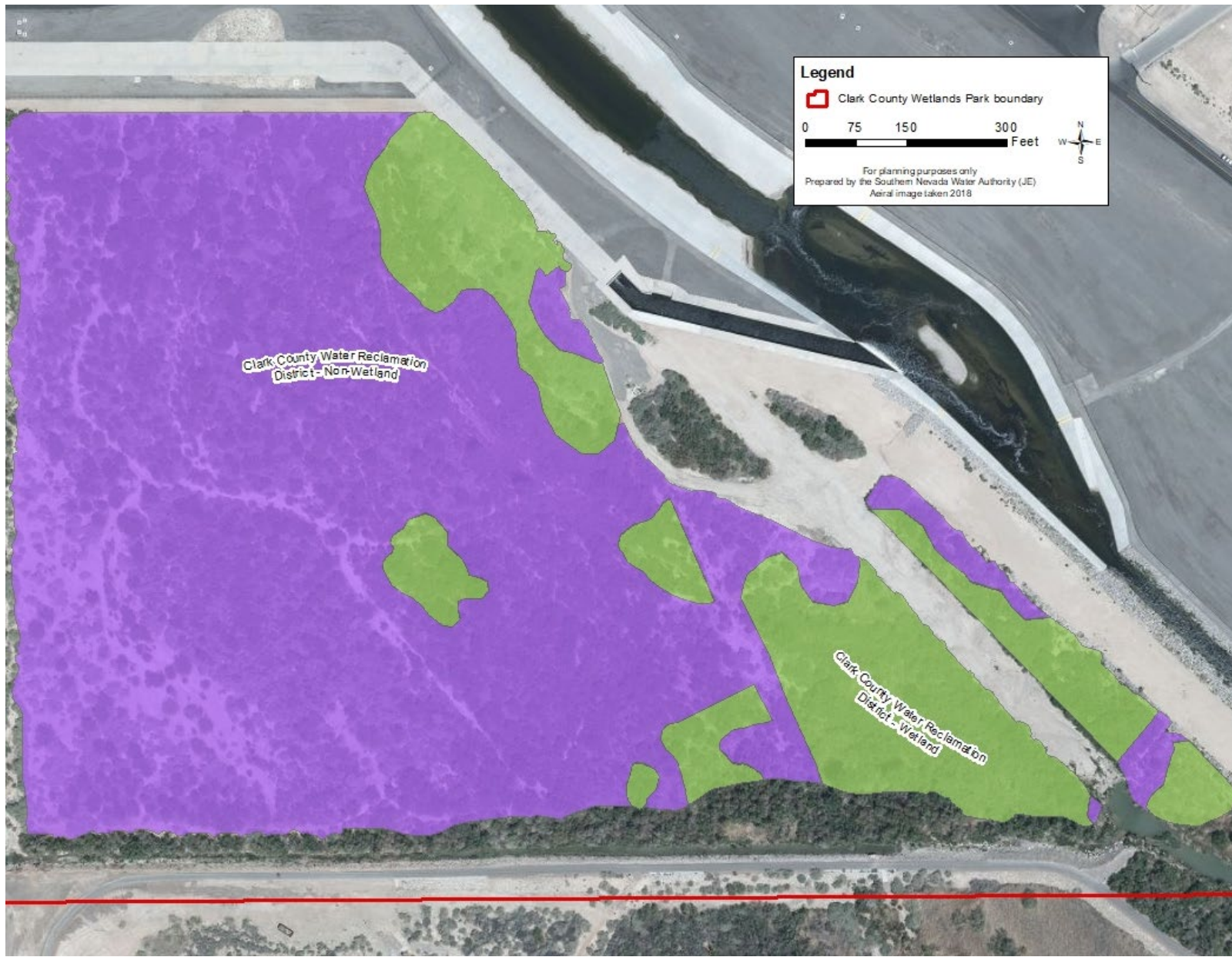
<sup>2</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 6. Monitoring results for the Clark County Water Reclamation District revegetation site in 2018.**

### 3.5 Cottonwood Cells

All seven of the revegetation sites at the Cottonwood Cells were monitored using ArcGIS for the 2018 monitoring year (Table 7, Figure 11). Therefore, only total cover and the changes in acreage are reflected in this year’s monitoring. The biggest change in the last year was the construction project expanding the Historic Lateral Weir. This weir is located downstream of most of the Cottonwood Cell sites (Figure 11). The expansion project required the removal of portions of four different revegetation sites; Cottonwood Cell North (CCN), Cottonwood Cell North Stockpiles



**Figure 9. Aerial photograph of 2018 delineated Clark County Water Reclamation District revegetation sites.**



**Figure 10. The Clark County Water Reclamation District revegetation site continued to be dominated by honey mesquite and quailbush in 2018.**

(CCNS), Cottonwood Cell Bank (CCB), and Cottonwood Cell 3 (CC3). CCN decreased from 4.83 to 4.23 acres, CCNS was reduced from 1.83 to 0.76 acres, CCB went from 0.21 to 0.09 acres, and CC3 decreased from 1.63 to 1.15 acres. All of the areas removed will be replaced in upcoming years along with additional areas created by the construction project.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
CC1	17	0.97	wet	50-75%	nm	nm	nm
CC2	14	0.53	wet	75-100%	nm	nm	nm
CC3	7	1.15	wet	75-100%	nm	nm	nm
CC3-2	6	0.40	wet	50-75%	nm	nm	nm
CCB	6	0.09	wet	75-100%	nm	nm	nm
CCN	7	4.23	non-wet	48.3%	nm	nm	nm
CCNS	7	0.76	non-wet	15.0%	nm	nm	nm

<sup>1</sup>CC1=Cottonwood Cell 1, CC2=Cottonwood Cell 2, CC3=Cottonwood Cell 3, CC3-2=Cottonwood Cell 3-2, CCB=Cottonwood Cell Bank, CCN=Cottonwood Cell North, CCNS=Cottonwood Cell North Stockpiles

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 7. Vegetation monitoring results for Cottonwood Cell revegetation sites in 2018.**



Figure 11. Aerial photograph of 2018 delineated Cottonwood Cell revegetation sites.

### 3.6 Demonstration Weir

The two sites at the Demonstration Weir were monitored in the field in 2018 after being monitored with ArcGIS in 2017 (Table 8, Figure 12). The Upstream Demonstration South – non-wetland (UDS-N) site had the same cover as the past four growing seasons of 25-50%. There was one new species identified on the site in 2018, bush seepweed (*Sueda nigra*). The total cover of Upstream Demonstration South – wetland (UDS-W) decreased from 75-100% to 50-75% since last growing season but was the same as the last field monitoring year in 2016. This is likely a result of the actual plant cover being near 75%. Either the field method or ArcGIS method could measure the cover slightly above or slightly below the actual cover resulting in changing cover classes. This site also increased in species richness to 10 species, up two from 2016. One new species on the site is bassia (*Bassia hyssopifolia*) which is a common weed. It only had a cover of 0.5% in 2018 but will be monitored to see if management actions are necessary.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
UDS	16	1.69	non-wet	25-50%	0.0%	9	4.11
UDS	16	0.50	wet	50-75%	2.5%	10	2.74

<sup>1</sup>UDS=Upstream Demonstration South

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland  
nm = this attribute was not monitored

**Table 8. Vegetation monitoring results for Demonstration Weir revegetation sites in 2018.**

### 3.7 Duck Creek Confluence and Upper Narrows Weirs

All actively planted revegetation sites at the Duck Creek Confluence and Upper Narrows weirs were monitored in the field in 2018 except for Duck Creek Upper Narrows Emergent (DCUNE) which was monitored with ArcGIS (Table 9, Figure 13). ArcGIS was also used to monitor the four passively created sites; Duck Creek Channel South (DCCS), Duck Creek Confluence Weir (DCCW), Upstream Duck Creek Confluence Island (UDCCI), and Upper Narrows Weir (UNW). DCUNE was monitored with ArcGIS because the total cover has been the same, 75-100%, for its first five growing seasons and was the same this year, its sixth growing season.

Three of the sites monitored in the field in 2018 increased in total cover while the remainder stayed the same as in 2017. Duck Creek Upper Narrows North (DCUNN) increased its cover from 50-75% to 75-100% despite decreasing in species richness from 31 to 17. Desert saltbush was the dominant species, which increased in cover from 25-50% to 75-100%. The other sites that increased in cover from 2017 to 2018 were Duck Creek Upper Narrows North Stockpile (DCUNNS) and Duck Creek Upper Narrows South 3 (DCUNS-3). Planted in the spring of 2015, DCUNS-3 has been dominated by desert saltbush with 50-75% cover in the past three years, but there are also zones of dense alkali sacaton (Figure 14).



Figure 12. Aerial photograph of 2018 delineated Demonstration Weir revegetation sites.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
DCUNE	6	6.58	wet	75-100%	nm	nm	nm
DCUNN	5	13.76	non-wet	75-100%	0.0%	17	4.16
DCUNNR	5	1.43	non-wet	75-100%	0.0%	9	4.18
DCUNNS	5	1.31	non-wet	5-25%	0.5%	9	3.97
DCUNS-1	5	7.96	non-wet	75-100%	2.5%	25	3.56
DCUNS-2	4	10.66	non-wet	25-50%	0.0%	11	3.80
DCUNS-3	4	9.54	non-wet	75-100%	2.5%	15	3.81
DCUNSR	4	2.94	non-wet	75-100%	0.5%	11	3.96
DCCS	4	1.14	wet	75-100%	nm	nm	nm
DCCW	5	3.32	wet	75-100%	nm	nm	nm
UDCCI	5	1.28	wet	75-100%	nm	nm	nm
UNW	5	2.38	wet	75-100%	nm	nm	nm

<sup>1</sup> DCUNE=Duck Creek Upper Narrows Emergent, DCUNN=Duck Creek Upper Narrows North, DCUNNR=Duck Creek Upper Narrows North Riparian, DCUNNS=Duck Creek Upper Narrows North Stockpile, DCUNS-1=Duck Creek Upper Narrows South 1, DCUNS-2=Duck Creek Upper Narrows South 2, DCUNS-3=Duck Creek Upper Narrows South 3, DCUNSR= Duck Creek Upper Narrows South Riparian, DCCS= Duck Creek Channel South, DCCW=Duck Creek Confluence Weir, UDCCI=Upstream Duck Creek Confluence Channel, UNW=Upper Narrows Weir

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland  
nm = this attribute was not monitored

**Table 9. Vegetation monitoring results for Duck Creek Confluence and Upper Narrows Weirs revegetation sites in 2018.**

### 3.8 DU Wetlands No. 1 Weir

A new revegetation site was added to the monitored sites associated with the DU Wetlands No. 1 Weir (Table 10, Figure 15). The DU Wetlands No. 1 Tamarisk site (DU1T) is located north of other revegetation sites at both the DU Wetlands No. 1 Weir and DU Wetlands No. 2 Weir. This 1.17-acre site was dominated by salt cedar (tamarisk) up until 2015, when it was cut down and herbicide was applied to the stumps. No active planting was done on the site, but it was hypothesized that native plants would be able to establish on the site once the tamarisk was removed. The large successful revegetation sites to the south would provide a source population for the site. It appears that the hypothesis was correct. In 2018, the total cover on the site was 50-75% with just 1-5% coming from salt cedar. Two other weeds were found on the site: bassia and Russian thistle (*Salsola tragus*); the other six species were all native species. The two codominant species were bassia and bush seepweed which both had 5-25% cover. The salt cedar on the site was a result of resprouts of the cut down trees. No additional treatments have been made. If there is an increase in cover in 2019 of salt cedar, additional herbicide will be applied to control this noxious weed species. Bassia will also continue to be controlled using a combination of herbicide application and manual removal.

