Powerline Crossing Weir Planting Plan

June 2007
Powerline Crossing Weir
Planting Plan

SOUTHERN NEVADA WATER AUTHORITY
Las Vegas Wash Project Coordination Team

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June 2007
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1.0 PURPOSE AND GOALS OF THE PLANTING PLAN

A variety of erosion control activities are currently being implemented along the Las Vegas Wash (Wash) as part of a comprehensive stabilization and ecological restoration strategy. These activities include the construction of weirs and bank stabilization structures. Because these structures are constructed within the boundaries of jurisdictional waters of the U.S., they are subject to regulatory compliance as outlined by the Clean Water Act. Erosion control structures that are constructed along the Wash are typically permitted under the nationwide permit program. Nationwide permits (NWPs) are a type of general permit issued by the U.S. Army Corps of Engineers (Corps) and are designed to regulate with little, if any, delay or paperwork certain activities having minimal impacts to jurisdictional waters of the U.S. Current stabilization activities in the Wash are permitted under NWP 27 (stream and wetland restoration activities) and NWP 3 (maintenance). Although stabilization activities are permitted under the NWP program, post-construction mitigation is required; and mitigation activities typically consist of planting native vegetation on areas adjoining the erosion control structure. This plan was developed to meet Corps requirements for erosion control activities engaged by the Southern Nevada Water Authority (SNWA) along the Wash.

The purpose of this plan is to describe the revegetation strategies to be implemented at the recently completed Powerline Crossing Weir. Not only do these revegetation activities help us meet our regulatory requirements, but they also provide for additional erosion control and habitat for the diverse fauna found in the Wash ecosystem. The general goals for this and other revegetation activities along the Wash are to develop ecologically functioning wetland, riparian, and upland areas that are self-sustaining in the long-term. Revegetation activities are coordinated by staff from the SNWA’s Las Vegas Wash Project Coordination Team (Project Team) as part of wetland mitigation requirements specified by the Corps.

Specific activities required to successfully revegetate areas along the Wash are described herein. Typically these activities include removal of non-native invasive species, investigation of soil condition, identification of the subsurface hydrologic condition, and planting native vegetation. Also included in this document are brief descriptions of monitoring strategies for revegetation sites, water quality and an array of biological resources found along the Wash. Revegetation site monitoring provides us with an indication of site success while monitoring additional biological resources provide us with an indication of proper ecosystem functioning.

2.0 PROJECT SUMMARY

2.1 Site Location
The Powerline Crossing Weir (Figure 1 and Figure 2) is located along the lower Wash, approximately 0.5 miles upstream of the channel intake structure for the Lake Las Vegas Resort development (see Appendix A). The most southern polygon displayed in Figure 2 was not included in the revegetation plan as it is being used as a rip-rap stockpile site for future weir construction.
Figure 1: Powerline Crossing Weir location.

Figure 2: Powerline Crossing Weir potential revegetation sites.
2.2 Site Conditions

2.2.1 Vegetation
Prior to construction, the Powerline Crossing Weir site was fully bordered on the north and south by linear strips of riparian and wetland vegetation. Riparian plant species that were found near the site include salt cedar (*Tamarix ramosissima*) and quailbush (*Atriplex lentiformis*) while wetland species include common reed (*Phragmites australis*) and southern cattail (*Typha domingensis*). On the historical floodplain, creosote bush (*Larrea tridentata*) and salt cedar dominate. Other plants, however, have been observed in the vicinity of the site (Appendix B).

2.2.2 Soils
Soils data is important to investigate prior to developing site revegetation strategies. Soil composition and profile are important indicators for determining the potential success of a revegetation project as it can detail the subsurface conditions that plants will be exposed to. Soil texture (i.e., the amount of sands, silts, and clays) and below ground moisture gradients can often be the limiting factors for plant survival and growth. Along the Wash, soil descriptions and analyses can be helpful to determine their suitability, limitations, and management for specific uses. Soil texture for most of the planting site is a sandy loam to silty loam. These textures offer good drainage conditions for revegetation activities. Soil hydrology differs substantially across the planting areas with greater than 10 feet depth to water on the upland areas and less than five feet depth to water on the lower planting areas. For this reason, plants to be used in these areas will need to vary.

