



Las Vegas Wash Long-Term Revegetation Management Plan

November 2019



SOUTHERN NEVADA
WATER AUTHORITY®

Las Vegas Wash
Coordination
Committee



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**Las Vegas Wash Long-Term
Revegetation Management Plan**

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

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ABSTRACT

Long-term management of the revegetation along the Las Vegas Wash will be necessary to ensure success of the restoration program that began in 2000. This management will include continued removal of noxious weeds, either currently identified or new species as well as other undesirable species that impact revegetation sites negatively. Additionally, trash and other debris will need to be removed as needed, especially from wetland and riparian sites after storm events. Other ecological enhancements may be desired or needed to improve a specific revegetation site's ability to provide wildlife habitat, erosion control, water quality enhancement or other benefits. Activities to enhance sites could include additional plantings of native species, thinning of existing plants, or physical changes to the site. Finally, vegetation on and near erosion control structures will be an ongoing management activity to balance the functionality of the structures with the ecological improvement provided by wetlands in the Wash.

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Many people have helped to make monitoring of the Las Vegas Wash revegetation program a success and even more have contributed to the success of the revegetation and restoration program in general. I would like to thank my fellow staff members at SNWA as well as Keiba Crear, the manager overseeing the ecological restoration and monitoring programs along the Wash. I would also like to thank the members of the Las Vegas Wash Coordination Committee for the vision of a sustainable system along the Wash and efforts to ensure that these efforts are preserved.

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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.

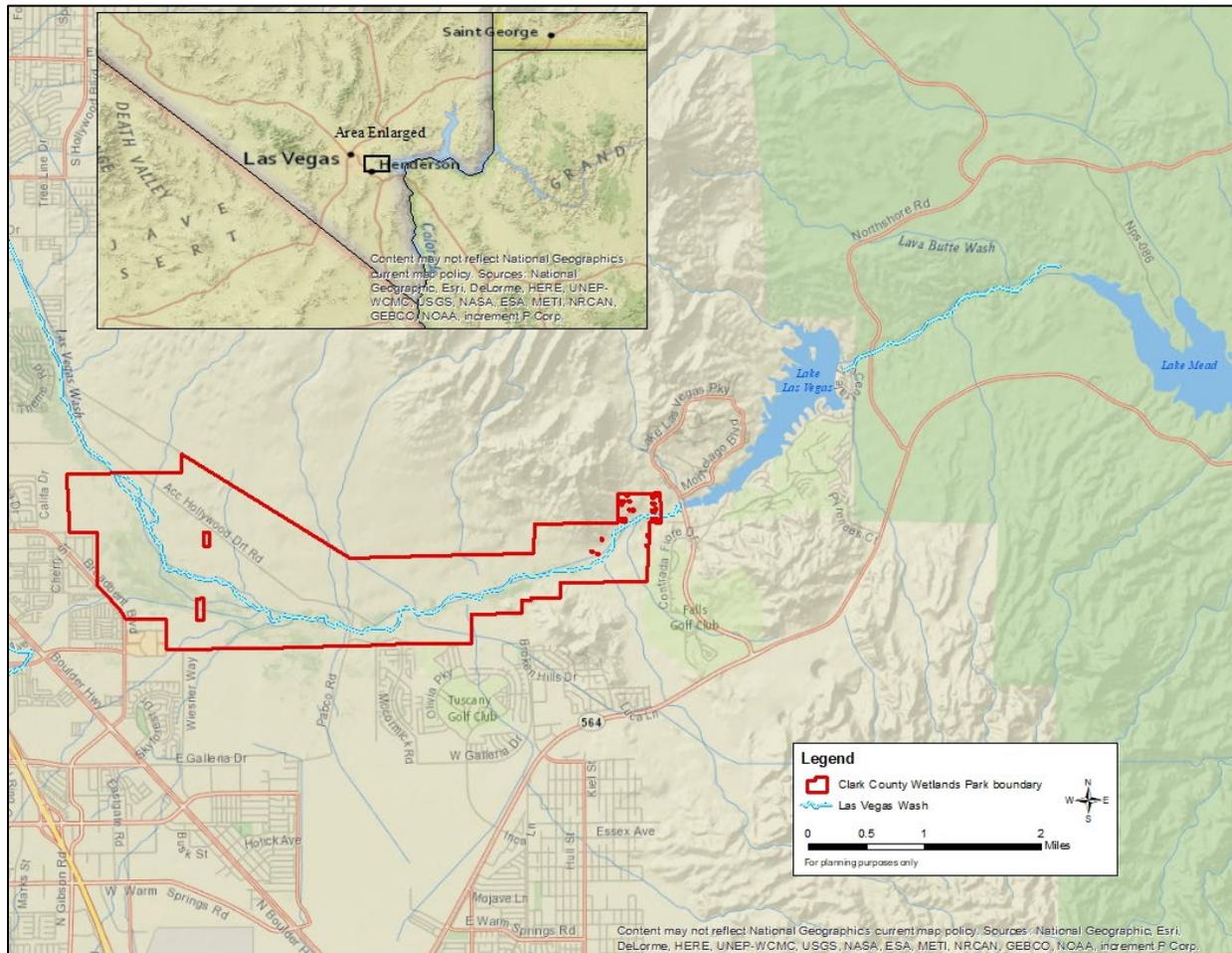


Figure 1. Las Vegas Wash location and general study area map.

A critical component of the overall plan to stabilize and enhance the Wash is the revegetation program. Erosion control is enhanced by plants by 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 (Figure 2). 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.



Figure 2. Salt cedar is a noxious weed that was once the dominant species along the Las Vegas Wash.

1.2 Need for Long-Term Management

Management activities will be required long after revegetation sites have been established to ensure the success of the restoration projects. Most revegetation projects typically require regular management to ensure the survival of desirable plants and removal of undesirable plants. The revegetation projects along the Wash have additional requirements due to its location. Specifically, Wash revegetation areas are within a public park, adjacent to roads and housing developments, in the main drainage channel for the Las Vegas Valley, and subject to regular disturbances.

Beyond regular activities that are certain to occur on a regular basis, such as weeding, pruning, herbivory control, etc. There are also activities that would need to be done following unforeseen impacts to revegetation areas along the Wash. One concern is fire which could occur naturally or

be human-caused. Intentional vandalism has not been an issue when related to plants in revegetation areas along the Wash in the past. There is however a substantial amount of vandalism to buildings and hardscapes adjacent to revegetation areas and planning should be done to address potential vegetation disturbance.

In addition, ecological enhancement activities are a component of the Las Vegas Wash Comprehensive Adaptive Management Plan (LVCAMP; LVWCC 2000) as well as the Las Vegas Wash Wildlife Management Plan (Shanahan et al 2008). These activities would go beyond the replacement of non-native and undesirable species with native species and specifically target wildlife habitat, water quality, soil stability, and other ecological improvements that could be achieved with additional revegetation.

For all these activities, there will be different methodologies used for management or mitigation of disturbances based on the existing plants. This includes whether the area is a wetland or non-wetland area, whether it is dominated by trees or shrubs, and what the natural recovery rate would be. Many plant-specific needs are laid out in the Clark County Wetlands Park Vegetation Maintenance Best Management Practices (Trathnigg et al 2010).

2.0 ANNUAL VEGETATION MONITORING

Annual monitoring of all Wash revegetation sites has been conducted since 2003 (SNWA 2005). This exercise is the means by which decisions of most management activities will be made. Most established sites are monitored in the field every other year with alternate years being monitored using ArcGIS to get measurements of total plant cover. This schedule may be extended to less frequent field monitoring if it is determined that substantive data is not being acquired given the effort put in to monitoring activities. The most recently published monitoring report at the writing of this document was from 2017 (Eckberg 2019).

ArcGIS will be able to provide data for large disturbances and changes to the sites that may need to be addressed. Field monitoring will be necessary to identify specific weed issues, trash accumulation, herbivore damage, and overall health of native plants. This field information, which is currently collected in the fall, will give the data needed to plan the subsequent year's management needs for revegetation sites. In addition, the specific plant information will be useful in developing long-term activities that could improve the ecology of sites such as wildlife habitat, water quality, soil erosion, etc. These could include additional plantings, weed removal, thinning of native plants, pruning for access, and more.

3.0 REGULAR LONG-TERM MANAGEMENT ACTIVITIES

3.1 Invasive and other undesirable species removal

The majority of Wash revegetation sites were dominated by invasive weeds or other undesirable vegetation prior to restoration activities removing them and replacing them with native species. These efforts have been considered successful in that all revegetation sites are currently dominated by a variety of native species. However, it was regular treatment of weeds that allowed the native species to successfully establish on most sites and continued treatment of these weeds would be needed for long-term success of the revegetation and ecosystem as a whole.

The most prevalent weed species along the Wash prior to the onset of restoration activities was salt cedar. This shrubby non-native tree has invaded many of the waterways of the western United States and has caused substantial ecological degradation. The removal of this species is time consuming and can be expensive. The Wash restoration project has successfully eradicated more than 90% of the salt cedar in the area. Initial removal has typically come from clearing for the construction of erosion control structures. Secondary removal has been an ongoing effort after native plants have been established in revegetation sites. Because there is regular surface water from the Wash, many areas with high groundwater tables, occasional stormwater flows, and initial irrigation water applied to revegetation sites, there is ample opportunity for salt cedar and other weeds to reestablish.

Other weeds that have been issues along the Wash since the inception of the revegetation program are tall whitetop (*Lepidium latifolium*) and giant reed (*Arundo donax*). Tall whitetop is widespread but large populations are not common. Eradication and control of this species have been successful in that currently only spot treatments are necessary to remove populations, and it appears that this species is having little negative impact on native species. Giant reed was thought to be completely eradicated from the Wash for many years until a single large stand was discovered during the construction of the Duck Creek Confluence Weir. Since that time, additional individual clusters have established on some of the weirs. Due to the current small population size, there is currently little concern of the impact of this species on native species. However, control of this weed must be continued for its impact to remain minimal.