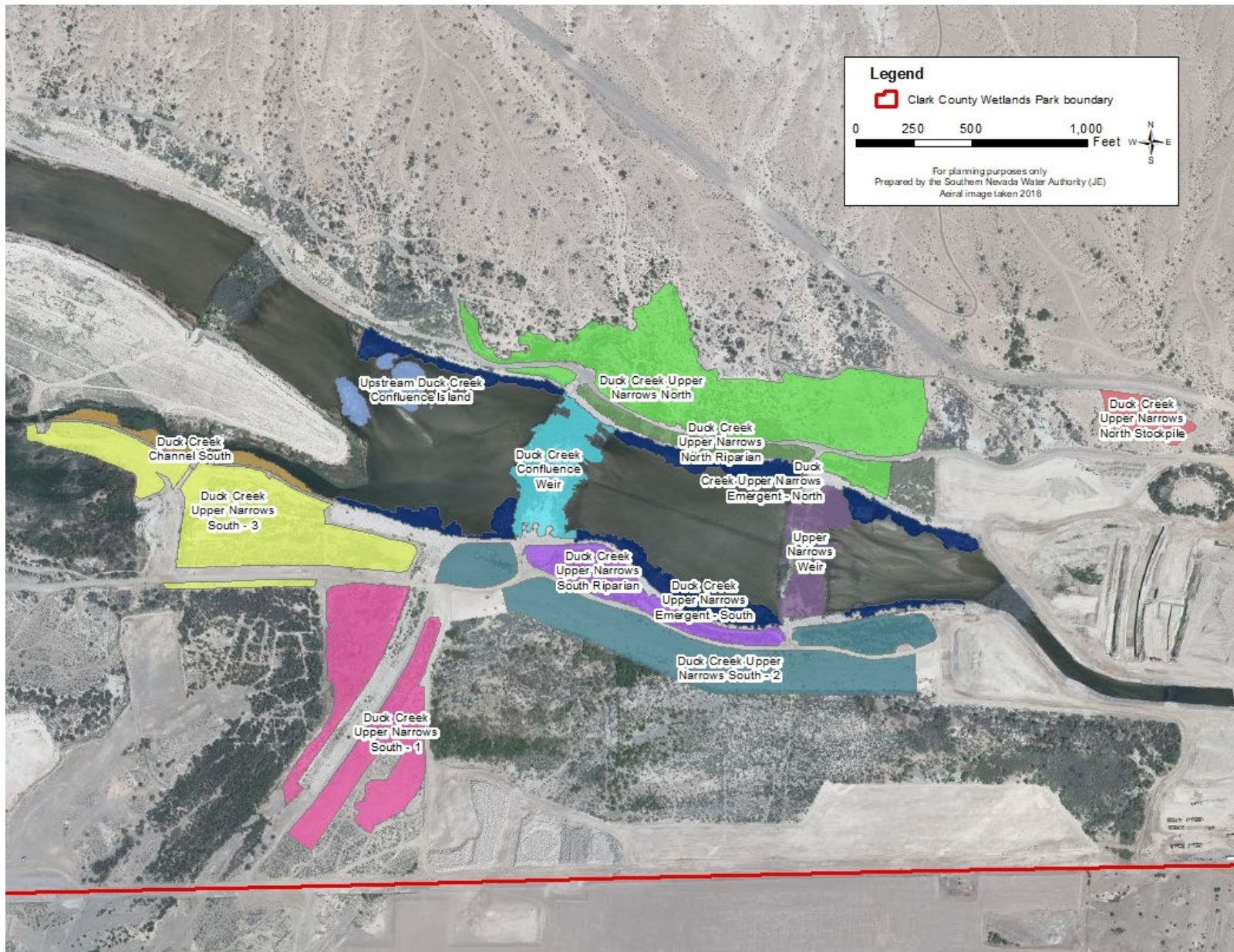


Figure 13. Aerial photograph of 2018 delineated Duck Creek Confluence and Upper Narrows Weirs revegetation sites.





**Figure 14. Areas of dense alkali sacaton were found in the Duck Creek Upper Narrows South 3 revegetation site in 2018.**

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
DU1E	6	2.51	wet	75-100%	nm	nm	nm
DU1S	6	7.87	non-wet	50-75%	nm	nm	nm
DU1T	6	1.17	non-wet	50-75%	nm	nm	nm
DU1W	6	0.67	wet	75-100%	nm	nm	nm

<sup>1</sup> DU1S=DU Wetlands No. 1 South, DU1E=DU Wetlands No. 1 Emergent, DU1T=DU Wetlands No. 1 Tamarisk, DU1W=DU Wetlands No. 1 Weir

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 10. Vegetation monitoring results for DU Wetlands No. 1 Weir revegetation sites in 2018.**

The two wetland sites at the DU Wetlands No. 1 Weir had the same cover in 2018 as they did in 2017, 75-100%. The DU Wetlands No. 1 South revegetation site decreased in total cover from 75-100% to 50-75% as monitored using ArcGIS. Future monitoring will determine if this is a trend or a single year decline based on weather or other factors.

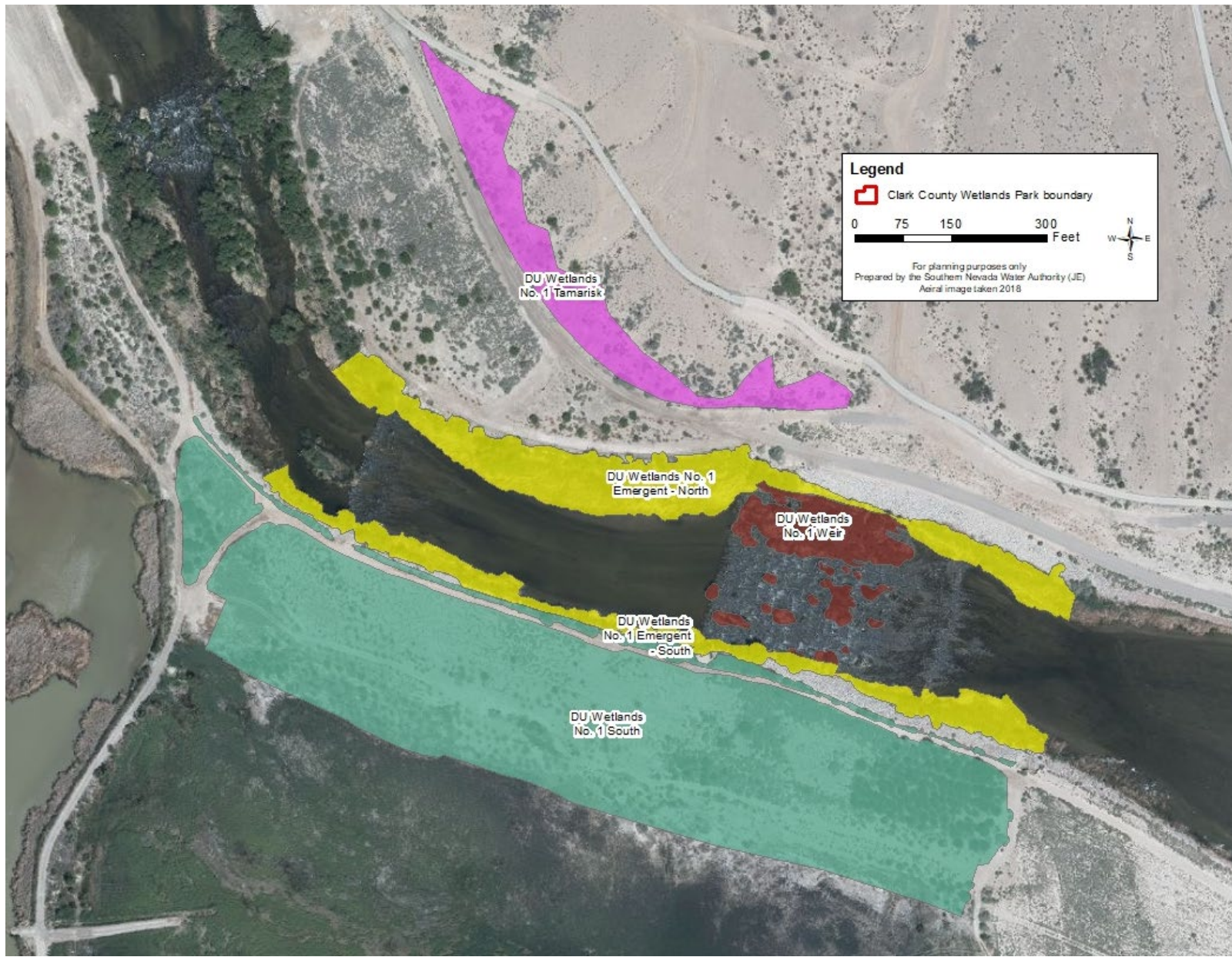


Figure 15. Aerial photograph of 2018 delineated DU Wetlands No. 1 Weir revegetation sites.

### 3.9 DU Wetlands No. 2 Weir

All four of the revegetation sites at the DU Wetlands No. 2 Weir had the maximum total cover for vegetation in 2018, 75-100% (Table 11, Figure 16). This data comes from two of the sites being monitored in the field with the other two being monitored using ArcGIS. The two sites monitored in the field were DU Wetlands No. 2 Emergent (DU2E) and DU Wetlands No. 2 South (DU2S). DU2E has had the maximum cover value since the first monitoring year in 2010. Now in its ninth growing season, there were 23 species found on the site; the dominant species was Goodding’s willow with a cover of 50.6% in 2018 (Figure 17). The total cover and species cover values are derived from a weighted average of monitoring areas on the north and south banks.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
DU2E	9	2.07	wet	75-100%	0.3%	23	1.85
DU2N	9	2.98	non-wet	75-100%	nm	nm	nm
DU2S	9	1.53	non-wet	75-100%	2.5%	14	3.46
DU2W	9	0.87	wet	75-100%	nm	nm	nm

<sup>1</sup>DU2N=DU Wetlands No. 2 North, DU2S=DU Wetlands No. 2 South, DU2E=DU Wetlands No. 2 Emergent, DU2W=DU Wetlands No. 2 Weir

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps’ 1987 Wetland Delineation Manual. “wet” = wetland and “non-wet” = non-wetland

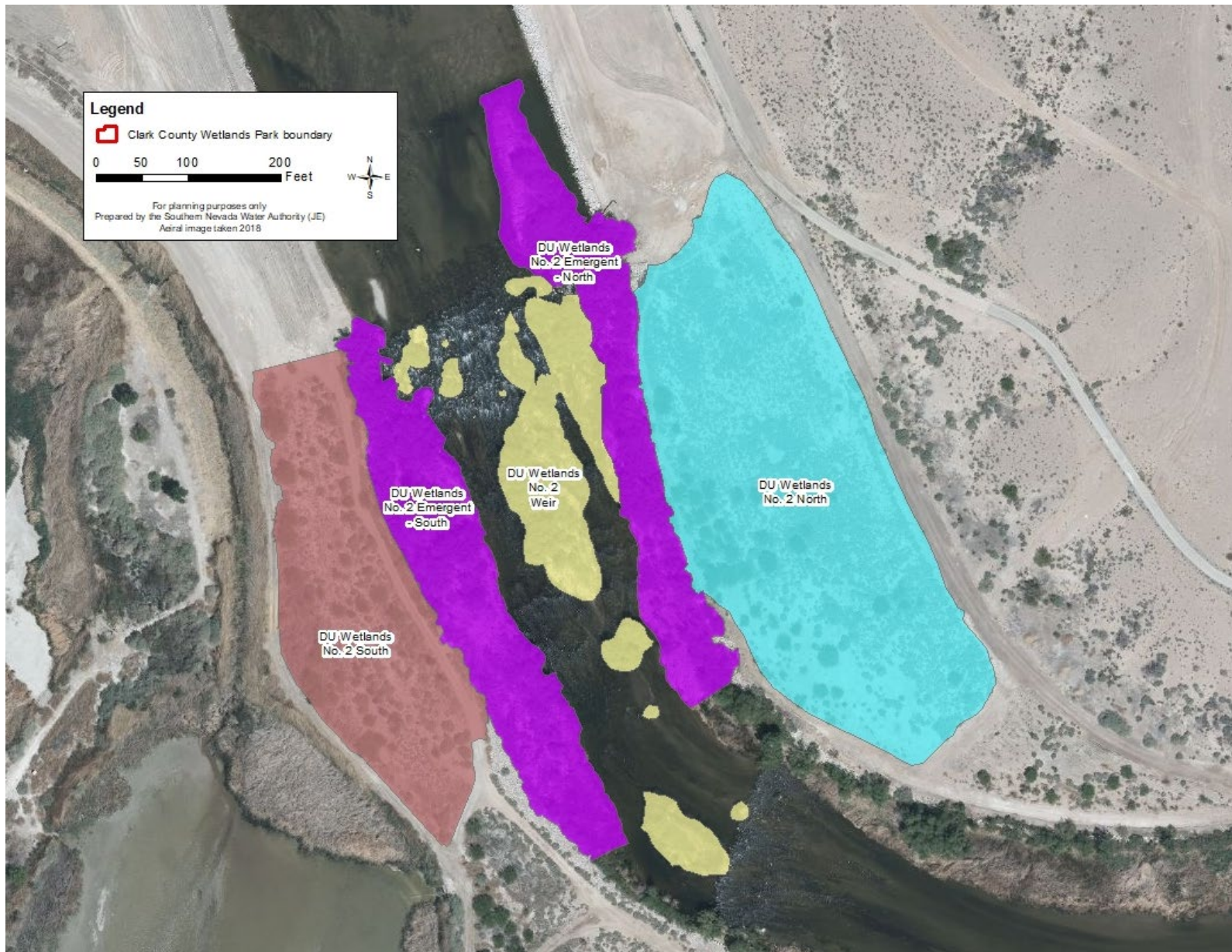
<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland  
nm = this attribute was not monitored