2.2.3 Wildlife
Studies by Bradley and Niles in the early 1970’s identified the presence of 2 fish, 6 amphibians, 29 reptiles (1 tortoise, 13 lizards, and 15 snakes), 39 mammals (1 shrew, 10 bats, 16 rodents, 2 rabbits, 9 carnivores, and 1 ungulate), and 161 birds along the Wash corridor (Appendix C). These data were compiled from a variety of sources including biological inventory studies, personal records and notes, and published literature. Quantitative information collected from this historical account may prove useful for comparative purposes. As a result of increasing water flows, habitat that is available to animals has changed dramatically since this time. Wetland habitat, consisting primarily of emergent vegetation (i.e., cattails, bulrush, etc.), has been reduced more significantly than transitional vegetative communities such as saltbush scrub and mixed shrub-woodlands.

Current systematic biological inventory studies have shown that wildlife communities along the Wash have been altered, however, many of the species that were found in the 1970’s are still found along the Wash today. Further, some taxa that have been observed recently were previously not recorded along the Wash. Of the 231 species that were reported by Bradley and Niles, 67% of them have been observed during current inventory studies. So far, recent studies indicate that there are 7 fish, 2 amphibians, 15 reptiles (13 lizards and 2 snakes), 26 mammals (1 shrew, 10 bats, 9 rodents, 2 rabbits, 4 carnivores), and 128 birds along the Wash corridor.
3.0 REVEGETATION DESIGN

The Wash plays an important role in the ecological integrity of the region. Prior to modern settlement of the Las Vegas Valley, the Wash was a typical ephemeral desert wash. Vegetation was characteristic of a desert drainage. As the population of Las Vegas grew, the discharge of reclaimed water into the Wash increased. With the addition of this new and seemingly replenishable supply of water in the Wash, the once ephemeral desert wash underwent dramatic changes. Hydrologic changes resulted in permanent surface water flows and elevated groundwater levels, which caused a transition from xeric and mesic plant communities to more hydric plant communities. The Wash slowly started to transform from a desert wash to a desert riparian ecosystem. During this change, pioneering plants, many of which are non-native, came to dominate. Revegetation activities along the Wash do not attempt to restore the pre-settlement desert vegetation nor the post-settlement non-native vegetation; rather, these activities attempt to create similar native vegetative conditions found along many of the riparian drainages of the lower Colorado River basin.

Typical native vegetation found in the lower Colorado River basin includes Fremont cottonwood (Populus fremontii), willows (Salix spp.), mesquites (Prosopis spp.), arrowweed (Pluchea sericea), wolfberry (Lycium spp.), seepwillow (Baccharis salicifolia), saltbush (Atriplex spp.), cattails (Typa spp.), and bulrush (Schoenoplectus spp.). These species are found in areas where hydrologic and edaphic conditions permit. Revegetation sites along the Wash provide suitable environmental conditions for these species as well as for other more desert adapted species like creosote bush and white bursage (Ambrosia dumosa). Revegetation sites are generally designed to maximize native vegetative coverage, while also providing for physiognomic features that mimic native riparian conditions.

Hydrologic and edaphic conditions near the Powerline Crossing Weir are suitable to plant much of the native vegetative features that are typical of a southwestern riparian area. Three distinct planting conditions in order of decreasing water availability, wetland, riparian, and upland, are found adjacent to the Powerline Crossing Weir (Figure 3). Wetland areas are located within and adjacent to the channel where saturated soils or standing water is present. Plants that can be planted here include spikerush (Eleocharis macrostachya), Torrey spikerush (E. rostellata), alkali bulrush (Schoenoplectus maritimus), Olney’s threesquare (S. americanus), California bulrush (S. californicus), hardstem bulrush (S. acutus), common threesquare (S. pungens), baltic rush (Juncus balticus), and Cooper’s rush (J. cooperi). Riparian areas are those areas leading from the water’s edge towards the upland. The width of the riparian zone can change depending on the availability of water. Plants that are used to revegetate these areas include Fremont cottonwood, Gooding willow (Salix gooddingii), sandbar willow (Salix exigua), screwbean mesquite (Prosopis pubescens), honey mesquite (Prosopis glandulosa var. torreyana), arrowweed, seepwillow, salt grass (Distichlis spicata), yerb mansa (Anemopsis californica), salt heliotrope (Heliotropium curassavicum), alkali sacaton (Sporobolus airoides), velvet ash (Fraxinus velutina), wolfberry and quailbush. Where groundwater depths have become too deep for riparian plants to use, xeric upland plants start to dominate. Plants that are used to revegetate these areas include creosote bush, white bursage, catclaw acacia (Acacia greggii), desert willow (Chilopsis linearis), broom baccharis (Baccharis sarothroides), fourwing saltbush (Atriplex...
canescens), shadscale (A. confertifolia), and desert saltbush (A. polycarpa). To meet mitigation requirements, wetland followed by riparian and upland acreage will be planted.