Additional noxious weeds and non-native species have become as much of a concern as the three noxious weeds described above which were the early focus of weed control along the Wash (Bickmore 2003). One state-listed noxious weed, johnsongrass (*Sorghum halepense*), has become common in riparian areas and fills in bare space very quickly, preventing the establishment of native species. While bassia (*Bassia hyssopifolia*) and common reed (*Phragmites australis*) are not on the state list of noxious weeds, these species are widespread and difficult to control. Regular treatment is necessary to ensure the success of native species plantings. Other non-native species occurring in revegetation sites more often than should be controlled when possible and given special attention to determine if their impact to revegetation efforts are significant include chaste tree (*Vitex agnus-castus*), Russian thistle (*Salsola tragus*), and cocklebur (*Xanthium strumarium*).

One native species that is an important component of the revegetation program in certain areas is a nuisance in others. Quailbush (*Atriplex lentiformis*) is important for wildlife habitat and can establish quickly on disturbed soils. However, it is also able to grow so large and quickly that it outcompetes other native species resulting in a monoculture which ends up being a detriment to the overall ecological enhancement goals. In addition, the rapidly growing individuals often die off leaving dead branches. Therefore, there are certain situations where quailbush must be thinned or removed entirely.

Both mechanical and chemical means are used to remove weeds from revegetation sites. The method used will be determined using a combination of the species being treated, the infestation amount, and the speed in which the project needs to be completed. It is also understood that complete eradication of most species is an unfeasible goal. Therefore, cost of treatment will always

be considered with weed control, and most revegetation sites can be healthy functioning ecosystems while containing individuals of invasive weeds and other undesirable species.

3.1.1 Vegetation removal to protect erosion control structures

A specific scenario of undesirable species is when vegetation, in particular woody species, establish on erosion control structures and grow to a density where they alter water flows or physically move rocks on the structure. In particular, two species are of concern on the weirs: Fremont's cottonwood (*Populus fremontii*) and Goodding's willow (*Salix gooddingii*). Hand crews can be used to remove individuals of these species while they have a trunk of less than one-foot inch diameter. Limitations on a hand crew's ability to remove trees may also come as a result their location and if they can safely be reached.

If hand crews are not able to reach the trees, or if the trees grow larger than hand tools are able to remove, large equipment will be needed from specialized contractors and agencies. Past removal efforts of this size were done by large construction companies, such as those that built many of the weir's or the Bureau of Reclamation. Removal by hand crews are the preferred method. The large equipment method results in larger disturbance to surrounding vegetation, is more expensive, and typically results in weir repairs being needed, which can bring additional cost.

An assessment of the Wash's facilities was recently completed by Louis Berger under a contract with SNWA (Louis Berger 2019). This report describes the areas that vegetation is causing water to flow at high enough velocities to create sheer on the weirs that displaces rock and prevents the weir from working correctly and potentially causes damage to the weir. All vegetation located on weirs themselves is included in this group of vegetation that may harm weirs. In addition, bank vegetation in certain areas that extend far enough into the channel may also create a similar problem and will need to be removed.

A schedule of vegetation removal from weirs will be developed to balance the wildlife needs of habitat created on the weirs and in the channel. This is primarily accomplished by clearing every other weir in a given year of maintenance. This allows wildlife species to find a new home nearby at the next weir if impacted by the clearing.

3.2 Trash removal

Three types of trash accumulate on revegetation sites throughout the Wash. First, park visitors may litter during their visit to Clark County Wetlands Park (Wetlands Park) intentionally or unintentionally. A second category of trash comes from homeless camps or small habitation sites built by people. These can be small or large and contain a variety of different materials. No long-term sites have been identified in recent years and most get abandoned during the year, either after weather events force people to move or police actions.

The third way trash gets into the Wash is much more prevalent, which is during storm events (Figure 3). Trash from throughout the Las Vegas Valley that gets washed into flood channels or other Wash tributaries eventually reaches the Wetlands Park and gets deposited throughout various areas. It is most prominent in riparian areas along the banks of the Wash, but after large storm events can reach far away from the water.

Litter is relatively easy to control. Most is near the trailheads and trails which are maintained by Clark County. Only a small amount has been identified in revegetation areas. This can be accomplished using contractors, crews from the Nevada Division of Forestry (NDF), or if larger accumulations occur than volunteer events could be coordinated. Active homeless camps are also dealt with by Clark County and law enforcement agencies to remove the persons living there and typically removal of larger items. Abandoned camps as well as the third trash source, deposits from storm events, needs to be a coordinated effort from Clark County and SNWA. Contractors, NDF, and volunteers will need to work continuously to manage this impact to plants and wildlife.

The Upper Diversion Weir, in particular, needs special attention when it comes to the large amount of trash that accumulates after storm events (Figure 3). Initially, trash accumulates in the backwater of the weir. But during larger, longer, or multiple storm events, the water and trash go over the weir and the trash is deposited downstream of the weir as well. Crews need to visit this weir after every storm event to quickly remove as much trash as possible. Additional cleaning will also need to be done throughout the year.



Figure 3. Trash regularly collects upstream of the Upper Diversion Weir after storm events.

3.3 Herbivore control

Herbivore control is needed in many areas to prevent plants from being eaten by different species of wildlife (Figure 4). Most herbivore control begins during the initial installation of revegetation. This currently consists of fencing to keep herbivores out of revegetated areas or fencing placed around individual plants. Long-term management activities will primarily involve the upkeep of fencing to continue to control herbivory and the removal of fencing that is determined to be no

longer necessary or inhibiting plant growth. Less often, herbivore control may need to be installed on sites not previously affected or thought to have need for fencing.



Figure 4. Beaver damage to a cottonwood tree not protected by fencing.

4.0 ECOLOGICAL ENHANCEMENT ACTIVITIES

The Las Vegas Wash Wildlife Management Plan (Shanahan et al. 2008) laid out seven recommended actions for habitat protection and enhancement. They are as follows:

1. Maximize the type and distribution of aquatic habitats including pools, riffles, runs, and mudflats.
2. Continue working to prevent unauthorized OHV usage in the management area with particular emphasis on protecting more vulnerable habitats.
3. Continue to implement a comprehensive invasive plant management program. This program should address the prevention of exotic plant invasions by monitoring for new species and eradicating them early on. Where feasible, existing areas of infestation should be removed and replaced with functionally equivalent or superior native species. No net loss policies for functional habitat types should be pursued.
4. Continue to implement a comprehensive native plant revegetation and enhancement program focused on planting native species in areas that have been disturbed by anthropogenic activities. Planting size, density, structure, and floristics should: complement historical vegetation types, adjacent native plant communities, and regional reference sites; incorporate specific parameters known to be important to the Wash's native wildlife; and consider substrate and hydrologic conditions.

5. Conserve and incorporate remnant native plant communities into revegetation efforts where possible.
6. Sustain natural processes important to the maintenance and propagation of native habitats.
7. Continue to monitor the effectiveness of invasive plant removal and native plant revegetation at enhancing wildlife habitats by evaluating changes in the abundance and diversity of the wildlife using those habitats. If large declines in abundance and richness are observed, limit invasive plant removal until successful or functional replacement habitat is available.

Of these recommended actions, 2 is out of the scope of the revegetation program and this long-term management plan. Numbers 3 and 6 are addressed above under section 3.1. This leaves recommended actions numbers 1, 4, 5, and 7 that can be addressed under the long-term management plan of the Wash's revegetation program.

The action of maximizing the type and distribution of aquatic habitats, including pools, riffles, runs, and mudflats has been shared by the weir construction and revegetation programs, with the former incorporating such considerations into weir design and the latter leaving extensive aquatic area unplanted to allow for these habitats. Now, moving into long-term management, the Wash Team will investigate whether any vegetation or other substrate needs to be removed or cleared to recreate them.

Actions 4 and 5 are closely tied enough to be addressed as one under this plan. The expectation is that this plan will be implemented at the end of revegetation that takes place as part of the Las Vegas Wash Capital Improvements Plan (SNWA 2018) which covers the revegetation that takes place as part of the construction of the weirs throughout the Wash. The final two weirs were constructed in 2018 and revegetation efforts for these projects will begin in 2019.

Once the revegetation associated with weir construction concludes, there will be ample opportunity to improve habitat throughout the Wash. Once concluded, there will be over 600 acres of revegetation along the channel. Most revegetation sites are successful installations of native plants and have very few invasive weeds encroaching on them. However, improvements can be made to many sites to enhance wildlife habitat. Specific improvements can be made by installing plants that are known to be habitat for individual species or groups of species. In addition, more general improvements can be made by installing plants of varying density, structure, and floristics. A diversity of plant types and structures will invite a diversity of wildlife to inhabit the Wash.

Regarding action 7, the manager of revegetation programs will regularly confer with biologists conducting wildlife monitoring surveys and experts in habitat needs of Wash wildlife to determine if specific actions can be implemented to address declines, if found.

5.0 SITE SPECIFIC MANAGEMENT ACTIVITIES

5.1 Upper Diversion Weir and East Diversion Channel

The biggest management issue at the Upper Diversion Weir is the trash accumulation upstream of the weir/bridge in the backwater. Being the uppermost structure along the Wash, all the trash that gets deposited in the washes throughout the valley gets caught up here. This has largely been taken

care of by removal of vegetation in the backwater. When trash would accumulate in the stands of vegetation that had formed there, it was difficult and dangerous to retrieve. Now the trash is mainly along the weir/bridge, which can be removed much easier. This will continue to be cleaned up regularly, particularly after valley storm events.

Vegetation removal will continue in the backwater behind the weir/bridge. There is also a substantial amount of vegetation including large woody trees that have established on the weirs in the East Diversion Channel. These will likely require regular management to ensure future functionality of the structures.