**Table 11. Vegetation monitoring results for DU Wetlands No. 2 Weir revegetation sites in 2018.**

The non-wetland site DU2S has had the maximum cover value of 75-100% in all but one of the nine years it has been monitored (in 2016 it had a cover of 50-75%). Also, in its ninth growing season, this site had 14 species with three codominant plants: common reed, honey mesquite, and bassia. Each of these species had a cover of 25-50%. Honey mesquite is a native tree. Common reed has both native and non-native individuals along the Wash, but it is unclear which were at this site, while bassia is an aggressive weed. Contractors should be directed to manage the bassia on the site before it begins to outcompete native species.

### 3.10 Historic Lateral Weir

None of the nine Historic Lateral Weir revegetation sites were monitored in the field in 2018 (Table 12, Figure 18). All of the sites had their total cover measured using ArcGIS and aerial imagery. This was planned due to the ongoing construction of the Historical Weir expansion that was completed in late 2018. All but the two passive wetland sites were field monitored in 2017 and will be again in 2019. The expansion project required the removal of some entire revegetation sites at the Historic Lateral Weir as well as substantial portions of others. The result was a larger weir with a larger backwater. This backwater is theorized to provide additional groundwater movement to revegetation sites not far from the Wash banks. It is expected that if true, future monitoring will show fast plant growth and perhaps changes in species diversity on sites upstream of the weir.



**Figure 16. Aerial photograph of 2018 delineated DU Wetlands No. 2 Weir revegetation sites.**



**Figure 17. Goodding’s willow (background) was the dominant plant on the DU Wetlands No. 2 Emergent revegetation site in 2018.**

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
DHLPW	18	1.95	wet	75-100%	nm	nm	nm
HLW	18	0.42	wet	75-100%	nm	nm	nm
UHLN	18	4.57	non-wet	75-100%	nm	nm	nm
UHLN	18	2.00	wet	75-100%	nm	nm	nm
UHLNS	18	1.74	wet	75-100%	nm	nm	nm
UHLSB	18	1.20	non-wet	75-100%	nm	nm	nm
UHLSB	18	1.14	wet	75-100%	nm	nm	nm
UHLSUP	11	2.93	non-wet	75-100%	nm	nm	nm
UHLSUP2	8	10.72	non-wet	52.8%	nm	nm	nm

<sup>1</sup>DHLPW=Downstream Historic Lateral Passive Wetlands, HLW=Historic Lateral Weir, UHLN=Upstream Historic Lateral North, UHLNS=Upstream Historic Lateral North South, UHLPW=Upstream Historic Lateral Passive Wetlands, UHLS=Upstream Historic Lateral South, UHLSB=Upstream Historic Lateral South Bank, UHLSS=Upstream Historic Lateral South Stockpile, UHLSUP=Upstream Historic Lateral South Upper Plateau, UHLSUP2=Upstream Historic Lateral South Upper Plateau 2

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps’ 1987 Wetland Delineation Manual. “wet” = wetland and “non-wet” = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 12. Vegetation monitoring results for Historic Lateral Weir revegetation sites in 2018.**

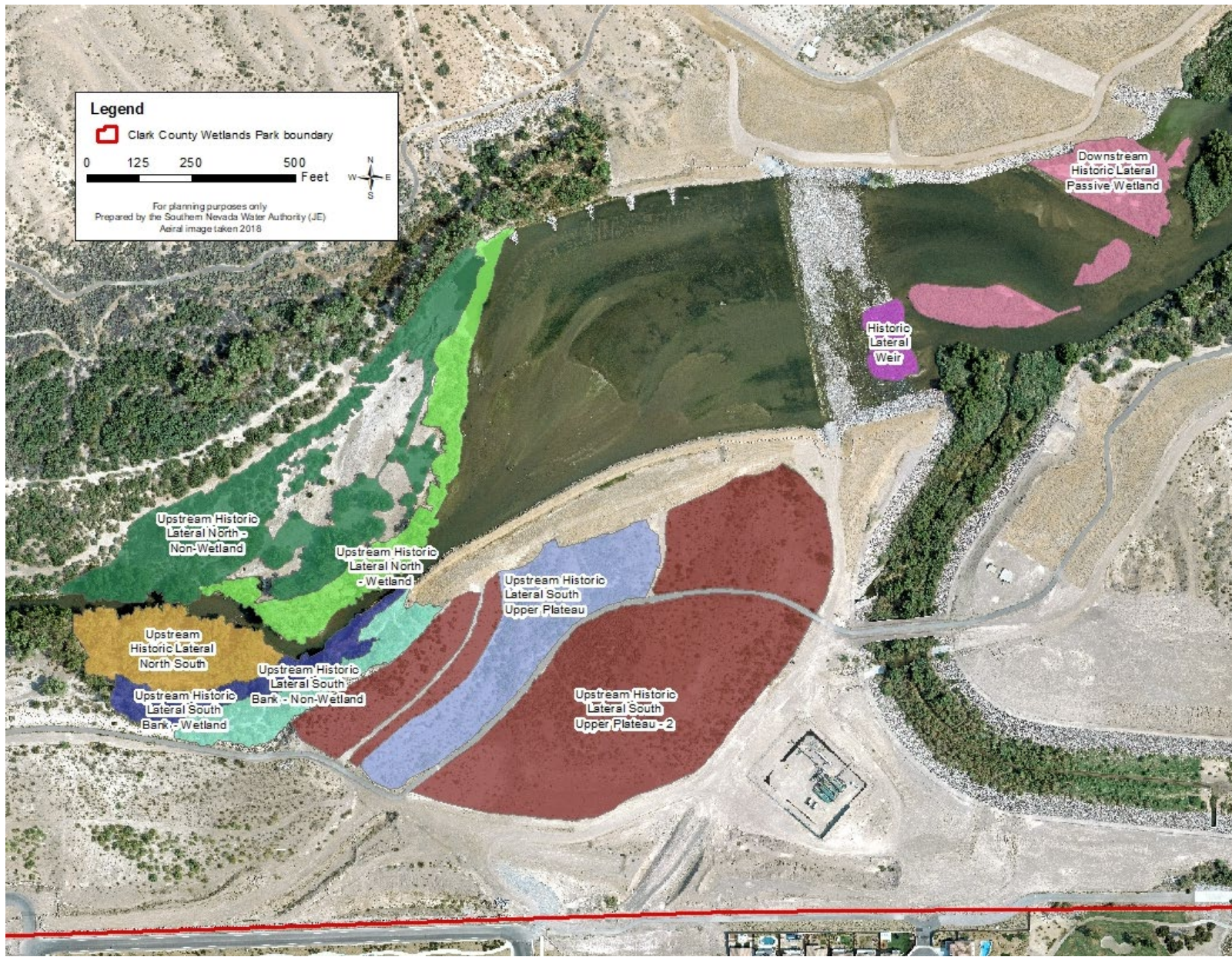


Figure 18. Aerial photograph of 2018 delineated Historic Lateral Weir revegetation sites.

### 3.11 Lower Narrows and Homestead Weirs

Three of the seven revegetation sites at the Lower Narrows and Homestead Weirs were monitored in the field in 2018 (Table 13, Figure 19). Included with these was Lower Narrows Homestead Emergent (LNHE), which was last monitored in the field in 2016. The total cover for this site remained at the highest possible value of 75-100%. However, species richness on the site declined substantially from 33 species to just 14. LNHE is broken up into three monitoring areas: the north bank, the south bank, and the vegetation in the channel itself upstream and downstream of the two weirs. The channel was not included in the 2016 monitoring, which makes the decline perhaps even more substantial. The north bank declined from 26 species to nine while the south bank declined from 27 species to 11. The channel vegetation had six species identified in 2018. Despite being a substantial drop, only one of the 33 species identified in 2016 had more than 5% cover. American bulrush (*Schoenoplectus americanus*) had a weighted total cover of 8.3% and was not identified in 2018. This may be due to incorrect identification in 2018; close attention will be made in subsequent monitoring. However, there were also substantial declines in California bulrush (*Schoenoplectus californicus*), which went from 25.4% to 9.0%, and sandbar willow which declined from 27.1% to 15.0%. These species seemed to be replaced by common reed, which increased in cover from 2.5% to 21.1%, and southern cattail, which similarly increased from 2.5% to 24.4% in the two years.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
HW	7	3.18	wet	75-100%	nm	nm	nm
LNW	7	2.59	wet	75-100%	nm	nm	nm
LNHE	7	4.69	wet	75-100%	1.2%	14	1.61
LNHN	7	40.75	non-wet	25-50%	nm	nm	nm
LNHS1	7	7.38	non-wet	50-75%	0.1%	16	4.85
LNHS2	6	6.60	non-wet	25-50%	0.0%	10	4.85
LNHS3	7	2.22	non-wet	25-50%	nm	nm	nm

<sup>1</sup>HW=Homestead Weir, LNW=Lower Narrows Weir, LNHB-S=Lower Narrows Homestead Bank South, LNHB-N=Lower Homestead Bank North, LNHE=Lower Narrows Homestead Emergent, LNHN=Lower Narrows Homestead North, LNHS1=Lower Narrows Homestead South 1, LNHS2=Lower Narrows Homestead South 2, LNHS3=Lower Narrows Homestead South 3

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value. WPI≤2.0 = wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

**Table 13. Vegetation monitoring results for Lower Narrows and Homestead Weirs revegetation sites in 2018.**

The two non-wetland sites that were monitored in the field in 2018 had opposite movements in total cover compared to 2017 when they were both monitored using ArcGIS. Lower Narrows Homestead South 1 (LNHS1) increased in total cover from 25-50% to 50-75%. The total cover was also 50-75% in 2016, the last time it was monitored in the field. The species richness on the site also increased, from eight species in 2016 to 16 in 2018. Lower Narrows Homestead South