3.1 Phase 1 Revegetation
The first phase of revegetation at the Powerline Crossing Weir was accomplished during a “Green-Up” volunteer planting day. This revegetation effort focused on the desert upland matrices on the north and south sides of the Wash. The desert upland area is approximately 14 acres in size. The site was planted on March 10, 2007. The desert upland matrices for the north and south side described above were utilized for this revegetation effort and included, creosote bush, white bursage, four-wing saltbush, and a mix of honey mesquite, and catclaw acacia.

3.2 Phase 2 Revegetation
The second phase of revegetation at the Powerline Crossing Weir included the planting of riparian and wetland areas (Figure 3). Riparian areas were planted in April-May 2007 and included Goodding’s and sandbar willows, Fremont cottonwood, saltgrass, yerba mansa, and Emory waterweed (Baccharis emoryi) among others. Wetland areas were also planted in April-May 2007 with a variety of bulrush species. These wetland areas include approximately 1.85 acres.

Figure 3: Powerline Crossing Weir revegetation sites.
4.0 PROJECT IMPLEMENTATION

4.1 Planting Methods and Materials
Data gathered from past and present monitoring activities have helped us refine our planting methods and materials. This includes determining the best period of the year to plant and a list of plants that perform well in our area (see species lists under Revegetation Design). Through these efforts, we have identified that October-November and February-April are the best planting periods of the year. Vegetation planted during these periods is helped by above average precipitation that generally falls during the summer and winter months in Las Vegas. Powerline Crossing Weir planting events have been conducted during these peak periods of success.

Riparian and upland plants that have been used to revegetate the Powerline Crossing Weir were primarily containerized stock, pole cuttings, and plugs. One-gallon stock is typically used for shrub species and poles are often used for the cottonwood and willow species. Since, wetland plants typically grow as multiple stems saltgrass, threesquare and California bulrush are be planted as plugs from flats of various sizes. There are two local nurseries where we normally purchase plant material from for our planting projects, the Nevada Division of Forestry nursery at Floyd Lamb State Park and the National Park Service nursery at Lake Mead National Recreation Area. If desirable species are not available from either nursery, local commercial native plant nurseries are used. Prior to planting, sites were tilled with a soil ripper. This is done because areas within construction easements are often very compacted and they are sprayed with dust suppressant after weir completion. These conditions harden the surface of the soil and do not beneficially contribute to native plant recruitment.

After the soil surface was prepared and an irrigation strategy was designed (see discussion below), holes were pre-dug using shovels and a Bobcat® skid-steer loader with an attached auger. Depressions were created around shrubs and trees so that moisture is retained close to the plant. Trees were interspersed within a planting zone and were spaced approximately 5-15 feet apart (depending on type). Shrubs and other low vegetation were planted at closer distances in tree interspaces. Planting densities at our revegetation sites range from 100-700 plants/acre, depending on site configuration. The greatest success that we have observed is from sites that have been planted densely and with a diverse species palette. Therefore our strategy for the Powerline Crossing Weir was to plant densities around 300-700 plants/acre with as many species as possible. Although high-density plantings may be most successful in the short-term, long-term competition between species will likely reduce total plant survivability. This is to be expected; but by crafting revegetation strategies for high diversity and density, the most well adapted species will ultimately dominate. This “shot gun” approach has proven effective at our mitigation sites, since underlying, obscured site conditions are not always determined prior to implementation.