With the backwater of the weir/bridge to stay clear of vegetation, the remaining areas suitable for wetlands and riparian habitat area are densely vegetated and diverse in species and structure. There are improvements that could be done to the upland habitats. Two revegetation sites were planted as part of a Wash Green-Up in 2008, Downstream Upper Diversion North and Upper Diversion Island (Figure 5). These sites are both successful and densely vegetated. However, both sites are dominated by saltbush. Some mesquite trees were planted and are still present but have not put on much growth. It is recommended that a few hundred cat-claw acacias, which are more drought tolerant than mesquite, be planted throughout the area to diversify the habitat for wildlife use.

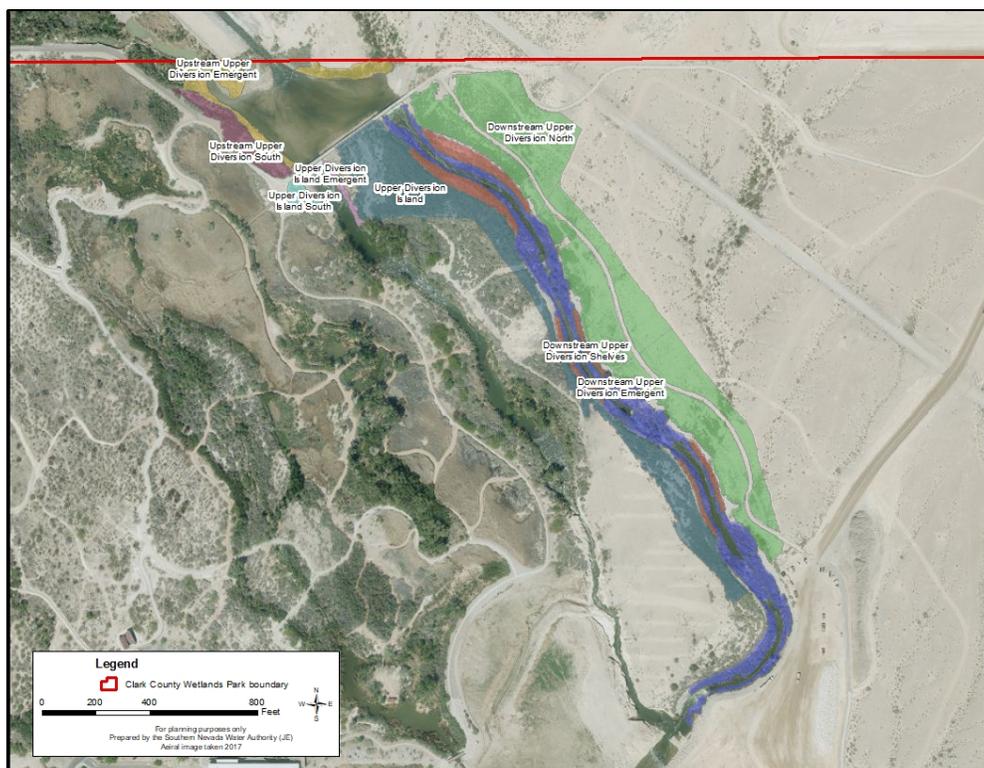


Figure 5. Revegetation sites associated with the Upper Diversion Weir and East Diversion Channel.

5.2 Monson and Visitor Center Weirs

Being just downstream of the Upper Diversion Weir and bridge, these areas do get some trash that is able to pass over or through that structure during storm events. This has typically occurred in relatively small amounts in the past and is not seen as a large management need. The largest management activity at this time is the removal of salt cedar from the banks. The eastern bank,

now an island between the Wash and the East Diversion Channel (Figure 6), has a large amount of salt cedar. The western side has been more controlled since it is primarily maintained by Clark County and its contractors. The eastern bank is more difficult to access. The Visitor Center Weir was reconstructed and expanded, which also removed some salt cedar, and that project improved the accessibility of the site. These trees should be removed to reduce their potential to spread into downstream sites.

Currently there is good diversity of plant species and structures at these sites. Additional plantings may be appropriate in areas where salt cedar is removed. These would be along the banks, making willows a good choice for most locations.

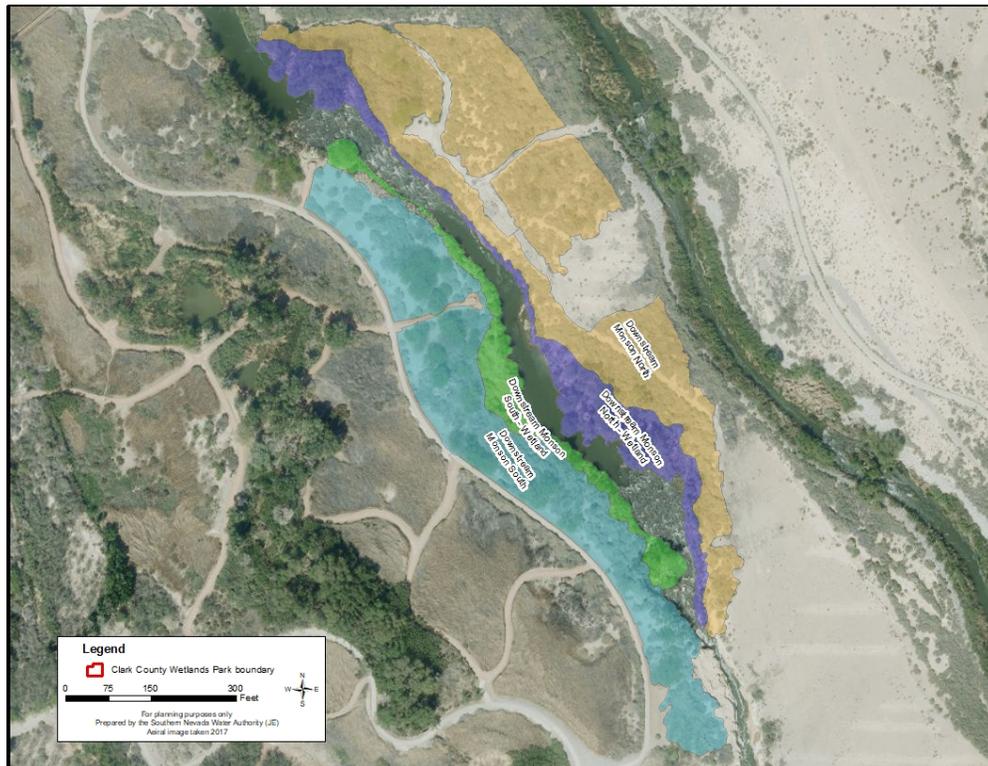


Figure 6. Revegetation areas associated with the Monson and Visitor Center Weirs.

5.3 Tropicana Weir

The Tropicana Weir was the second to last project along the Wash and therefore has less known long-term management needs than other weirs (Figure 7). The western areas were a monoculture of common reed prior to the start of weir construction and subsequent revegetation efforts. There may be a need for a regular removal of reed to continue to allow space for native plants to grow in the area. The western revegetation areas are adjacent to the Nature Preserve and will have more visitation than many of the other projects. This may result in more frequent and long-term trash removal activities to ensure that the site remains clear of trash and vegetation is allowed to grow into suitable wildlife habitat.

5.4 DU Wetlands No. 2 Weir

The upland area on the south side of the DU Wetlands No. 2 Weir has a large amount of bassia on it that needs to be removed and replaced with native plants. In some areas, if the bassia is properly removed, native plants will be able to fill in. If the stands of the weed are large, then additional planting may be necessary to ensure that this or other weeds do not fill back in the space. This weir was covered in vegetation for many years until removed in early 2019. Previously, the vegetation established quickly here. Annual monitoring will be done to determine the rate of establishment in the future and when removal operations will need to be done.

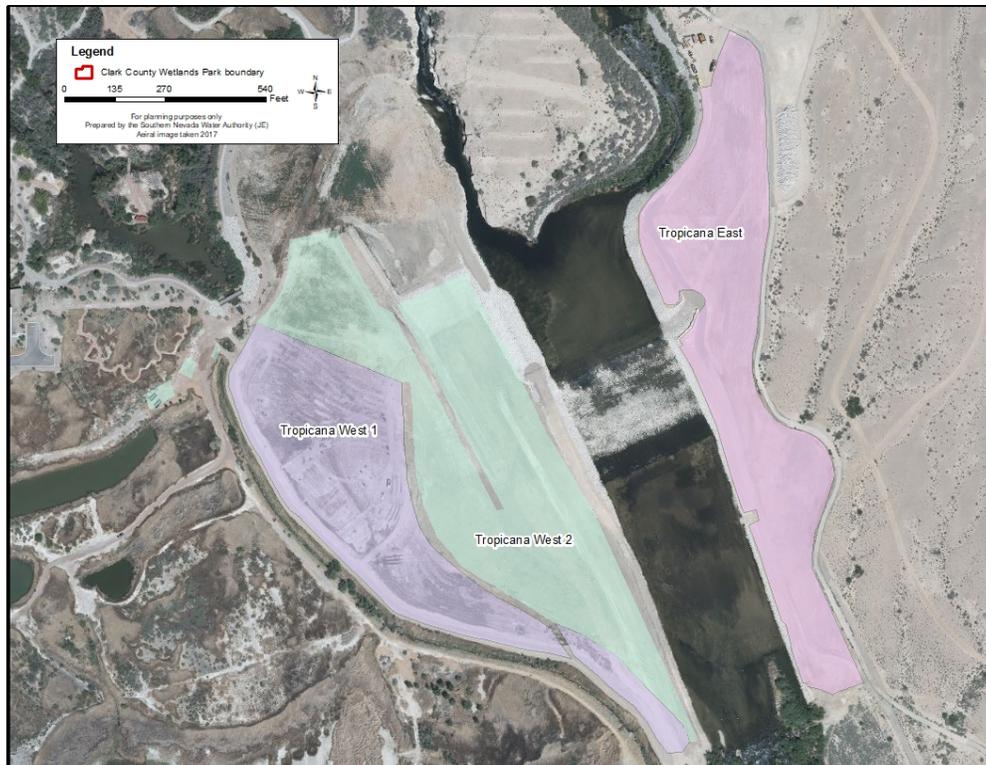


Figure 7. Revegetation areas associated with the Tropicana Weir.