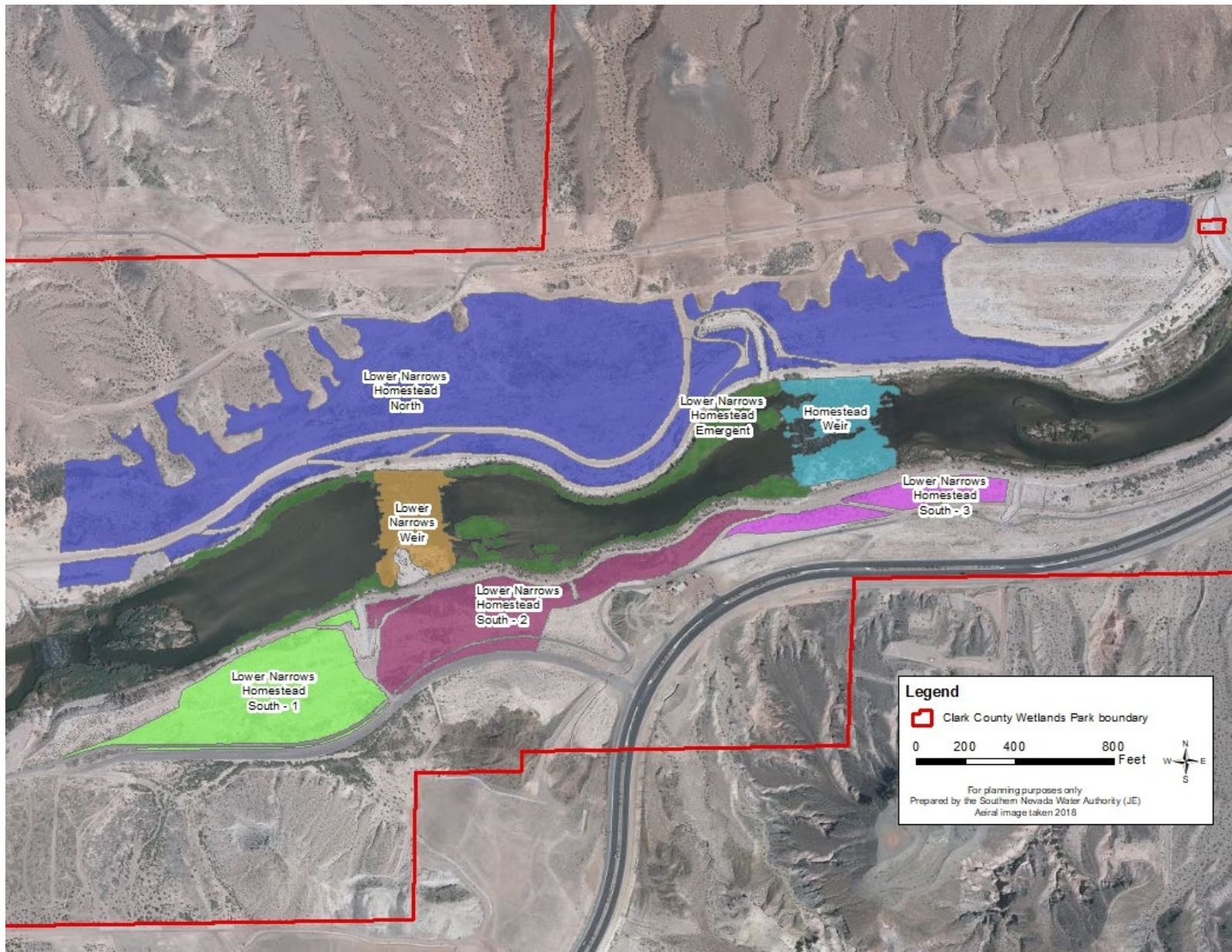


Figure 19. Aerial photograph of 2018 delineated Lower Narrows and Homestead Weirs revegetation sites.



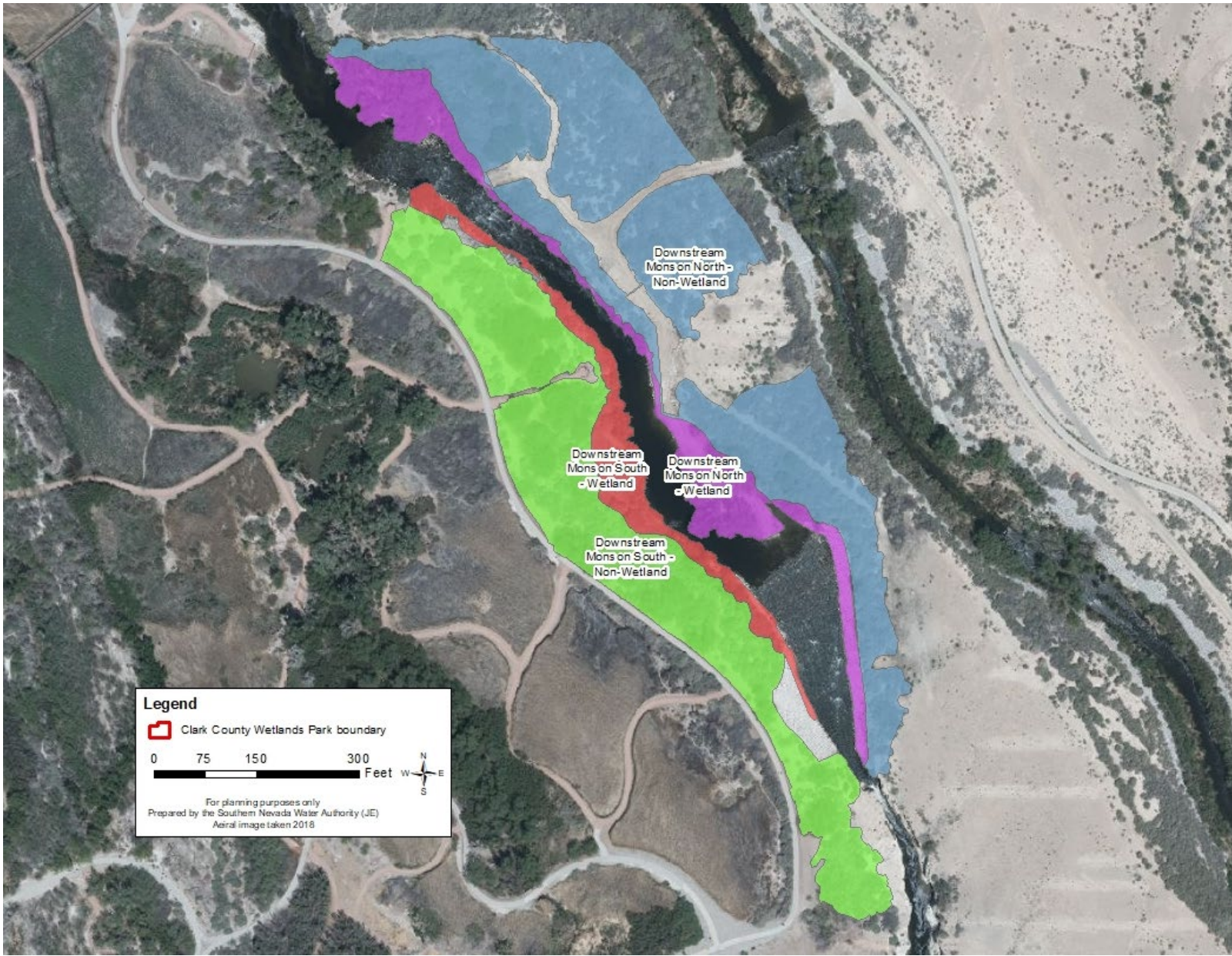
2 (LNHS2) declined to 25-50% total cover after having 50-75% total cover in the past three growing seasons. Although the site had the same number of species in 2018 as it did in 2016, 10, the cover of creosote declined from 5-25% to 1-5%, which was the main reason the total site cover declined as well.

### 3.12 Monson and Visitor Center Weirs

All four of the revegetation sites at the Monson and Visitor Center Weirs had the maximum 75-100% total cover in 2018 (Figure 20, Table 14) just as they did in 2017. Downstream Monson South - Non-wetland (DMS-N) and Downstream Monson South – Wetland (DMS-W) were both monitored in the field while the two north side sites were monitored for total cover using ArcGIS. All in their 16<sup>th</sup> growing season, there are typically only minor changes to the sites in terms of plant cover, species richness and species composition. There were larger than usual changes to the lower portions of both DMS-W and Downstream Monson North – Wetland (DMN-W) in 2018. In the early part of the year, the Visitor Center Weir was almost completely rebuilt (Figure 21). The length of the weir was expanded and some portions of the width as well. There was also new rock riprap installed. This project removed vegetation along the banks and in the channel; combined, the sites decreased by 0.3 acres. This new weir should provide a more stable backwater and will support new wetland areas in the future.



Figure 20. The Visitor Center Weir after reconstruction in 2018.



**Figure 21. Aerial photograph of 2018 delineated Monson and Visitor Center Weirs revegetation sites.**

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
DMN	16	3.73	non-wet	75-100%	nm	nm	nm
DMN	16	1.00	wet	75-100%	nm	nm	nm
DMS	16	2.89	non-wet	75-100%	0.5%	9	3.53
DMS	16	0.60	wet	75-100%	18.0%	24	2.33

<sup>1</sup>DMN=Downstream Monson North, DMS=Downstream Monson South

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 14. Vegetation monitoring results for Monson and Visitor Center Weirs revegetation sites in 2018.**

### 3.13 Pabco Road Weir

Eight of the 15 revegetation sites associated with the Pabco Road Weir were monitored in the field in 2018 (Table 15, Figure 22). The remaining six had their total cover monitored using ArcGIS. The vegetation at most of the sites is very old and includes vegetation planted at the first Green-Up event in 2001. Vegetation along the banks continues to have minor changes as a result of scouring and sedimentation, but the majority of the sites, especially on the interior, have not had much change in many years. There are a few sites that are younger and therefore are more dynamic in terms of plant growth and species richness.

In 2017, but after that year's monitoring, Downstream Pabco South Upper Plateau (DPSUP) had a second Green-Up event to plant shrubs on the site (Figure 23). This is the first Green-Up to plant a site for a second time. Much of DPSUP was considered successful but the dominant plants were trees, primarily mesquites. This second planting was designed to diversify the plant species on the site, provide additional wildlife habitat, as well as make the site more attractive to park visitors as this site is adjacent to the Pabco Trailhead at the CCWP. In addition to planting within the existing DPSUP area, an adjacent area was planted along the road entering the pabco trailhead. This site was named DPSUP-3 as DPSUP itself is broken up into two monitoring areas: DPSUP-1 and DPSUP-2.

In conjunction with the construction of the Sunrise Mountain Weir upstream of the Pabco Road Weir, a large portion of the Upstream Pabco South (UPS) site was removed in late 2017. This site had measured 4.36 acres but was reduced to 1.66 to allow for a larger backwater behind the Pabco Road Weir and prevent damage to the weir during flood events. The smaller UPS maintained the maximum cover value of 75-100% and species richness was only reduced by two species. There were 26 species identified in 2018. The main concern is that the dominant species is now salt cedar. There was a substantial amount of salt cedar in the portion of the site that was not removed and salt cedar was able to establish on the edges of the cleared area near the Wash channel. In 2018, salt cedar covered 48.9% of the site compared to just 13.8% in 2017. In contrast, one of the

dominant species prior to the removal was sandbar willow, which had a total cover of 30.2% in 2017 but was reduced to 11.4% in 2018. Crews from the Lake Mead Exotic Plant Management Team were contracted to remove the salt cedar from this and other sites in 2018. Future monitoring will be able to tell how successful these efforts were and if other actions need to be taken such as additional weed treatment and/or planting of more native species in the remaining area.

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
DPI	18	1.23	wet	75-100%	nm	nm	nm
DPN	10	9.45	non-wet	75.2%	0.7%	16	4.04
DPNB	7	0.82	wet	75-100%	nm	nm	nm
DPS	18	4.22	wet	75-100%	nm	nm	nm
DPSUB	8	0.89	non-wet	25-50%	1.0%	19	3.80
DPSUP	8	9.51	non-wet	50-75%	2.5%	28	4.13
DPSUP-3	1	0.58	non-wet	25-50%	15.0%	20	2.62
PN	18	3.57	non-wet	50-75%	2.5%	11	2.95
PN	18	0.84	wet	75-100%	0.5%	16	2.20
PS	18	1.23	non-wet	75-100%	nm	nm	nm
PS	18	0.39	wet	75-100%	nm	nm	nm
UPI	18	0.37	wet	75-100%	nm	nm	nm
UPN	13	2.64	wet	75-100%	nm	nm	nm
UPS*	17	1.66	wet	75-100%	48.9%	26	2.70
UPSUP	17	2.19	non-wet	75-100%	2.5%	16	2.82

<sup>1</sup>DPI=Downstream Pabco Island, DPN=Downstream Pabco North, DPNB=Downstream Pabco North Bank, DPS=Downstream Pabco South, DPSUB=Downstream Pabco South Upper Bank, DPSUP=Downstream Pabco South Upper Plateau, PN=Pabco North, PS=Pabco South, UPI=Upstream Pabco Island, UPN=Upstream Pabco North, UPS=Upstream Pabco South, UPSUP=Upstream Pabco South Upper Plateau

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

\* UPS includes Upstream Pabco South Lower Plateau

nm = this attribute was not monitored

**Table 15. Vegetation monitoring results for Pabco Road Weir revegetation sites in 2018.**

### 3.14 Powerline Crossing Weir

None of the 10 revegetation sites at the Powerline Crossing Weir were monitored in the field in 2018 (Table 16, Figure 24). Table 16 show the total cover of all of the sites as determined using ArcGIS. All of the sites were in their 12<sup>th</sup> growing season and have mature vegetation. Only three of the 10 sites have less than the maximum 75-100% total cover value. These are all non-wetland sites and are not expected to have the dense vegetation that the wetland sites typically achieve along the Wash. The four non-wetland sites are also the only sites to have changed in total cover since 2017. Non-wetland sites are more susceptible to have changes in vegetation because of weather than wetland sites.