The Powerline Crossing Weir revegetation sites are located on both the north and south sides of the Wash. For ease of planting, the site was broken down into 6 matrices based on the hydrologic and edaphic conditions determined at the site. A detailed revegetation design is located in Appendix D.
Desert Upland Matrix-North Side (Polygons 1A, 1B, 1C)
This area is characterized by deep groundwater depths which will support xeric upland plants. Therefore, the desert upland matrix consists of a diversity of native drought tolerant species, including: creosote bush, white bursage, fourwing saltbush, and honey mesquite. Honey mesquite planting was focused around the mouths of the desert washes. Five gallon containers of honey mesquite were planted at a random spacing for a total density of 12 trees/acre. Among the mesquite, five gallon containers of creosote bush were planted in random groupings 15 feet on center (O.C.) at densities of 142 shrubs/acre. One gallon containers of both white bursage and fourwing saltbush were planted in random groupings 10 feet O.C. at densities of 154 shrubs/acre and 42 shrubs/acre, respectively. Broom baccharis were planted along the edge of each polygon closest to the Wash.

Desert Upland Matrix-South Side (Polygons 12A, B, C, D; 13; 14A, B, C)
The south side desert upland matrix consisted of the same species as the north side desert matrix with the exception of the absence of honey mesquite. Spacing and densities of all the plants were the same as described above.

Riparian Sandbar Willow Matrix (Polygons 6B, 4, 5)
This riparian area leads from the waters edge towards the upland, where the groundwater depths are relatively shallow. Sandbar willow is commonly found along the water’s edge in southwest desert riparian areas. Therefore, this area was planted primarily with one gallon containers of sandbar willows.

Riparian Goodding’s Willow Matrix (Polygons 6A)
Goodding’s willow five gallon containers were planted linearly along the base of the slope between the sandbar willow and the desert upland matrix in Polygon 6. Fremont cottonwoods were also used in this area.

Riparian/Wetland Saltgrass Matrix (Polygon 6C)
Saltgrass is naturally found in southwestern riparian/wetland ecosystems and it can withstand relatively high soil salinities. A band of saltgrass plugs were planted on the periphery of the sandbar willow poles (Polygon 6) 5 feet O.C. along the Wash for a total of 238 plugs. Yerba mansa and alkali sacaton was also planted in this area.

Wetland Olney Threesquare Matrix (Polygon 6D)
Wetland areas are located within and adjacent to the channel where saturated soils or standing water is present. Olney threesquare requires saturated soils and shallow shoreline habitat. Adjacent to the band of saltgrass and along the shoreline, a band of Olney threesquare were planted 5 feet O.C. for a total of 84 plugs within Polygon 6.

Wetland California Bulrush Matrix (Polygons 7, 8, 9, 10)
California bulrush and hardstem bulrush require deeper water levels to grow and proliferate, therefore these species were planted in the Wash where a perennial source of water is present. California bulrush material was planted from container stock, whereas, hardstem bulrush material was planted from salvaged material from the Pahranagat National Wildlife Refuge.
4.2 Invasive Species Management
The federal government defines an "invasive species" as 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Once vegetation has been provided general survival requirements (i.e., water, sunlight, air, minerals, and space), competition with other plants for these resources may be the only impediment towards achieving a successful planting site. Typically, invasive species out-compete native species for resources and therefore displace native species to marginal habitats. This often results in the decline of native taxa. At revegetation sites along the Wash, invasive species are controlled by a variety of methods. These activities allow the optimal conditions for native plants to succeed. The Nevada Noxious Weed List outlines particularly harmful species in our state and it serves as the list of species that we manage at our planting sites. Some of these species have been reported along the Wash and management strategies for their control are discussed herein.

4.2.1 Salt Cedar
Salt cedar is a highly invasive non-native species that has been present in the Wash for over 30 years. It is currently the most dominant tree taxa found along the Wash and estimates of its infestation exceed 1,500 acres. The primary goal for managing salt cedar is to prevent the invasion of this taxa into newly revegetated areas. Since salt cedar is typically cleared around erosion control structure facilities, we are able to control its re-infestation by implementing a variety of suppression techniques. A summary of the techniques used to control salt cedar along the Wash during pre- and post-construction of erosion control structures is as follows.