The wetland and riparian areas along the banks at this weir are diverse in terms of numbers of species and plant types including trees, emergents, forbs, and grasses. The two upland revegetation sites are also doing very well in terms of providing potential wildlife habitat, having a diversity of plants. The one potential ecological enhancement project will be when bassia and other weeds are removed, primarily from the southern site. Besides bassia, the site is dominated by honey mesquite and four-wing saltbush. It is recommended that grasses such as alkali sacaton be used to fill in the spaces left by weed removal.

5.5 DU Wetlands No. 1 Weir

The only known management issue at the DU Wetlands No. 1 Weir is trees that have established on the weir. These were also removed in early 2019. There were not as many as at DU Wetlands No. 2 Weir, but they will need to be removed in the future as well. Both the wetland and upland revegetation sites at this weir are doing very well. Planted in 2013, there is a diversity of plant species and structures in both areas. There is also a large population of bassia on the southern non-

wetland site measured at 5-25% in 2017. This needs to be removed, but bassia distribution on this site is less concentrated in one area and additional plantings should not be necessary.

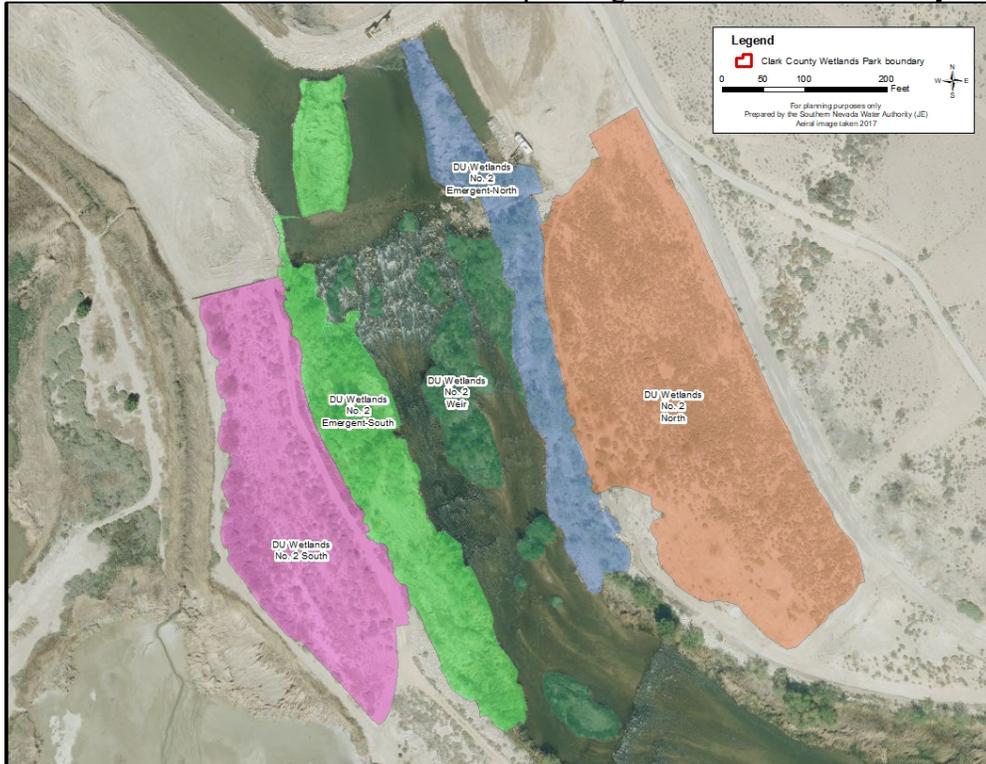


Figure 8. Revegetation areas associated with the DU Wetlands No. 2 Weir.

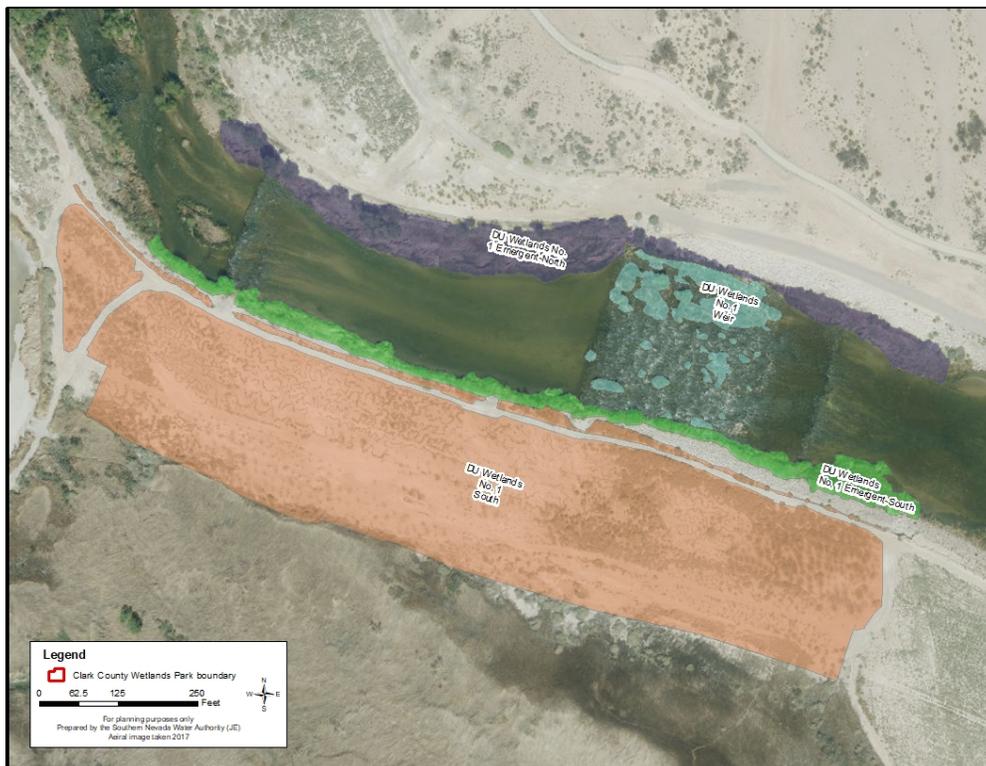


Figure 9. Revegetation areas associated with the DU Wetlands No. 1 Weir.

5.6 Archery and Silver Bowl Weirs

Like most weirs, these also had trees that established on them that were removed in 2019. Vegetation is expected to reestablish, although the species may differ, and the frequency of removal may change based on the impact to the structure. The two large sites on the south side of these weirs were planted as Wash Green-Ups in 2015 and have very few weeds that have established on them. The site on the north side is narrow but long, about 3,500 feet. This site was has many weeds including Russian thistle and bassia that need removal.

The two south side upland areas had a variety of species planted on them in 2015, but the desert saltbush, which was hydroseeded on the site, is by far the dominant species. Areas should be explored to incorporate trees such as mesquites and cat-claw acacia. Additional shrub types could also be incorporated if suitable areas are identified.



Figure 10. Revegetation areas associated with the Archery and Silver Bowl Weirs.

5.7 Duck Creek Confluence and Upper Narrows Weirs

There are trees that have established on both of these weirs, which will require removal. Weeds have not been an issue on any sites at these weirs yet. Some of the sites on the south side have had some bassia begin to establish there, which needs to be removed in order to prevent it becoming a larger issue. The Duck Creek Upper Narrows South 1 revegetation site is located at the end of the Burns Street drainage which comes from the City of Henderson. This results in trash, weeds, and other debris accumulating here that will need to be removed. In addition, this site is near an unofficial entrance to the Wetlands Park that many people use to bring in trash and landscape debris to illegally dump. The Wetlands Park is working on solving the entrance issue, but in the meantime, additional clean-up activities may be necessary.



Figure 12. Areas surrounding the Sunrise Mountain Weir will be revegetated in upcoming years.

which needs to have vegetation regularly cleared to keep it working properly. The Wetlands Park has a trailhead near the weir and this increased visitation. This results in a minor increase in trash nearby, but to date, this has been minimal. Greater amounts of trash come during storm events and get caught in vegetation downstream of the weir. This has not been addressed to the level needed in the past and should be a higher priority in the long-term management program. Ecologically, most of the Pabco Road Weir sites are also doing very well. Sites have a wide diversity in plant species and structure. There is also a wide variety of wildlife found in these areas, perhaps due to the age of the plants. There are specific activities that could be done to potentially improve the habitat for bird species. Downstream Pabco South and Upstream Pabco North have large stands of Fremont’s cottonwoods and Goodding’s willows which have been known to host migrating willow flycatchers. Improvements in hydrology and understory may improve the habitat for these species on the site. Further examination of these sites needs to be done. One idea is to dig trenches or channels from the Wash into the interior of the site. Another is to dig ponds or pools within the center of the site down to the water table to expose it as surface water under the canopy of the large trees. Planting of a greater density of smaller shrubs, such as sandbar willow (*Salix exigua*) or similar species, is also needed.