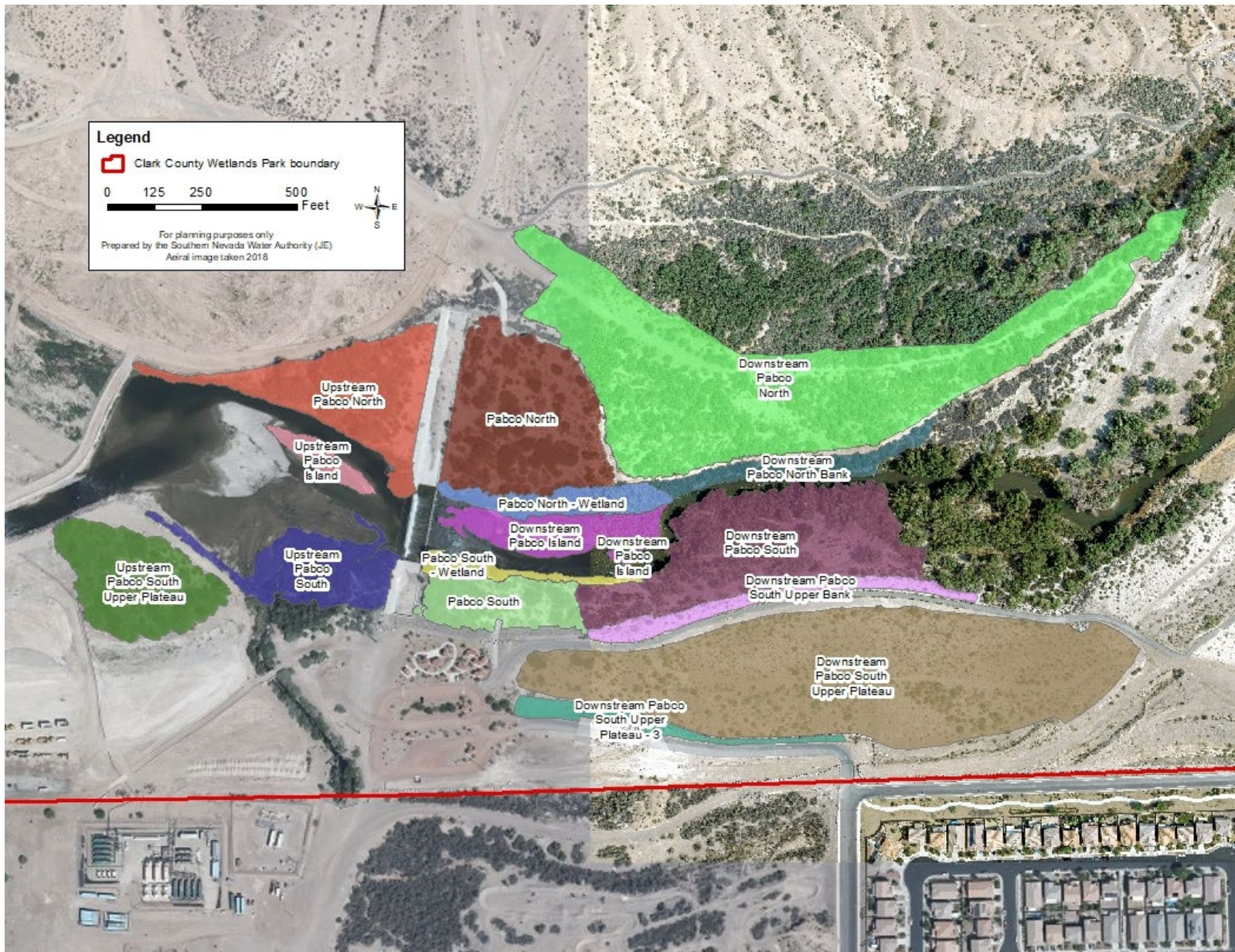


Figure 22. Aerial photograph of 2018 delineated Pabco Road Weir revegetation sites.



**Figure 23. Additional shrubs were planted at the Downstream Pabco South Upper Plateau revegetation site in 2017.**

Site Code <sup>1</sup>	Growing Season	Acreage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
DPLNB	12	0.31	wet	75-100%	nm	nm	nm
DPLSB	12	0.25	wet	75-100%	nm	nm	nm
PCW	12	0.07	wet	75-100%	nm	nm	nm
PLSB	12	0.57	non-wet	75-100%	nm	nm	nm
UPLNB	12	0.65	non-wet	25-50%	nm	nm	nm
UPLNE	12	1.10	wet	75-100%	nm	nm	nm
UPLNP	12	3.83	non-wet	60.5%	nm	nm	nm
UPLNW	12	0.37	wet	75-100%	nm	nm	nm
UPLSB	12	0.81	wet	75-100%	nm	nm	nm
UPLSP	12	5.67	non-wet	69.1%	nm	nm	nm

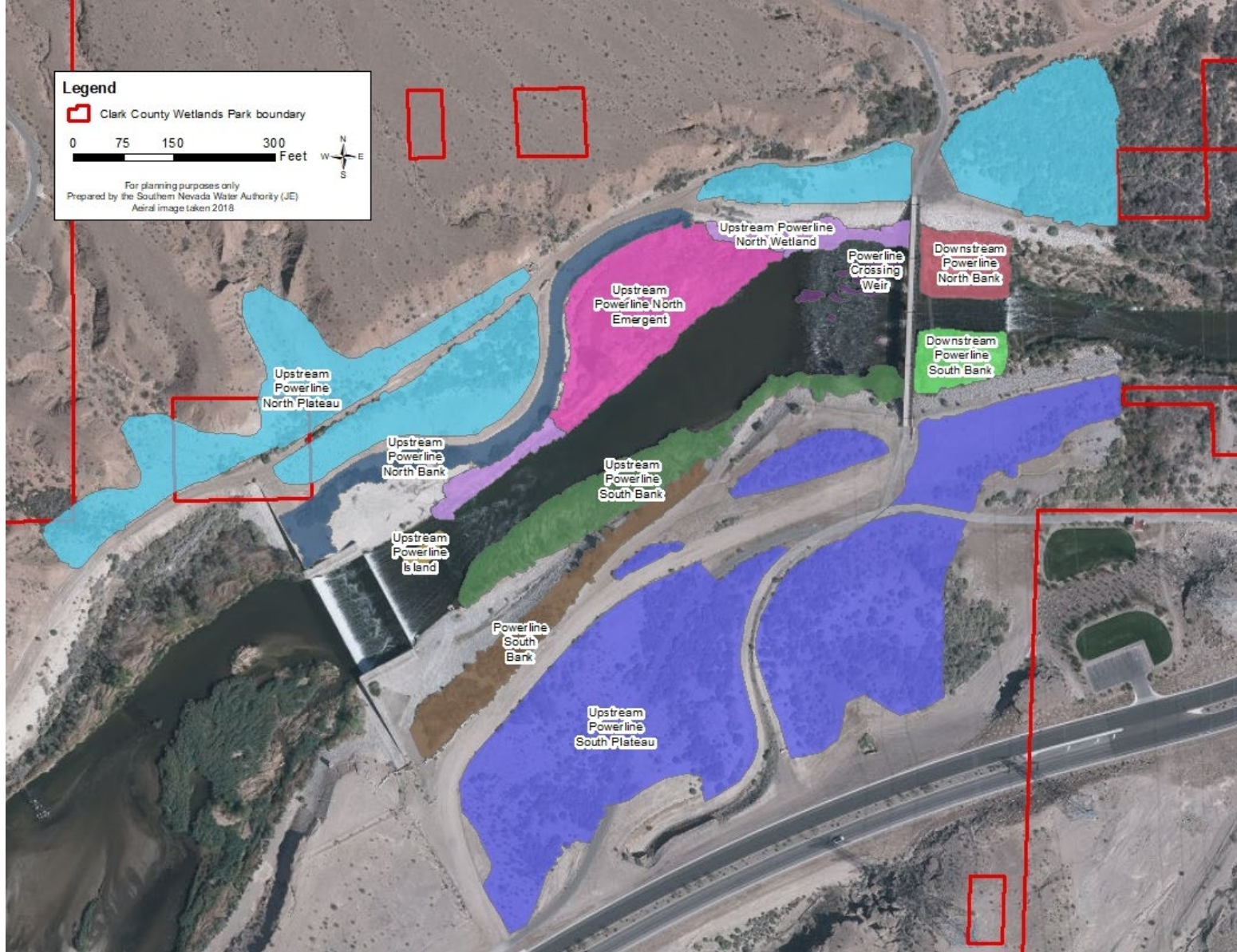
<sup>1</sup>DPLNB=Downstream Powerline North Bank, DPLSB=Downstream Powerline South Bank, PCW=Powerline Crossing Weir, PLSB=Powerline South Bank, UPLNB=Upstream Powerline North Bank, UPLNE=Upstream Powerline North Emergent, UPLNP=Upstream Powerline North Plateau, UPLNW=Upstream Powerline North Wetland, UPLSB=Upstream Powerline South Bank, UPLSP=Upstream Powerline South Plateau

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>3</sup>Wetland Prevalence Index (WPI) value. WPI≤2.0 = wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

**Table 16. Vegetation monitoring results for Powerline Crossing Weir revegetation sites in 2018.**



**Figure 24. Aerial photograph of 2018 delineated Powerline Crossing Weir revegetation sites.**

### 3.15 Rainbow Gardens Weir

Five of the eight revegetation sites associated with the Rainbow Gardens Weir were monitored in the field in 2018 (Figure 26; Table 17). All five of these sites had the same total cover in 2018 as they had in 2016 with very small differences, if any, in species richness. Upstream Rainbow South Bank 2 (URSB2) at just over a half-acre in size has one of the highest percentages of noxious weeds of all revegetation sites along the wash with 15%. This is down from the 2017 measurement of 62.5%. The only noxious weed found on the site in any year has been salt cedar. There were no active removals of salt cedar on the site since the 2017 monitoring. It is not clear what resulted in such a substantial decrease.