Chemical application techniques have proven to be effective in controlling salt cedar. Garlon® 4 (triclopyr; Dow AgroSciences, Indianapolis, IN) herbicide can be applied basally to the cut stumps of salt cedar trees. This method involves cutting the tree at ground level with a chain saw, and then immediately spraying the remaining stump with the herbicide. The material can than be moved to a stockpile location to await permanent disposal (i.e., by controlled burn). For extensive infestations, mechanical clearing can be an effective control technique. Mechanical clearing is achieved by removing the plants root crown from the soil using a root plow. This method can be followed up by herbicide applications if required. Another form of mechanical clearing is achieved by simply hand-pulling re-sprouting plants. This technique is labor intensive, however, under the right circumstances it can be quite effective. These methods may be used to control salt cedar at the Powerline Crossing Weir planting sites.

4.2.2 Tall Whitetop and Giant Reed
Tall whitetop (Lepidum latifolium) and giant reed (Arundo donax), non-native invasive weeds found in many western riparian drainages, have only recently been found in the Wash. Tall whitetop infests considerably more acreage than giant reed but because their distributions in the Wash are still somewhat limited, there is an aggressive campaign to remove them before they further spread. Herbicide application to the foliage is the method of choice for controlling these species. Rodeo® (glyphosate; Dow AgroSciences, Indianapolis, IN) and Escort® (metsulfuron methyl; DuPont, Wilmington, DE) is applied as needed to reduce the infestation. If tall whitetop or giant reed is found on Powerline Crossing Weir planting sites, they will be controlled by these methods.
4.3 Irrigation

Supplemental irrigation is important for plant establishment since precipitation near the Wash is generally less than five inches a year. Wetland plants, however, do not require supplemental irrigation as long as they are in saturated or standing water conditions. Wetland plants will not be planted away from these areas, and therefore supplemental irrigation is not required. Instead, our irrigation strategies primarily concentrate on riparian and upland plants. Riparian plants quickly develop extensive root systems that exploit groundwater sources, which allows them to depend less on supplemental irrigation. Upland plants, however, require extensive irrigation to become established.

The site will be irrigated with a system typically used in large-scale agriculture that can be reused and moved to other revegetation locations at the end of the project. The water for irrigation will be pumped out of the Wash using a John Deere® motor with a six cylinder Cornell Pump (172 HP at 1886 RPM) mounted on an axle tank trailer with a 10 inch diameter suction and eight inch diameter discharge. The pump pad and ramp will be located five feet above the wash which will be a sufficient distance for the suction hose. Six inch diameter mainline CERTA-LOK piping will transport the water from the pump to multiple three inch diameter above ground CERTA-LOK lateral lines spaced approximately 45 feet apart. The pipe diameter reduces to four inches as it crosses the Wash over the weir bridge to the north side, however once on the north side the pipe diameter returns to six inches. The lateral lines will transport the water to Nelson R2000 WF Rotator heads with a three inch take off assembly on a 30 by 40 foot grid. The rotator heads will be connected to flexible hose heads and movable posts in order to reposition the heads as needed during plant growth. The spray radius of each head is 25 feet, therefore spraying overlaps to ensure that the entire site receives complete coverage.

Each lateral line will have a shutoff valve located on the mainline in order to control the amount of water available to each section. There will also be a mainline isolation valve which controls the delivery of water to an entire section of lateral lines. These shut-off and isolation valves will be useful to isolate areas that require more or less irrigation without having to reassemble the entire system. Also, they will be useful in the case of a water leak or irrigation malfunction, by terminating water flow to a section under repair prevents an unnecessary waste of water. The irrigation design is located in Appendix E.

5.0 PROJECT MAINTENANCE AND MONITORING

5.1 Maintenance

5.1.1 Replanting and Contingency

Although this planting plan aims to create functioning wetland, riparian, and upland areas that are self-sustaining in the long-term, it is possible that environmental (e.g. flood events) and/or anthropogenic (e.g. vegetation destruction by off highway vehicle users) disturbances reduce the success of planted vegetation. Further, although every effort is made to pair plants with locations that appear to provide edaphic and hydrologic conditions favorable for their survival, it is possible that other, more obscured site conditions do not permit plant success. For this reason additional vegetation may need to be planted during future periods.
If permit requirements of 80% survival of native species planted with less than 20% encroachment of invasive species is not reached within the two year monitoring period, further mitigation activities will be developed and implemented at the site to ensure the objective of developing long-term, self-sustaining wetlands that are not dependent on further human intervention after the establishment period is reached.