5.10 Historic Lateral Weir

The Historic Lateral Weir has the second oldest vegetation along the Wash, but it also has some younger sites, as well as new areas that were created with the expansion of the weir that have yet to be planted. These areas do not have the trash and debris problems that the Pabco Road Weir has despite being just downstream. In addition, weeds have not been identified in large numbers at any

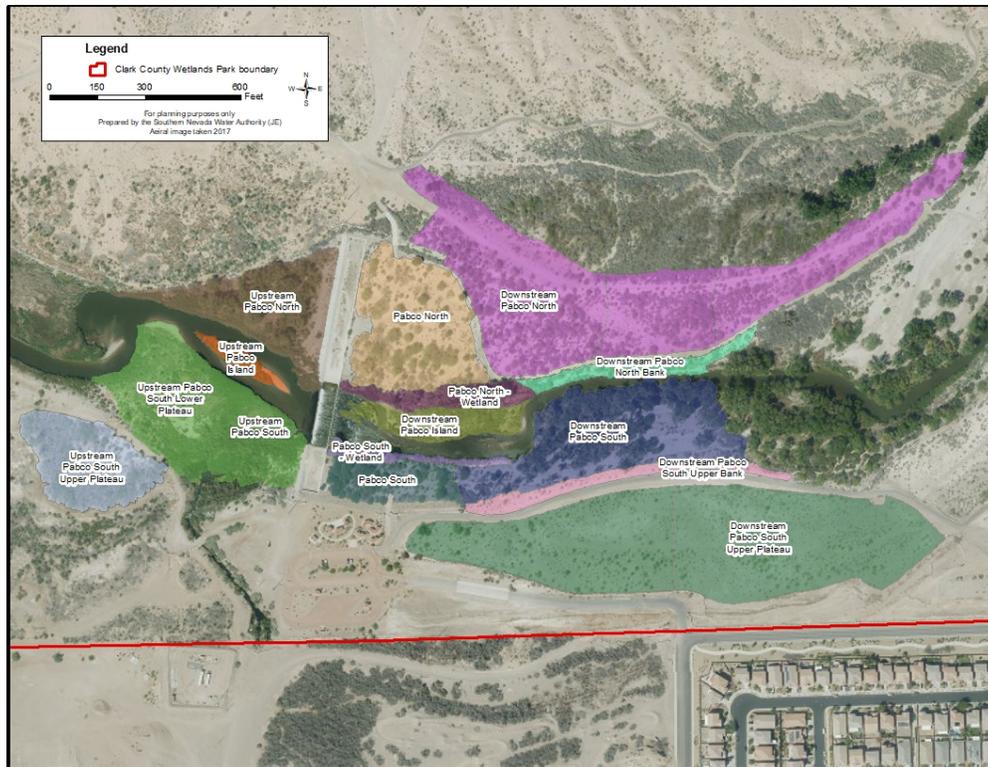


Figure 13. Revegetation areas associated with the Pabco Road Weir.

of the sites in recent years. Future monitoring will determine if this is a high management need later.

A large expansion of the weir was completed in 2018. Most of the major revegetation activities associated with this will take place in 2019 and 2020. There will be regular management activities at these sites for a few years after planting.

Four revegetation sites have mature riparian trees like those at Pabco and could potentially benefit from changes in understory and hydrology to make them more attractive to birds for nesting. These sites are Upstream Historic Lateral North – Non-wetland, Upstream Historic Lateral North – Wetland, Upstream Historic Lateral North South, and Upstream Historic Lateral South Bank – Wetland. It is proposed that channels or ponds be created by clearing gravel on the two sites on the north bank of the Wash. The sites on the south have more soil and digging down to the groundwater to create pools or mudflats may be feasible. Where these water areas are created, understory plants can be planted in amounts not expected to draw down the surface water created.

5.11 Bostick Weir

The Bostick Weir is the largest weir on the Wash and has a lot of revegetation surrounding it both in terms of size as well as habitat types. There have been numerous projects removing trees from the face of the weir, this activity will likely need to continue in the future. There are some salt cedar and other weeds found in the revegetation sites but no large amounts that require special attention. The large Bostick South Tamarisk revegetation site was planted in 2015 after removing about 12 acres of salt cedar. While this site does not currently have salt cedar in considerable

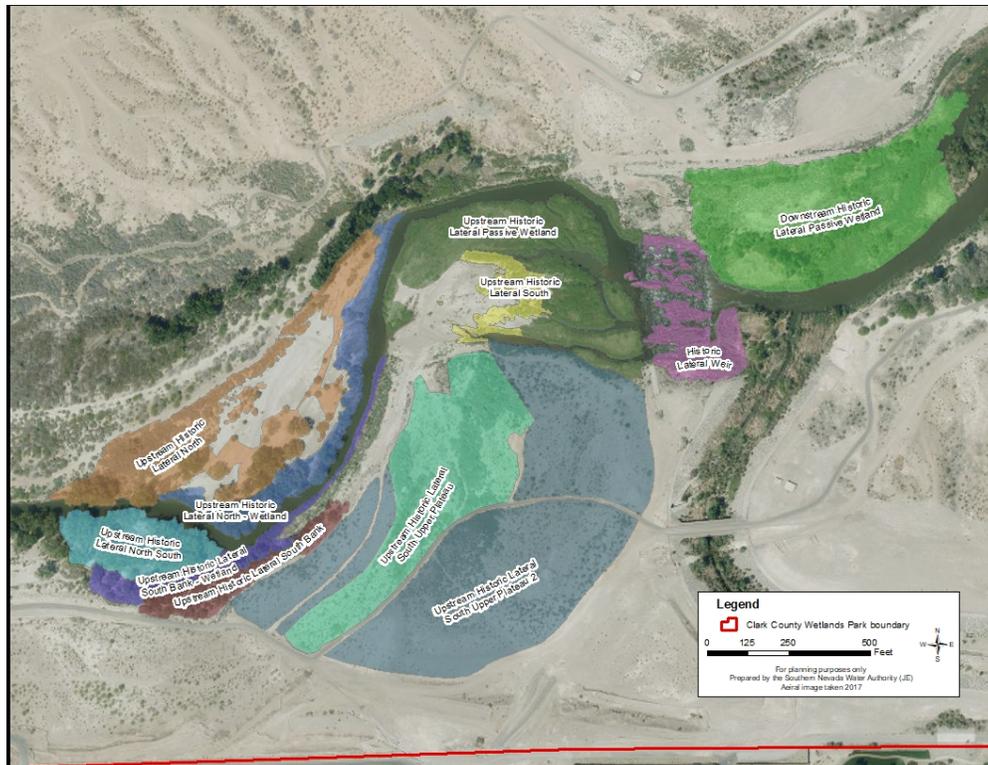


Figure 14. Revegetation areas associated with the Historic Lateral Weir.

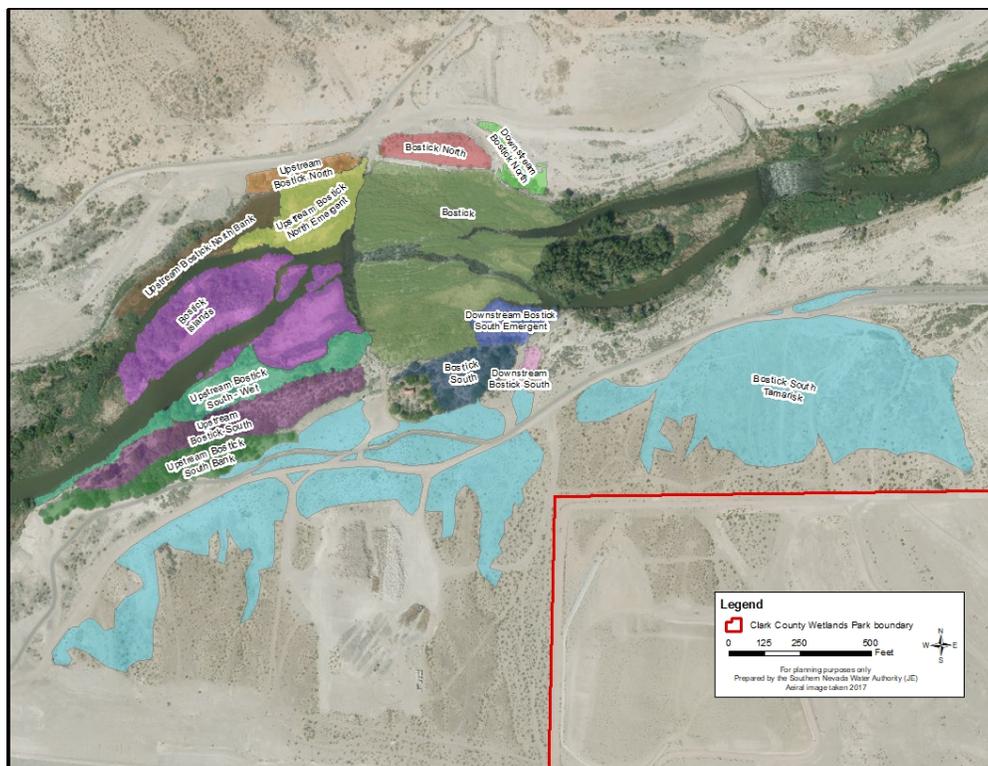


Figure 15. Revegetation areas associated with the Bostick Weir.

amounts, being that it was dominated by the invasive tree in the past suggests that careful monitoring should take place in the future to identify and treat resprouts before they get too abundant.

Most non-wetland areas are doing well at Bostick. The only site that could use some additional plants to improve diversity and potentially increase wildlife use is Downstream Bostick North. This site is high off the water table and very rocky, resulting in the mesquites and creosote planted there being very small despite being 14 growing seasons old. Supplemental planting should include very drought tolerant shrubs such as saltbush to compliment the plants already there.

The wetland sites at Bostick are also doing very well and have a diversity of plants. Improvements to the ecological function of these sites would include planting trees on sites that have expanded with cattails and reed upstream of the weir. These include portions of Bostick Islands, Upstream Bostick South – Wetland, Upstream Bostick North Emergent, and Upstream Bostick North Bank. This will likely require planting poles of riparian trees in the banks along the water's edge. Alternatively, paths can be cut through reed and cattails to access the center of these sites, and then holes can be dug or depth to water can be explored to see if poles can be planted directly.