Site Code <sup>1</sup>	Growing Season	Acreeage	Wetland Status <sup>2</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>3</sup>
RI	14	0.98	wet	75-100%	0.1%	5	1.60
URI	14	2.38	wet	75-100%	nm	nm	nm
URNB	9	1.58	non-wet	50-75%	nm	nm	nm
URNPW	14	2.33	wet	75-100%	nm	nm	nm
URSB1	13	0.02	non-wet	50-75%	0.0%	3	2.36
URSB2	11	0.58	non-wet	75-100%	15.0%	4	2.23
URSE	14	0.68	wet	75-100%	2.5%	11	2.04
URSP	13	1.39	non-wet	5-25%	0.0%	8	4.50

<sup>1</sup>RI=Rainbow Islands, URI=Upstream Rainbow Island, URNB=Upstream Rainbow North Bank, URNPW=Upstream Rainbow North Passive Wetlands, URSB1=Upstream Rainbow South Bank 1, URSB2=Upstream Rainbow South Bank 2, URSE=Upstream Rainbow South Emergent, URSP=Upstream Rainbow South Plateau

<sup>2</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

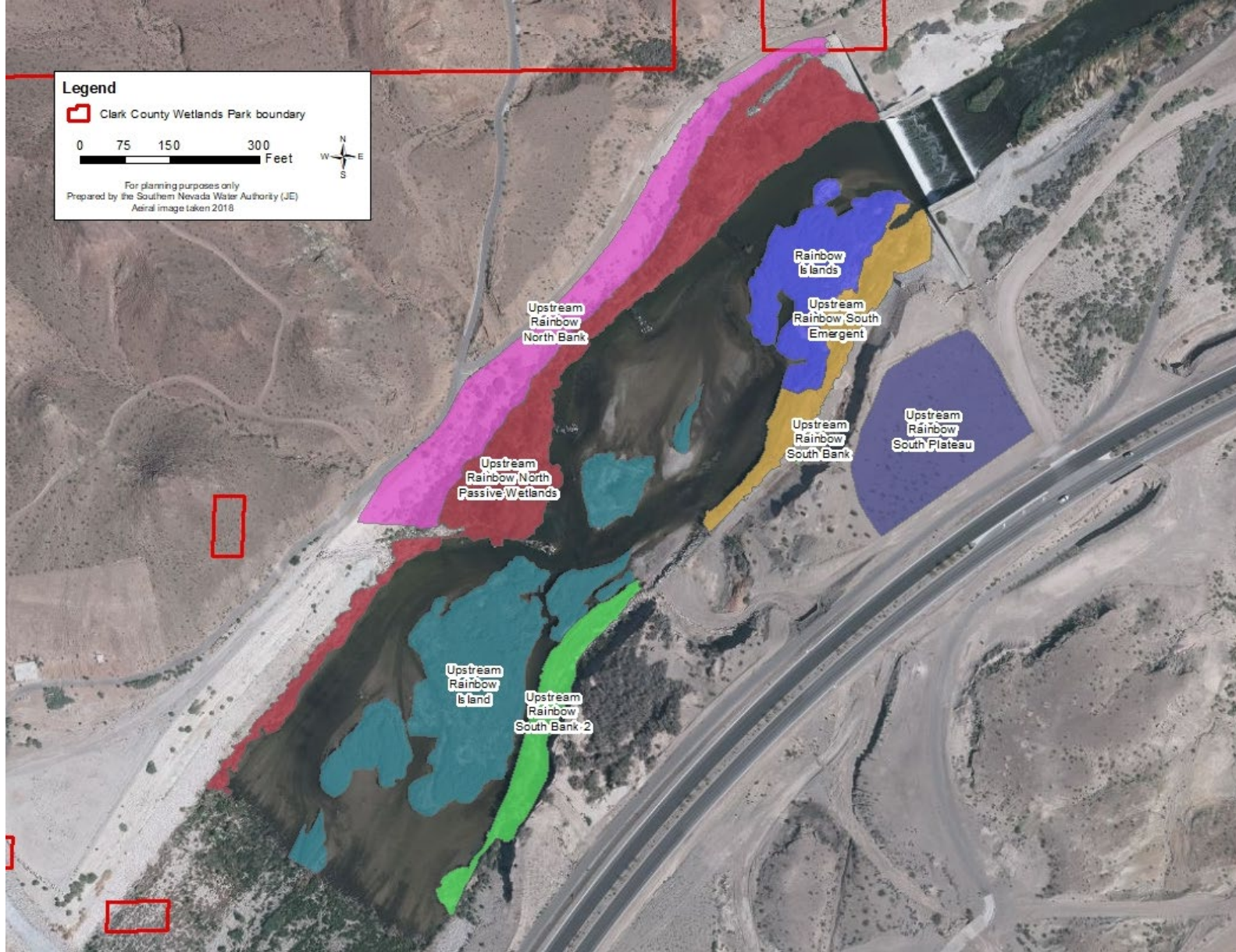
<sup>3</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland  
nm = this attribute was not monitored

**Table 17. Vegetation monitoring results for Rainbow Gardens Weir revegetation sites in 2018.**

### 3.16 Site 108

All of Site 108 was monitored for total cover using ArcGIS in 2018 (Table 18; Figure 27). The site was scheduled to be field monitored after being monitored using ArcGIS in 2017 as well. However, construction of the Sunrise Mountain Weir made it difficult to access certain areas. This construction also reduced the size of Site 108 by about 3 acres. Originally Site 108 measured close to 60 acres. Although substantially reduced to under 40 acres, it is still the largest contiguous revegetation site along the Wash. The decrease in over 20 acres has come as a combined result of the required space needed for the construction of the Duck Creek Confluence, Upper Narrows, and Sunrise Mountain Weirs. The northern and eastern edges were removed for access roads and staging areas for equipment used in the weir construction.





**Figure 25. Aerial photograph of 2018 delineated Rainbow Gardens Weir revegetation sites.**

Funding Areas	Growing Season <sup>3</sup>	Acreage	Wetland Status <sup>1</sup>	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>2</sup>
NDEP	12	5.72	non-wet	66.7%	nm	nm	nm
NDSP	12	12.15	non-wet	79.2%	nm	nm	nm
SNPLMA IV	12	7.49	non-wet	87.5%	nm	nm	nm
SNPLMA V	12	11.80	non-wet	85.7%	nm	nm	nm
<b>TOTAL</b>	<b>12</b>	<b>37.67</b>	<b>non-wet</b>	<b>82.1%</b>	<b>nm</b>	<b>nm</b>	<b>nm</b>

<sup>1</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual.

"wet" = wetland and "non-wet" = non-wetland

<sup>2</sup>Wetland Prevalence Index (WPI) value. WPI $\leq$ 2.0 = wetland, 2.0 < WPI < 2.5 = likely wetland, 2.5  $\leq$  WPI < 3.5 = may be wetland, 3.5  $\leq$  WPI < 4.0 = not likely a wetland, and WPI  $\geq$  4.0 = upland

<sup>3</sup>Portions of funding areas SNPLMA IV and SNPLMA V were planted in the spring of 2006 and others in the fall of 2006

nm = this attribute was not monitored

**Table 18. Vegetation monitoring results for the Site 108 revegetation site in 2018.**

The total cover for Site 108 in 2018 was 82.1%. This is calculated using a weighted average of 58 monitoring areas across the site. This is the highest total cover has ever been with 2017 being the second highest at 71.8%. One possible reason for this substantial increase could be that some of the areas removed for construction had lower plant cover. These areas will be replanted as part of the Sunrise Mountain Weir project, currently scheduled for 2021.

### 3.17 Site 111

At just under 15 acres, Site 111 is one of the larger revegetation sites along the Wash (Table 19, Figure 27). Prior to the current year, this site was broken up into 26 monitoring areas and a weighted average was used for the total cover of the site. This year, however, the site was monitored as a single monitoring area. Random pedestrian transects were used through the entire site to capture species richness and cover. This was done due to substantial growth of shrubs such as quailbush, fourwing saltbush (*Atriplex canescens* var. *canescens*), and desert saltbush as well as honey and screwbean mesquites (*Prosopis pubescens*) which made it impossible to enter some of the monitoring areas. Instead, information was collected from the edges of vegetated areas, as well as observations from higher elevations to get plant cover. In alternating years, when ArcGIS is used for plant cover, the monitoring areas can be used again to both provide more detailed data as well as provide a comparison to field measurements.

The total cover for the site in 2018 was 75-100%. Since the site was considered a single monitoring area, the cover class ranges were used as opposed to previous years when a more specific percentage was calculated using a weighted average of the monitoring areas. Using the midpoint of the range, 87.5%, this was the highest total cover for the site in its 12 growing seasons. This is up from 2017 when the total cover was 82%. The second highest was 2012 when the total cover was 86.9%.

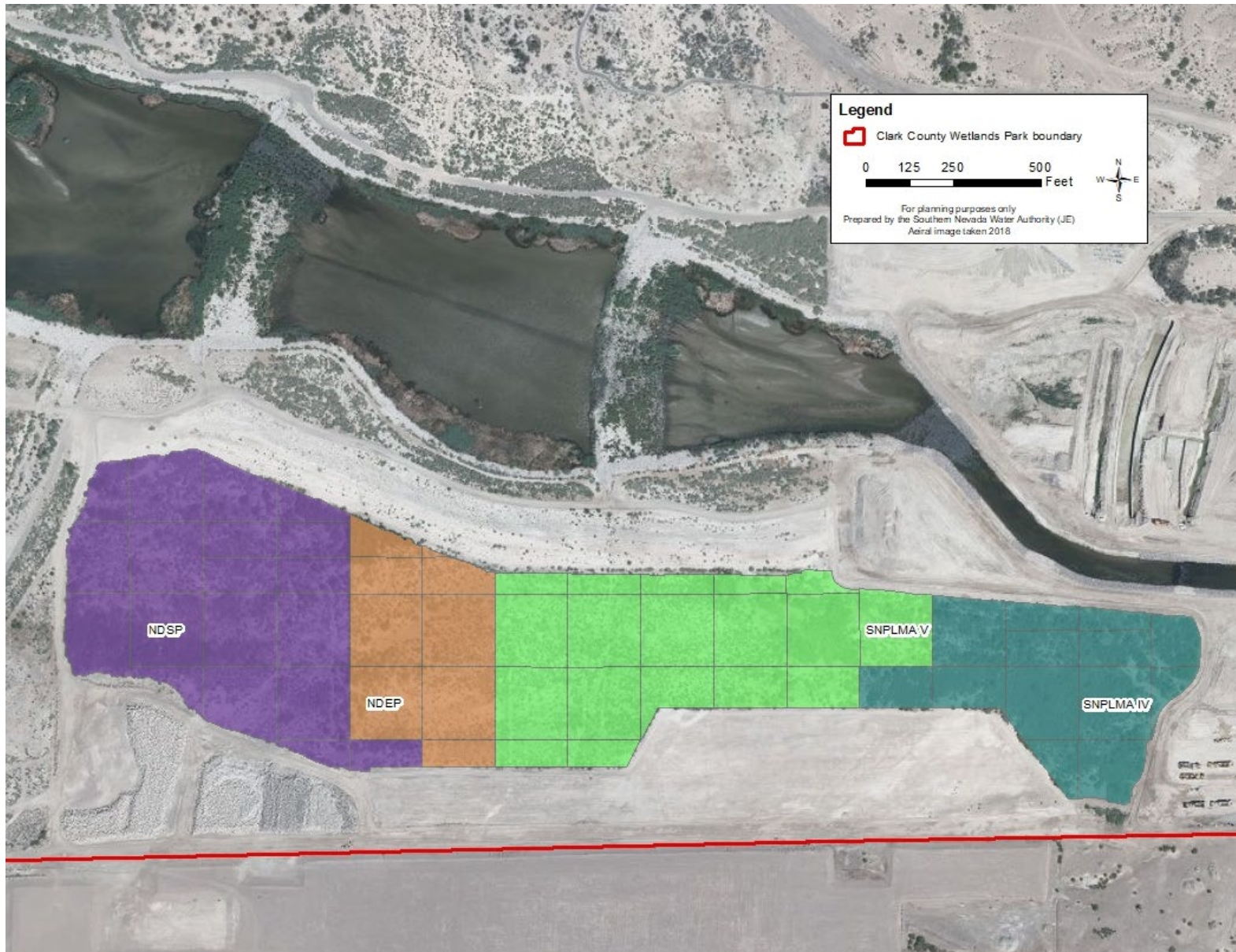


Figure 26. Aerial photograph of Site 108 with 2018 delineations based on funding source.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>2</sup>
S111	12	14.93	non-wet	75-100%	15.0%	13	3.39

<sup>1</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual.