5.2 Monitoring

5.2.1 Vegetation
In order to determine the effectiveness of revegetation activities, a variety of general vegetation parameters could be measured. Parameters that will be monitored for Wash revegetation projects, and have been approved by the Corps, include species composition, percent cover, survival rates, and encroachment of non-native weeds.

In order to determine species composition, field personnel walk random transects within the boundaries of the revegetation site until the $n$th species is found. This method allows for a complete inventory of all plants on a revegetation site.

Percent cover is an important characteristic to monitor in a stand of vegetation because it can serve as a criterion for relative dominance within the community. Cover is expressed as a percentage value and in a multi-layered community it can often exceed 100%. In a multi-layered community it may be important to separate cover estimates into different strata. In order to determine percent cover for revegetation sites, line-intercept and/or aerial photographic interpretation methods are used. In the line-intercept method, a tape is stretched between two stakes, and the canopy of a species that vertically projects over the tape is measured along its length. The total length of tape that is intercepted by the vertical projections of a species by the total length of tape is the percent cover. Line-intercepts are of sufficient length to reflect the community and allow for an accurate estimate of percent cover by species. Line-intercept data also provides an estimate of cover for both native (i.e., planted and passive) and non-native weed encroachment. As community physiognomy changes, the line-intercept method may prove too difficult to implement and other methods may have to be used (e.g., cover estimates from aerial photographs, Braun-Blanquet cover class, etc.). Methodologies to determine percent cover are dictated by site conditions.

Revegetation sites are often deemed a success by the number of plants that survive after plantings have stopped and a period of time has passed since intensive management. This is a general indicator that plants will continue to survive in the environment after revegetation activities have been completed. An appropriate method of measuring survival for a revegetation project is to simply count the number of planted plants that remain viable during the growing season. Using this method, survival can be expressed as a percentage where the number of plants that are viable is divided by the total number of plants on a site and then multiplied by 100. This survivability measure can be compared from growing season to growing season and ultimately expressed as a rate of survival.

The procedures for which survivability and survival rates are estimated is as follows. In order to determine post-planting survivability and survival rates, estimations are made using strip-transect
methods and/or random point sampling. Strip-transects are of sufficient length and width to accurately estimate survivability measures and random sample points are identified with the aid of geographic information system software. As community physiognomy changes, the strip-transect and/or random point sampling method may prove too difficult to implement and other methods may have to be used (e.g., infra-red aerial photographic interpretation, plot sampling, etc.). Methodologies to determine survivability and survival rate are dictated by site conditions.

### 5.2.2 Water Quality

Wash water quality is an important feature to monitor since we use this water to irrigate our revegetation sites. Water in the Wash comes from a variety of sources in the Las Vegas Valley, including stormwater, urban runoff, shallow groundwater, and reclaimed water. Each water source has a unique chemical signature. For example, shallow groundwater is typically high in salt content while reclaimed water is not. In an effort to monitor water quality for this program and other watershed management initiatives, SNWA engages in a comprehensive monitoring program. Water quality monitoring includes real-time mainstream, monthly mainstream, and quarterly tributary monitoring. A variety of water quality parameters are evaluated, including, nutrients, metals, temperature, pH, dissolved oxygen, and electrical conductivity. Monitoring data provides us with valuable information to facilitate successful irrigation strategies at our revegetation sites.

### 5.2.3 Additional Biological Resources

Revegetation activities may potentially benefit many of the biological resources found along the Wash (Appendix C). In order to document these benefits, multiple fish and wildlife monitoring studies have been implemented. Species that are currently being monitored include birds and bats, however, other monitoring activities that have been completed include studies for amphibians, small mammals, reptiles, and fish.