The Bostick Kiosk is a unique revegetation site as it has a informational kiosk, benches, and small trails for park visitors to enjoy. This requires more plant management than most sites to ensure that the trails, entrance and views are clear. In addition, the painting on the kiosk itself was recently repainted for the first time. This will not be a frequent activity but will need to be examined every five years or so.

5.12 Calico Ridge Weir

The Calico Ridge Weir is a unique style of weir along the Wash being a two-stage weir. The areas of the weir along the banks have accumulated vegetation while the center of the channel has very few plants on it. The bank areas that have vegetation are primarily common reed and are proposed for removal during regular weir management activities. However, since this type of vegetation is flexible in flood events and would not cause overbanking, it is relatively low on the priority list of vegetation removal projects.

The island upstream of the Calico Ridge Weir, Upstream Calico Emergent (UCE), has grown substantially in the past several years. Initially, the island was dominated by Goodding's willow, which altered the flow of the Wash to the north and south of the island. It has extended downstream within a few feet of the weir mostly with cattails, common reed, and sandbar willow. As sediment has accumulated on the island, the willows on the upstream end have noticeably declined in health. The Louis Berger assessment (Louis Berger 2019) identified this area as a location where vegetation could be removed and bring sediment to water level. This will allow for the installation of new wetland plants that are more sustainable long term. By heavily planting the area with native bulrush and similar species, it is less likely to get heavy establishment from woody vegetation.

The non-wetland areas on the north side of the Wash, planted in 2005, appear to have high survivorship of the plants that were originally planted. However, there has been slow growth of those plants and very little self-establishment of any additional plants. There are a variety of plant

types there with creosote, saltbush, and honey mesquites present. They are concentrated in specific areas and have stunted growth, especially the mesquites. An in-depth survey of the soils will need to be done to determine appropriate plant types and locations of additional plantings needed to improve these sites.

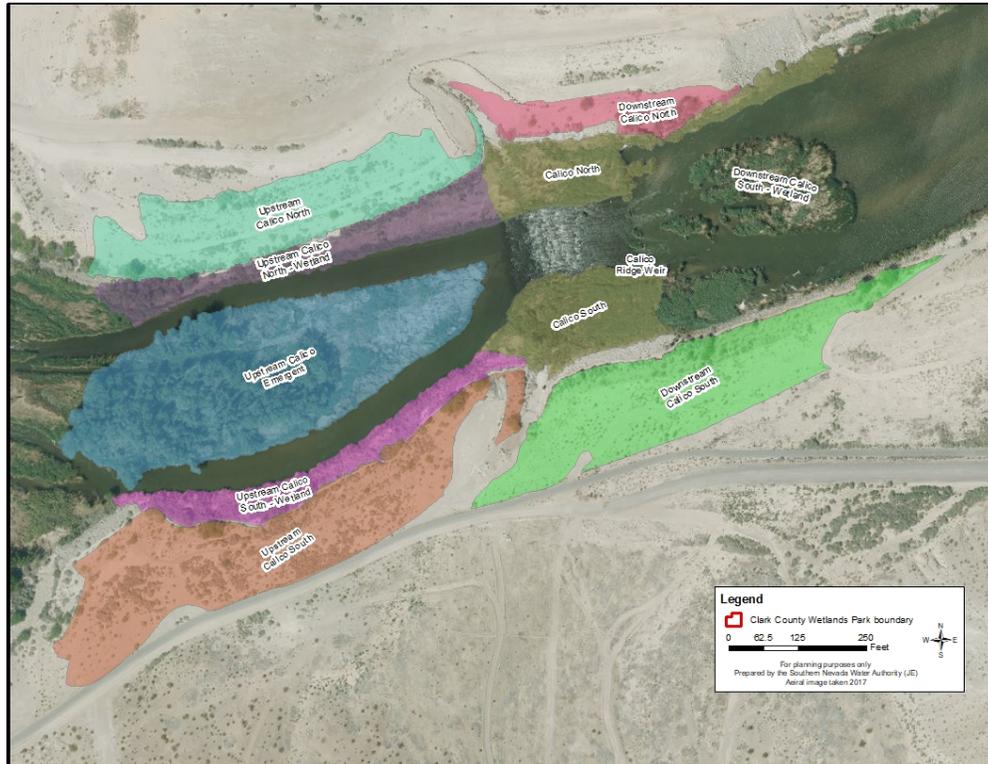


Figure 16. Revegetation areas associated with the Calico Ridge Weir.

5.13 Lower Narrows and Homestead Weirs

The Lower Narrows and Homestead Weirs were completed in 2011. Most of the revegetation activities took place that same year or in 2012. The weirs are almost completely covered in vegetation of all types and will need to be cleared to maintain functionality. Islands between these weirs and most vegetation on the banks, despite extending into the channel, do not pose a problem to their functionality.

The bank protection installed for these two weirs on the north and south side were covered with excess soil from the Three Kids Weir project just downstream. It was subsequently planted in 2015 with several types of vegetation. Since this area is both new and adjacent to the water, there is a higher likelihood of weed encroachment, and therefore it will likely need regular treatment until the native vegetation is much more mature.

The upland areas on both the north and south side of the Wash are dominated by saltbush species. These areas could be enhanced by additional plantings of trees such as cat-claw acacia. This would be more appropriate on the areas on the southern side of the Wash. The non-wetland areas on the north side of the Wash are much higher off the water and water table; it is unclear if trees even as xeric as cat-claw acacias would be successful there.

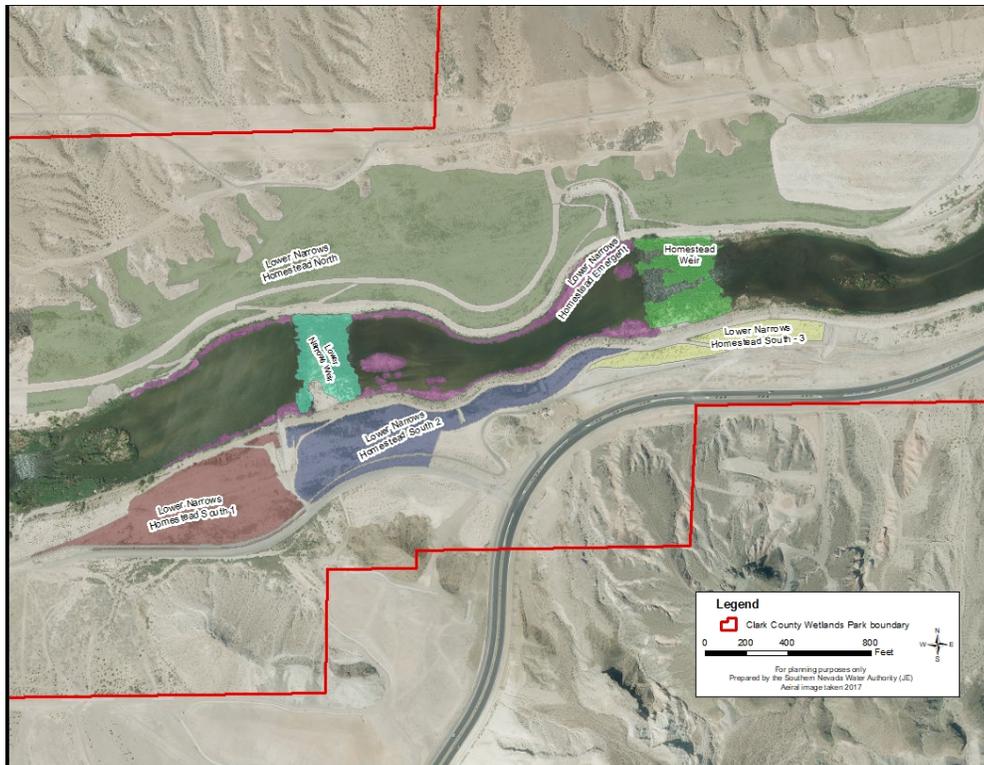


Figure 17. Revegetation areas associated with the Lower Narrows and Homestead Weirs.

5.14 Demonstration and Three Kids Weirs

The Demonstration Weir, as the name implies, was not intended to be a permanent structure although it remained in place for nearly two decades. One wetland and one non-wetland revegetation site were planted on the south side of the Wash in association with this weir. After many repairs the Demonstration Weir was essentially abandoned, and when the Three Kids Weir was completed in 2017, the backwater behind it submerged what was left. The revegetation sites remain, however. The wetland site is no longer connected to the water as a result of an access road being constructed adjacent to it. There are many trees that died or are in poor health and need to be removed and replaced with vegetation that is more suited to the new conditions.

An additional two revegetation sites were planted in 2017 as part of the Three Kids Weir. One is a wetland site dominated by riparian plants on the north side of the Wash just upstream of the weir. The other is a non-wetland site located on the south side of the Wash near the Wells Trailhead. Since both sites are very new, there are substantial amount of weeds encroaching on both sites, and removal will need to take place regularly until native plants are larger and fill up more space.

5.15 Rainbow Gardens Weir

Most of the revegetation sites at Rainbow Gardens were actively or passively created in 2005, the year the weir was completed. The exception is Upstream Rainbow North Bank, which was hydroseeded in 2010. The weir itself is a concrete structure and therefore vegetation does not grow on it. The vegetation in the channel upstream, however, has been managed in the past to allow flows to hit the weir directly instead of at an angle; this will continue in the future. The last major removal of vegetation from the channel left portions of vegetation along the banks dominated by common reed. Additional plantings of riparian trees, via pole plantings, should be done throughout

the south bank. The north bank has not been managed at all and consists entirely of plants that passively established. This includes salt cedar trees that should be removed and replaced with native riparian species. Additional pole planting and bulrush transplants can be planted along the entire northern bank as well.