"wet" = wetland and "non-wet" = non-wetland

<sup>2</sup>Wetland Prevalence Index (WPI) value. WPI $\leq$ 2.0 = wetland, 2.0 < WPI < 2.5 = likely wetland, 2.5  $\leq$  WPI < 3.5 = may be wetland, 3.5  $\leq$  WPI < 4.0 = not likely a wetland, and WPI  $\geq$  4.0 = upland

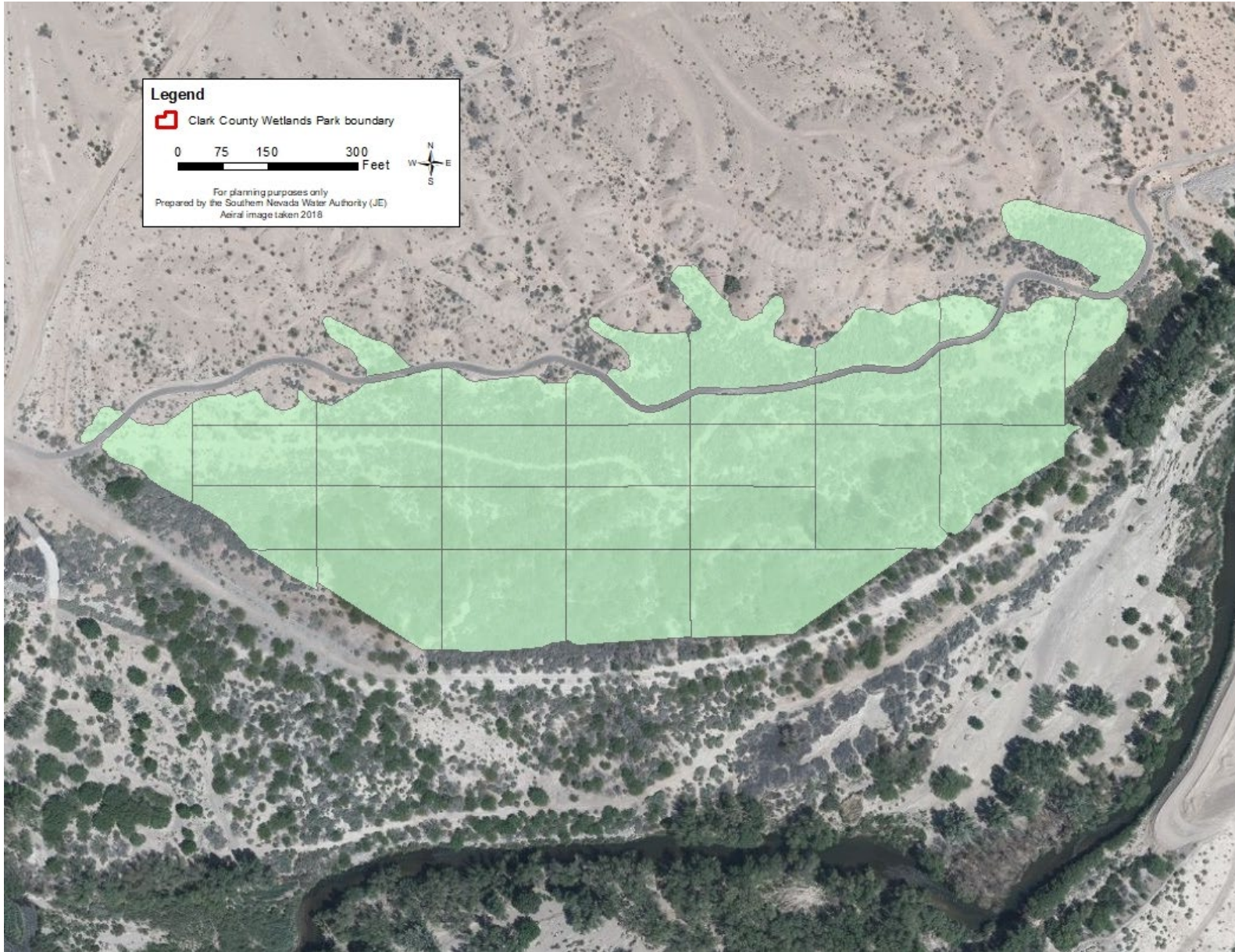
nm = this attribute was not monitored

**Table 19. Vegetation monitoring results for Site 111 revegetation site in 2018.**

### 3.18 Three Kids Weir

All but one of the eight revegetation sites at the Three Kids Weir increased or stayed the same in 2018 as compared to 2017 (Figure 28, Table 20). The two passively created wetland sites (Three Kids Weir and Upstream Three Kids Island) were monitored using ArcGIS, the remaining six sites were monitored in the field in 2018. The only site that decreased in cover was Lower Narrows Homestead Bank – South (LNHB-S) from 50-75% to 25-50%. This was a surprising result as the species richness increased from 14 to 22 in the same timeframe. The decline of total cover is directly related to the decrease of two species: fourwing saltbush, which declined from 25-50% to 5-25%, and sandbar willow, which declined from 5-25% to 1-5%. This site was created from soil spoils from the construction of the Three Kids Weir being deposited on the bank protection lining the Wash near the Lower Narrows and Homestead Weirs. This results in very different soil and water conditions when compared to other sites and varied success in plant establishment.

The lone Green-Up site at the Three Kids Weir is Upstream Three Kids South (U3KS). This site was planted on March 4, 2017, and was in its second growing season at the time of 2018 vegetation monitoring. There was a high success rate of planted plants with an 87% survivorship recorded in 2017. Survivorship was not recorded in 2018 due to difficulty knowing which plants were planted and which ones self-established. All of the planted species were still documented in 2018 despite a decline of five species from the previous year (Figure 29). Those species were mostly weed species that established on the site during heavy irrigation the first year. The dominant species on the site remained fourwing saltbush, which was hydroseeded on the site at the completion of the weir. The species with the second highest cover amount was the non-native weed bassia. After monitoring, extensive weed removal took place.



**Figure 27. Aerial photograph of the 2018 delineated Site 111 revegetation site.**

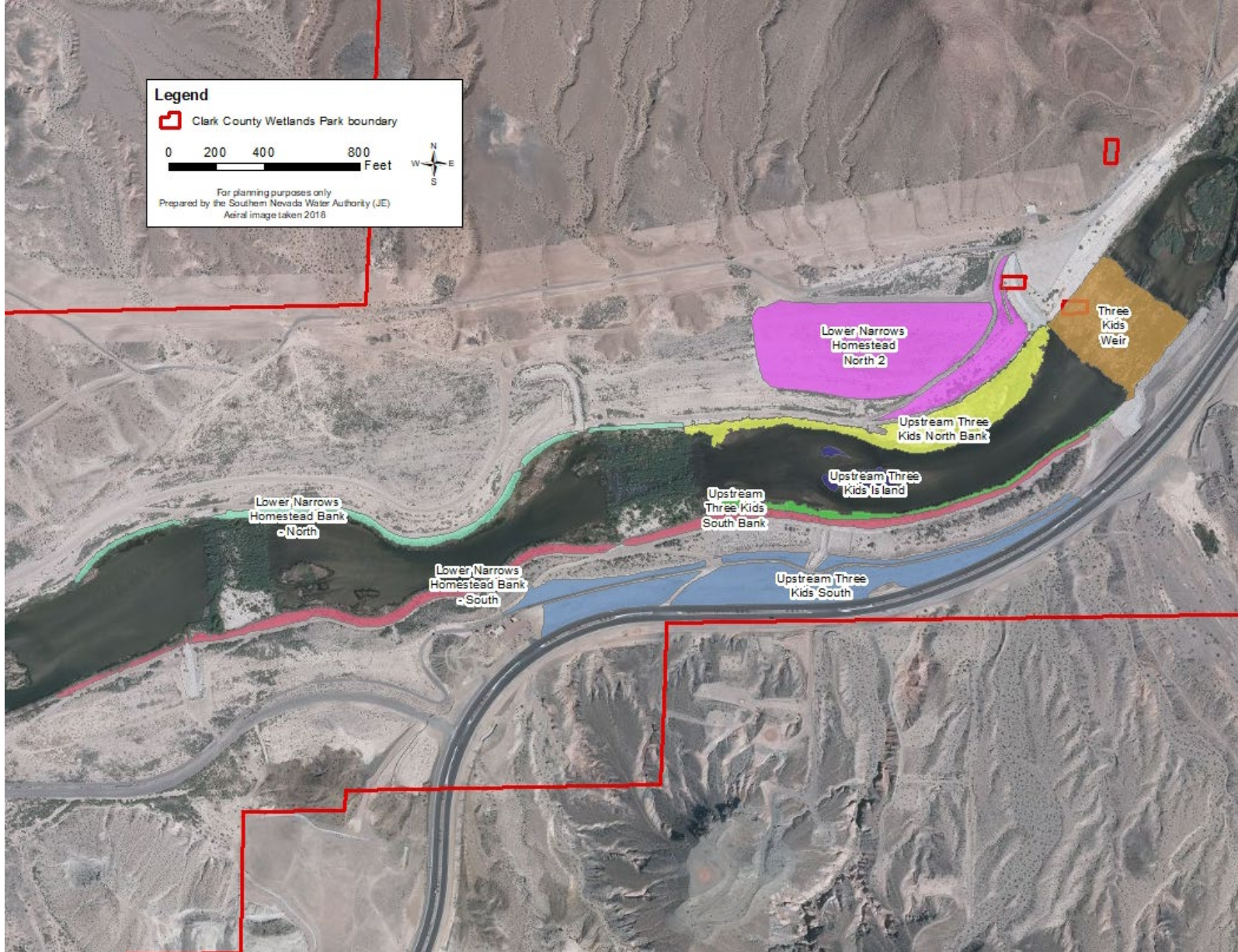


Figure 28. Aerial photograph of 2018 delineated Three Kids Weir revegetation sites.

Site Code	Growing Season	Acreeage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>2</sup>
LNHB-N	3	1.76	wet	50-75%	0.0%	9	3.61
LNHB-S	3	3.25	wet	25-50%	0.5%	22	3.45
LNHN2	2	7.66	non-wet	5-25%	0.0%	4	4.56
3KW	2	4.06	wet	75-100%	nm	nm	nm
U3KI	2	0.58	wet	75-100%	nm	nm	nm
U3KNB	3	3.49	wet	50-75%	2.5%	14	2.66
U3KS	2	6.89	non-wet	75-100%	0.1%	20	4.11
U3KSB	3	1.00	wet	75-100%	0.5%	15	2.01

<sup>1</sup>U3KNB= Upstream Three Kids North Bank (North=N, South=S), LNHN2=Lower Narrows Homestead North 2, 3KW=Three Kids Weir, U3KI=Upstream Three Kids Island, U3KSB= Upstream Three Kids South Bank, U3KS=Upstream Three Kids South

<sup>1</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>2</sup>Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

**Table 20. Vegetation monitoring results for Three Kids Weir revegetation sites in 2018.**

### 3.19 Tropicana Weir

The newest revegetation site and the most recent Green-Up prior to 2018 vegetation monitoring was Tropicana West 1 (TW1) located at the Tropicana Weir (Table 21; Figure 30). The Tropicana Weir was completed later in 2018 and will have additional revegetation projects on the west and east sides of the channel. The area where TW1 is located was almost a monoculture of common reed and was cleared as an additional area for restoration along with the construction of the weir. Common reed is a very difficult weed to control and eliminate from an area. As such, an aggressive planting design was implemented on TW1 to try and outcompete the reed. This meant planting more individual plants than at typical sites and designing the planting area to allow for mowing of the reed (Figure 31).

Despite the aggressive planting of natives and regular mowing and weeding of the common reed, this species was still one of the codominant species



**Figure 29. Rush milkweed was one of the 20 species identified at the Upstream Three Kids South revegetation site in 2018.**



Figure 30. Aerial photograph of 2018 delineated Tropicana Weir revegetation site.