Birds are the most probable taxa to quickly benefit from the construction of erosion control structures and subsequent revegetation activities. Habitat values for water dependent species will increase in the ponded areas behind the erosion control structures while riparian and wetland revegetation activities adjacent to the channel will improve habitat for other taxa. This is important since 80% of the breeding bird population in North America and 50% of the protected migratory bird population rely on riparian zones. In the southwestern U.S., most riparian areas are in decline as a result of anthropogenic disturbances or water resource management. Unique ecosystem enhancement projects like that found along the Wash aim to reverse these trends.
Appendix A
Photographs of Powerline Crossing Weir Restoration Process
Dozer and water truck tilling an upland site prior to revegetation.

Typical upland planting matrix after tilling and before planting.
Irrigation system installed on an upland planting matrix.

Volunteer planting event held on March 10, 2007.
Volunteer planting event held on March 10, 2007.

Wetland and riparian planting area.
View of the Powerline Crossing Weir with riparian and upland planting sites viewable in the background.

Hardstem bulrush (brown material in the foreground) planted along bank protection.
Hardstem bulrush material planted on the Powerline Crossing Weir.
Appendix B
Plants Observed Along the Las Vegas Wash
List of species detected by Bradley and Niles (1973) and Shanahan and Silverman (2006). Species presence is indicated by a 1. Family and species names follow the Integrated Taxonomic Information System (www.itis.usda.gov). Species names reported by Bradley and Niles (1973) have been updated here to reflect taxonomic changes.

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List of species detected by Bradley and Niles (1973) and Shanahan and Silverman (2006). Species presence is indicated by a 1. Family and species names follow the Integrated Taxonomic Information System (www.itis.usda.gov). Species names reported by Bradley and Niles (1973) have been updated here to reflect taxonomic changes.

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Grand Total 111 248
Appendix C
Wildlife Observed Along the Las Vegas Wash
List of species detected by Bradley and Niles (1973) and Shanahan et al. (2007). Species are listed alphabetically from left to right and presence is dictated by a 1. Species names reported by Bradley and Niles (1973) have been updated here to reflect taxonomic changes.

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List of species detected by Bradley and Niles (1973) and Shanahan et al. (2007). Species are listed alphabetically from left to right and presence is dictated by a 1. Species names reported by Bradley and Niles (1973) have been updated here to reflect taxonomic changes.

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Appendix D
Powerline Crossing Weir Planting Design
DESSERT UPLAND MATRIX - SEE SHEET 4 FOR PLANTING DETAIL

1. DESERT UPLAND MATRIX
2. PLANT ALL ACACIA ON LOW END OF NEAR WASH AND ALONG TRAIL
3. PLANT DESERT BROOM NEAR WASH

PLANTING NOTES
1. IN DESERT UPLAND MATRIX POLYGONS, PLANT DESERT BROOM ALONG THE EDGE IN EACH POLYGON SITE NEAREST TO LAS VEGAS WASH
2. ADD A HOLE PLANTING HOLES TO A 3 DEPTH AND 12" WIDE
3. TO PROMOTE SEED GERMINATION, IT IS RECOMMENDED THAT THE SITE BE BISCUIT WITH A BEND IMPRINTER OR DUG WITH A 2" RAKE.

PLANT SPECIE

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Southern Nevada Water Authority
Powerline Plantings
LAS VEGAS, NEVADA
Appendix E
Powerline Crossing Weir Irrigation Design
SEE DETAIL 1
P.O.C.

SEE DETAIL 2
3" TAKE OFF ASSEMBLY FOR FLEXIBLE RSERS-
NELSON R2000 WF ROTATION HEAD CONNECTED TO
FLEXIBLE HOSE HEADS AND MOVABLE POST. THIS ALLOWS
THE HEADS TO BE MOVED AS TREES GROW.

IRRIGATION LEGEND
- 6" Above Ground CERTA-LOK Mainline
- 4" Above Ground CERTA-LOK Mainline
- 3" Above Ground CERTA-LOK Laterals
- 6 Cylinder John Deere / Cornell 6 Rv Pump-10" Suction, 8" Discharge
- 6" Mainline Isolation Valve
- 4" Mainline Isolation Valve
- 6" x 3" Valve Take Off, With Shut Off Valve
- Nelson R2000 WF Rotary Head- With 2" Take Off Assembly

Southern Nevada Water Authority
Powerline Planting Sites
LAS VEGAS, NEVADA