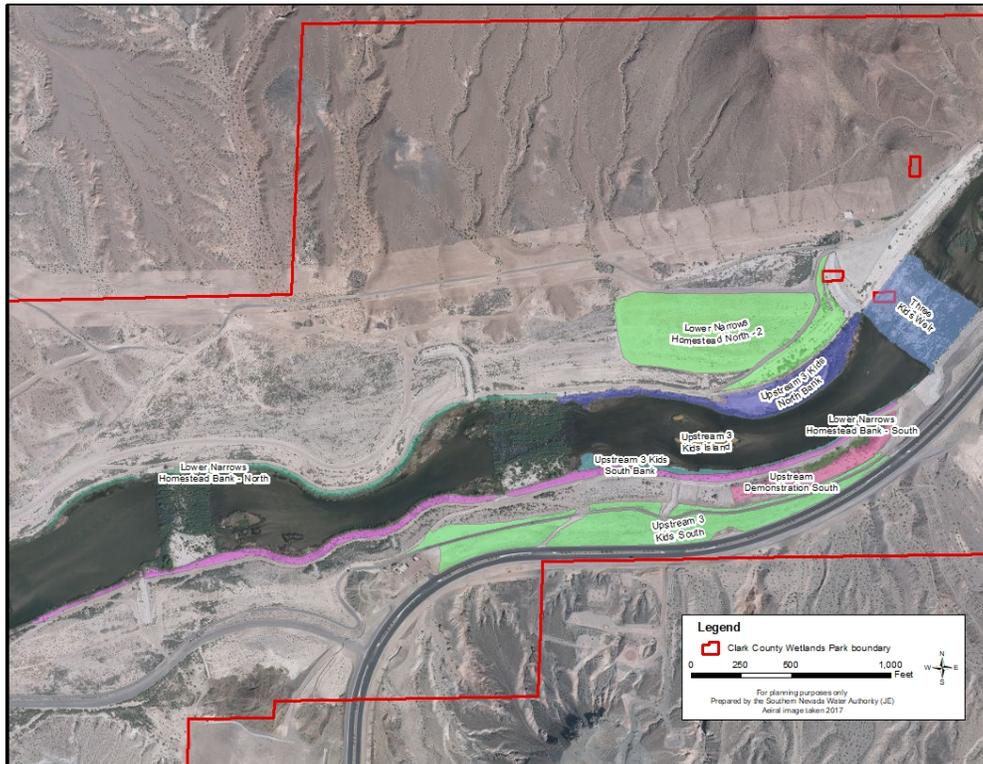


Figure 18. Revegetation areas associated with the Demonstration and Three Kids Weirs.

The one upland revegetation area on the south side, Upstream Rainbow Gardens South Plateau, should have additional plantings take place. Like many other upland revegetation sites, many of the planted plants are still present but have not grown much. This site primarily consists of creosote bush. A small number of cat-claw acacias could be planted as well as other shrubs to diversify the plant species there. In addition to creating better habitat, this area is now along the Galleria drive and is seen by hundreds of drivers a day. A more attractive area will be beneficial to recreationists using the park as well.

There is an area on the south bank with about one acre of salt cedar. This section of the bank is very unstable and currently would not be safe for workers to access to remove this stand of invasive trees. If plans develop in the future to reinforce this bank, the salt cedar could be removed otherwise, it will likely not be treated.

5.16 Powerline Crossing Weir

The Powerline Crossing Weir has had vegetation removed from the face in past years and this will likely be a recurring management activity to ensure the proper function of the structure.

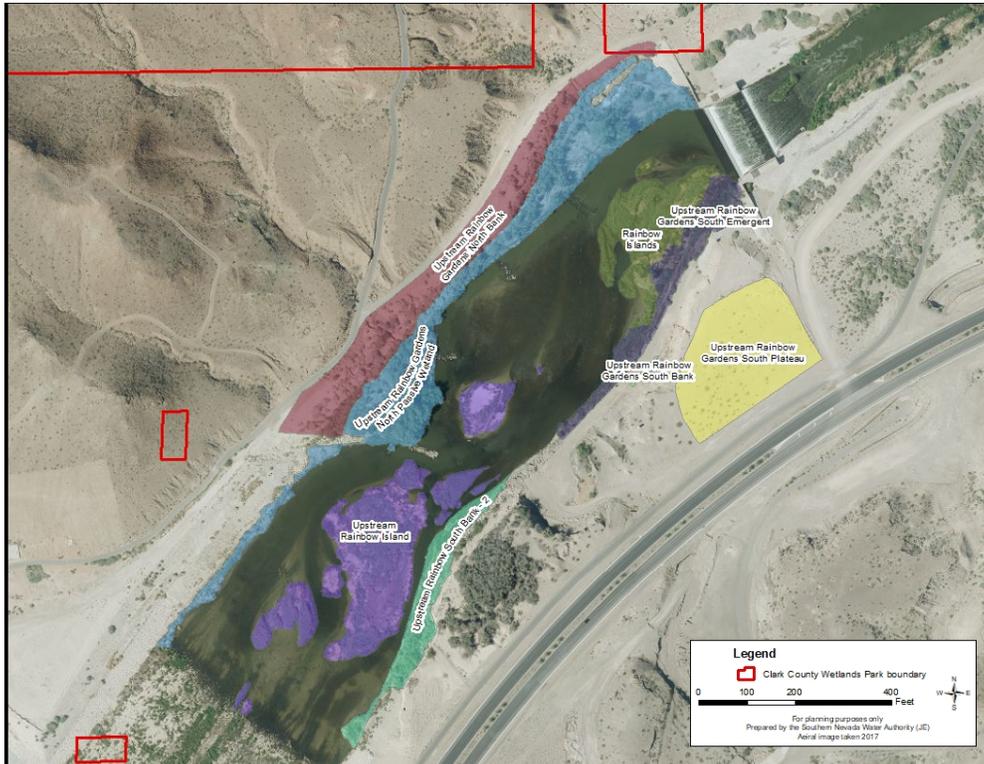


Figure 19. Revegetation areas associated with the Rainbow Gardens Weir.

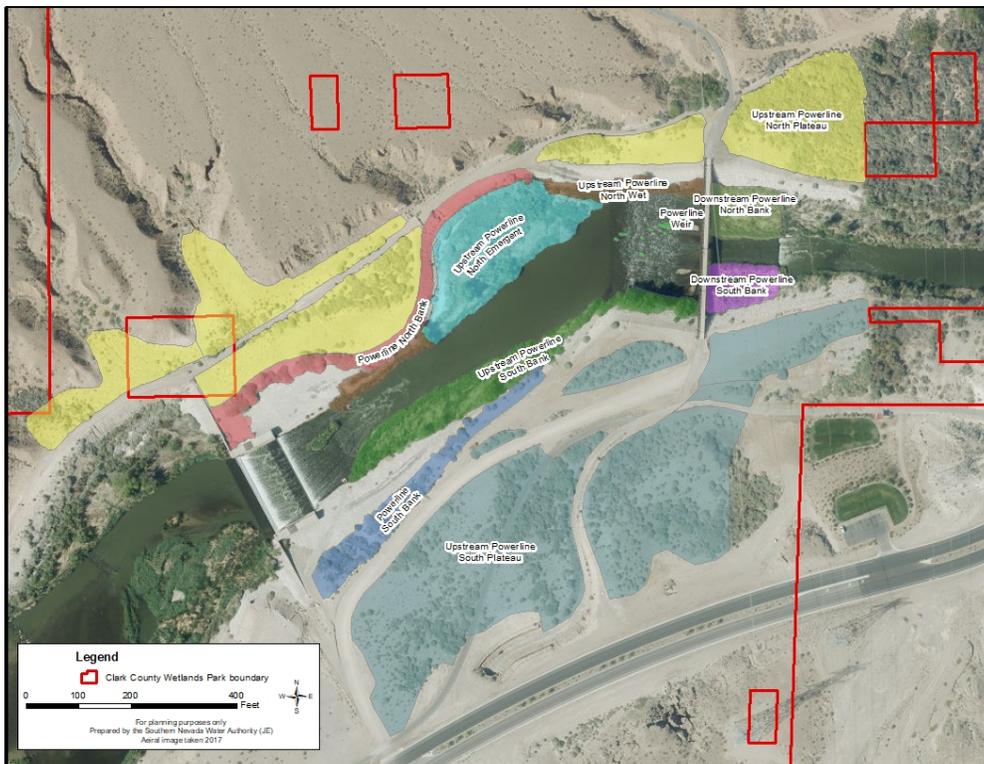


Figure 20. Revegetation areas associated with the Powerline Crossing Weir.

There are portions of non-wetland areas on both the north and south side of the weir that are bare or nearly devoid of vegetation. Substantial additional plantings could take place in these areas. The most successful plants at these sites have been saltbushes, so additional plantings should consist of other shrub species or trees to diversify the habitat.

The two areas adjacent to the weir downstream along the channel are unique areas in that they are mostly rock but have filled in with sediment and vegetation. Much of the vegetation is non-native including salt cedar. Treatment should take place regularly to keep these invasive plants from spreading into other areas. However, additional plantings are unlikely since the substrate is mostly rock.

5.17 Clark County Water Reclamation District

A 28-acre revegetation project on the Clark County Water Reclamation District property was completed in 2009. The site was very successful with fast growth of planted plants and self-establishment of other native plants. There has also been a lot of establishment from non-native plants including noxious weeds such as salt cedar and tall whitetop. This is the only current management need for the site. The site is upstream of all the other revegetation sites along the Wash and therefore controlling the weeds on this site should reduce efforts needed downstream.



Figure 21. The revegetation area located at the Clark County Water Reclamation District.

5.18 Site 108

This large site (just over 40 acres) was planted in 2006 and 2007. The plantings have done very well, and the species and types of plants are quite diverse. The only management need is salt cedar

removal. In the most recent vegetation monitoring, about 3% of the site was covered in salt cedar. Given the low percentage, it should be removed when most cost effective but is not a high priority.