**Figure 31. Regular control of common reed allowed native plants to put on substantial growth in their first growing season at the Tropicana West 1 revegetation site.**

on the site with 25-50% cover in 2 018. Prior to clearing, it would likely have been characterized as having close to 100% cover. A sign that the control measures may have worked is that alkali sacaton had the same cover range. This species was not known on the site prior to the Green-Up on March 17, 2017. The shallow groundwater table has allowed this species and others to grow rapidly in the first year. This rapid growth is also exemplified in the 75-100% total cover for the site measured just six months after planting.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>2</sup>
TW1	1	7.28	wet	75-100%	1.0%	37	1.30

<sup>1</sup>TW1=Tropicana West 1

<sup>1</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>2</sup>Wetland Prevalence Index (WPI) value.  $WPI \leq 2.0$  = wetland,  $2.0 < WPI < 2.5$  = likely wetland,  $2.5 \leq WPI < 3.5$  = may be wetland,  $3.5 \leq WPI < 4.0$  = not likely a wetland, and  $WPI \geq 4.0$  = upland

nm = this attribute was not monitored

**Table 21. Vegetation monitoring results for the Tropicana Weir revegetation site in 2018.**

### 3.20 Upper Diversion Weir

All but one of the eight revegetation sites at the Upper Diversion Weir were monitored in the field in 2018 (Table 22, Figure 32). Upper Diversion Island (UDI) was monitored using ArcGIS and is broken up into three monitoring areas. All but one of the eight revegetation sites had the maximum cover value range of 75-100%. Downstream Upper Diversion North (DUDN) was at 54.0%, similar cover it had in 2017 of 55.6%. However, this was a decline from cover being near 71% for the previous four years. Each of the 10 growing seasons since DUDN was planted, the dominant species by a large margin was fourwing saltbush. This species was both hydroseeded and planted on the site, and as some of the original plants have begun to die back, it appears that no other species or fourwing saltbush seedlings are establishing by themselves. The current cover is not of concern, however as it blends in well with surrounding native habitat.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI <sup>2</sup>
DUDE	10	3.91	wet	75-100%	1.1%	19	1.76
DUDN	10	9.76	non-wet	54.0%	0.9%	12	4.82
DUDS	10	1.43	wet	75-100%	3.3%	6	2.05
UDI	10	5.05	non-wet	75-100%	nm	nm	nm
UDIE	10	0.35	wet	75-100%	15.6%	15	2.08
UDIS	10	0.22	non-wet	75-100%	0.0%	2	4.94
UUDE	10	1.76	wet	75-100%	0.2%	21	1.18
UUDS	10	0.77	non-wet	75-100%	0.1%	3	4.00

<sup>1</sup>DUDE=Downstream Upper Diversion Emergent, DUDN=Downstream Upper Diversion North, DUDS=Downstream Upper Diversion Shelves, UDI=Upper Diversion Island, UDIE=Upper Diversion Island Emergent, UUDE=Upstream Upper Diversion Emergent, UUDS=Upstream Upper Diversion South, UDIS=Upstream Upper Diversion Island South

<sup>1</sup>Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

<sup>2</sup>Wetland Prevalence Index (WPI) value. WPI≤2.0 = wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland  
nm = this attribute was not monitored

**Table 22. Vegetation monitoring results for Upper Diversion Weir revegetation sites in 2018.**

In January of 2017, the majority of the vegetation in the backwater behind the Upper Diversion Weir, known as Upstream Upper Diversion Emergent (UUDE) was removed (Figure 32). The vegetation had collected a substantial amount of sediment and trash and had begun to alter the flow path of the Wash. The revegetation site was reduced from 3.65 to 1.04 acres. By 2018, nearly three-quarters of an acre had reestablished in the backwater, and the site is now at 1.76 acres (Figure 33). Based on the species-specific data, it appears that the main contributor to the growth is southern cattail, which increased from 50-75% cover to 75-100%. The number of species also increased, from 12 in 2016 to 21 in 2018, which is the highest since 2011. Perhaps the disturbance from the sediment removal allowed for additional species to establish on the site. Another option is that many species were difficult to detect with the expansive growth of southern cattails in years past and the newly cleared area allowed for detection of species that were always present. This is

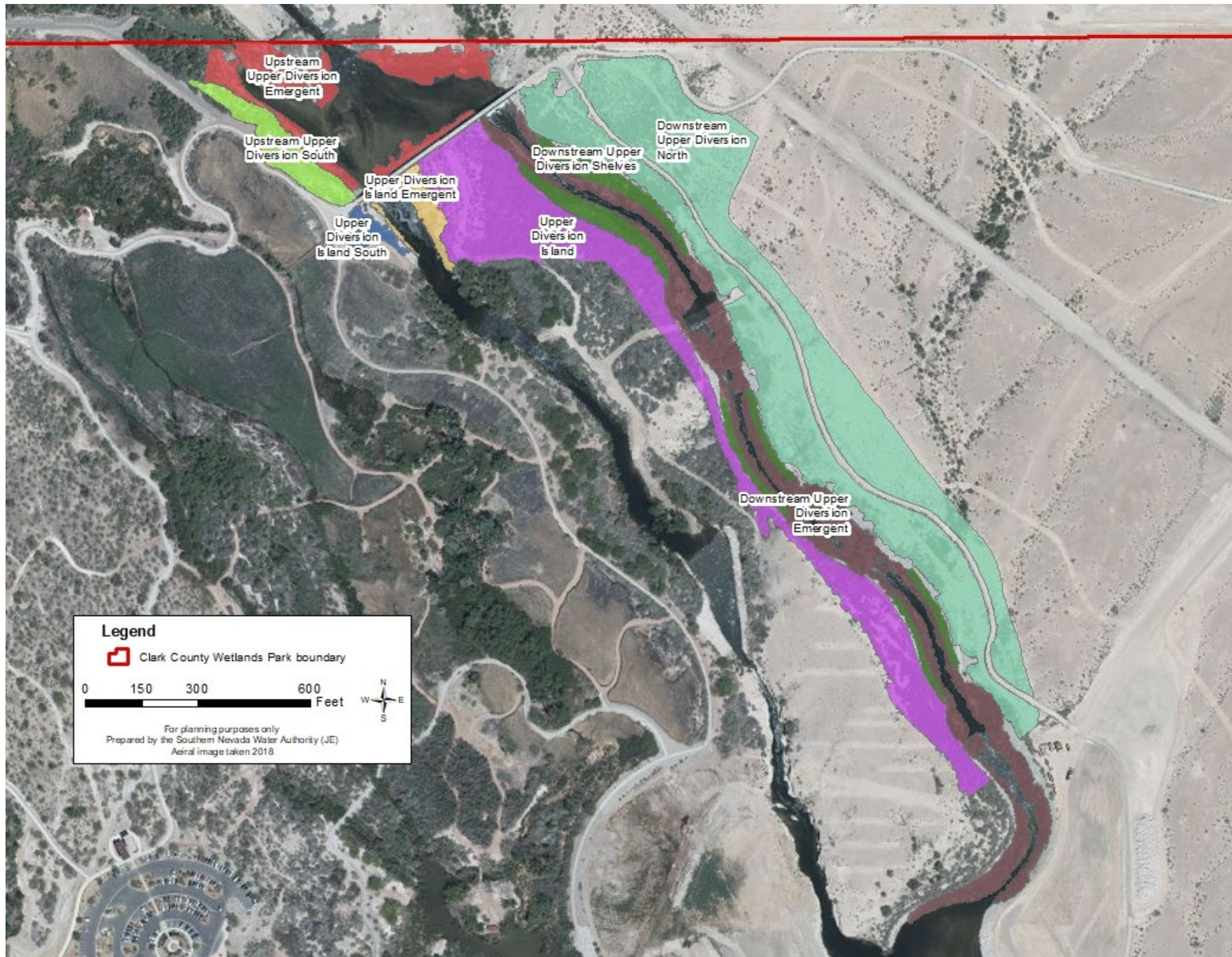


Figure 32. Aerial photograph of 2018 delineated Upper Diversion Weir revegetation sites.



**Figure 33. A substantial amount of vegetation had regrown at the Upstream Upper Diversion Emergent revegetation site in 2018 after being removed in 2017.**

likely since only three of the 21 species were not detected at least once in the previous nine monitoring years. The new species were prostrate pigweed (*Amaranthus albus*), dodder (*Cuscuta denticulata*), and Spanish false fleabane (*Pulicaria paludosa*). Of these, only Spanish false fleabane is considered a riparian or wetland species. The others established on the banks where an access ramp was created for the 2017 vegetation removal.

#### **4.0 CONCLUSIONS**

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Measuring success for a revegetation program such as the one along the Wash can be done in a variety of ways. This is especially true in a program as comprehensive as the Wash program where the goals are multi-faceted. Beyond the establishment and growth of native plants, other goals include erosion control, water quality improvements, wildlife habitat, and recreation. The revegetation is a vital component of all of these goals. In general, success of the revegetation program is measured by increasing native plant cover up to a sustainable level, survivorship of planted plants, reduction of noxious weeds, and overall ecological health. Of the 134 total sites monitored, (S108, S111, and CCWRD are considered one site each), 96 (71.6%) had the same

cover as they did in 2016, 20 (14.9%) increased in cover, and 15 (11.2%) decreased in cover. The remaining 3 sites (2.2%) were first monitored in 2018. These sites were the spring 2018 Green-Up, TW1, at the Tropicana Weir; DPSUP-3, which was part of the fall 2017 Green-Up near the Pabco Weir; and DU1T, which was a tamarisk removal site in 2016 but was first monitored in 2018. ArcGIS was used to measure the total cover for 65 (48.5%) of the sites.

## 5.0 RECOMENDATIONS

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As with individual sites and even individual species, single year increases or declines are not of major concern to a large restoration project such as that occurring along the Wash. Annual monitoring for the vegetation provides many years of data to compare and contrast. As a result, there are only a few sites where declines in total plant cover are a concern. These include DUDN, which has just over 50% total cover and that cover is almost entirely one species, fourwing saltbush. This needs to be closely watched to ensure this species continues to do well on the site or additional plantings will be needed to make sure the site is successful. In terms of noxious weed encroachment, eight of the 69 sites (11.6%) monitored in the field had over 5% noxious species cover. Of these only DMS-W had tall whitetop as the most prevalent noxious weed. Salt cedar was the most prevalent noxious weed on the seven other sites.

The final weirs had their construction completed in 2018. First was the Historic Lateral Weir expansion, which substantially increased the size of the Historic Lateral Weir and created new areas to revegetate on both the north and south side of the Wash. The second and last weir to be completed was the Sunrise Mountain Weir located upstream of the Pabco Road Weir. This site has over 20 acres to be revegetated on both the north and south side banks. Major revegetation activities will begin on these sites in 2019 and continue for at least three years.

For the existing sites, a long-term management plan has been developed to address wildlife habitat improvements, additional planting needs, noxious weed removal, trash removal and more (Eckberg 2019b). This plan should be utilized as a guide for how the Wash revegetation program will be move forward after the initial plantings have concluded at the Historic Lateral and Sunrise Mountain Weirs. However, some steps laid out in the plan can be incorporated concurrently with these projects if time and funding are available.

## 6.0 LITERATURE CITED

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- Eckberg, J.R. and S.A. Shanahan. 2008. Las Vegas Wash Vegetation Monitoring Report, 2003-2007. Southern Nevada Water Authority, Las Vegas, NV 61p.
- Eckberg, J.R. and S.A. Shanahan. 2009. Las Vegas Wash Vegetation Monitoring Report, 2008. Southern Nevada Water Authority, Las Vegas, NV 41p.

- Eckberg, J.R. 2019a. Las Vegas Wash Vegetation Monitoring Report, 2017. Southern Nevada Water Authority, Las Vegas, NV. 53p.
- Eckberg, J.R. 2019b. Las Vegas Wash Long-Term Revegetation Management Plan. Southern Nevada Water Authority, Las Vegas, NV. 26p.
- LVWCC (Las Vegas Wash Coordination Committee). 2000. Las Vegas Wash Comprehensive Adaptive Management Plan. Las Vegas Wash Project Coordination Team, Southern Nevada Water Authority, Las Vegas, Nevada.
- Saltonstall, K., Lambert, A.M., Rice, N. 2016. What happens in Vegas, better stay in Vegas: *Phragmites australis* hybrids in the Las Vegas Wash. *Biological Invasions* 18:2463-2474.
- SNWA (Southern Nevada Water Authority). 2005. Las Vegas Wash Vegetation Monitoring Report, 2002-2003. Southern Nevada Water Authority, Las Vegas, NV. 23p.