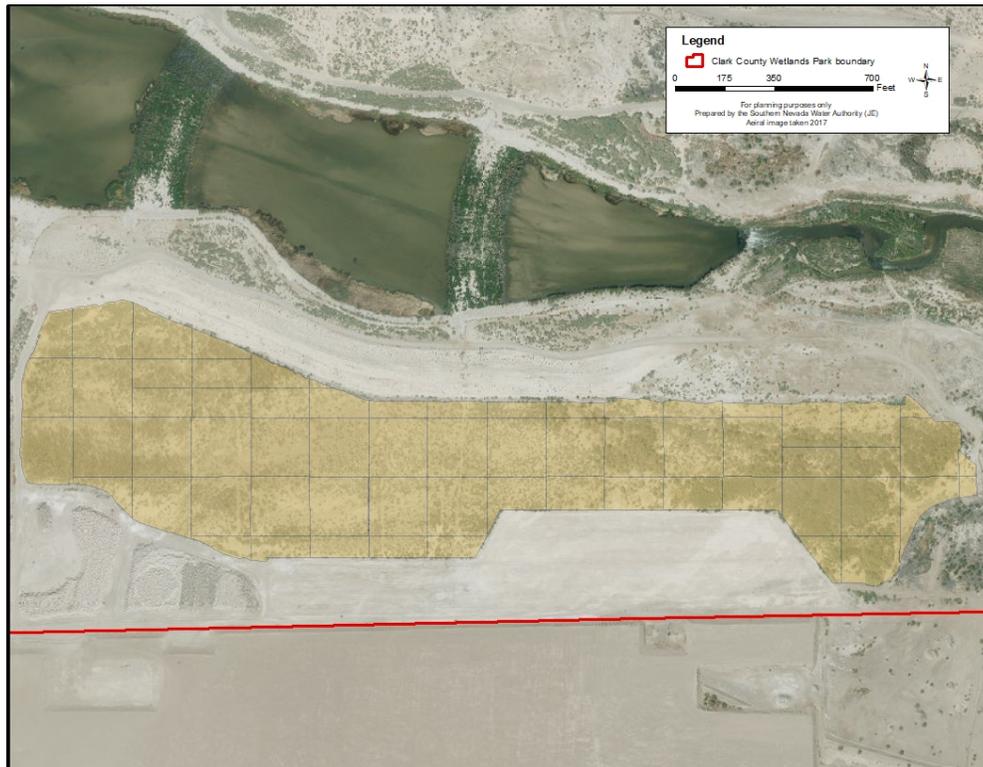


Figure 22. The Site 108 revegetation site.

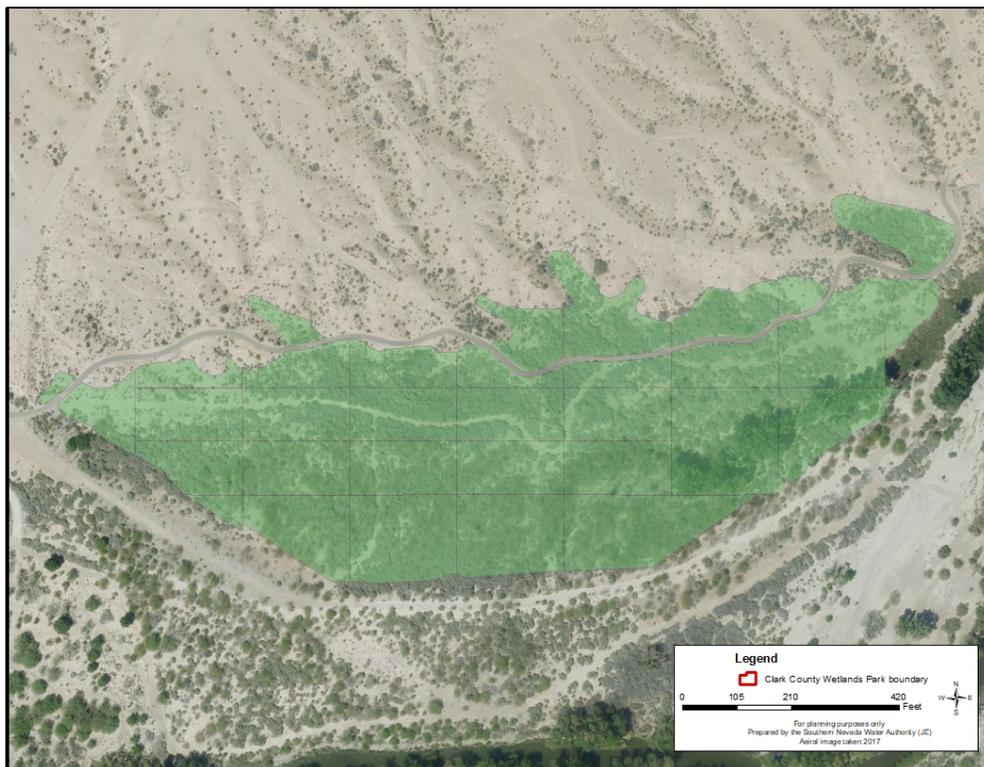


Figure 23. The Site 111 revegetation site.

5.19 Site 111

Another large revegetation site, Site 111 is just under 15 acres and was planted in 2007. Like Site 108, this site has been quite successful, and no additional plantings are warranted. In the most recent monitoring, just under 3% of the site was covered in salt cedar and this should be removed when most cost effective.

5.20 Cottonwood Cells

The area known as the cottonwood cells have been planted in various phases and consist of diverse habitat types. The original two cottonwood cells were established as nurseries for cottonwood pole collection for future restoration needs. It was rarely used for this purpose and the trees have grown substantially larger and denser than expected. The cottonwoods in Cottonwood Cell 1, planted in 2002, have been thinned naturally by beavers. Unfortunately, the void they left was primarily filled by johnsongrass, a state-listed noxious weed. While it has already been treated a few times, this may be a recurring management task, to keep it under control. Where these non-natives are removed, additional riparian plants should be planted. Specifically, understory plants to complement the large cottonwoods and Goodding's willows on the site. Cottonwood Cell 2 to the west, planted in 2005, has not had natural or mechanical thinning. The trees are likely to be healthier and the site can develop into a mature habitat if half or more of the cottonwoods are removed. After, like Cottonwood Cell 1, additional understory riparian plantings should take place to diversify and improve the habitat.

The second phase of plantings in this area took place in 2012. The areas planted at that time included additional riparian areas adjacent to the original cottonwood cells, as well as multiple

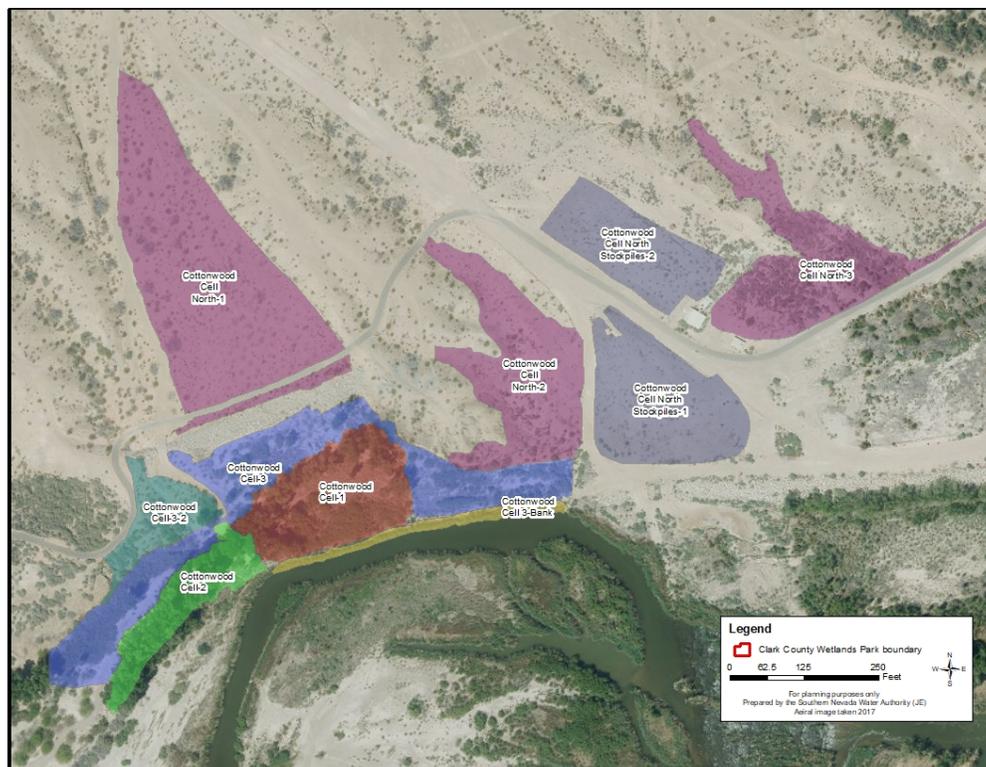


Figure 24. The Cottonwood Cell revegetation areas.

non-wetland areas. All these plantings did very well with survivorship and have limited weed encroachment. Some sizable portions of these sites were removed with the Historic Lateral Weir expansion project and will be planted again in the future.

6.0 CONCLUSIONS

The management needs and improvements to benefit wildlife at revegetation sites along the Wash are numerous and diverse. It is expected that it will take many years to accomplish the initial tasks laid out in this plan. However, by performing these activities in a directed manner and on a consistent basis site by site, the entire system will benefit. The activities laid out in this report are not expected to be the only ones needed to ensure long-term success of Wash revegetation sites in perpetuity. Being a natural system, new and unexpected challenges may arise in upcoming years. Once projects have been completed on each of the weir and non-weir areas, a reevaluation should be done to determine future management and ecological enhancement activities.

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