







las vegas wash coordination committee

lvwash.org

Las Vegas Wash Vegetation Monitoring Report, 2008-2012



January 2014





Las Vegas Wash Vegetation Monitoring Report, 2008-2012

SOUTHERN NEVADA WATER AUTHORITY Las Vegas Wash Project Coordination Team

Prepared for:

Las Vegas Wash Coordination Committee

Prepared by:

Jason R. Eckberg Southern Nevada Water Authority 100 City Parkway, Suite 700 Las Vegas, Nevada 89106

October 2013

ABSTRACT

Revegetation projects have been conducted along the Las Vegas Wash in Southern Nevada since 1999 to meet federal, state, and local regulatory requirements, as well as the goals of the Las Vegas Wash Coordination Committee. In the fall of every year at the end of the local vegetative growing season, monitoring takes place at all revegetation sites. As of the most recent monitoring in 2012, there were 359.6 a cres monitored, made up of 244 individual monitoring areas. Each monitoring area and revegetation site has multiple criteria monitored each year, including; total vegetative cover, noxious weed cover, individual species cover, species richness, survivorship, wetland prevalence index, cover composition, and site condition. This report describes the current status and trend of vegetation criteria over the past five years for each revegetation site along the Las Vegas Wash. Overall the majority of sites have shown improvement over the past five monitoring years. This conclusion is made by documenting increasing total cover values while maintaining low noxious weed amounts on most sites.

ACKNOWLEDGEMENTS

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. Specifically, I would like to thank the following people for their assistance: Marissa Foster, Sandra Harris, Carol Lane, Nick Rice, Tim Ricks, and Debbie Van Dooremolen. In addition, I would like to specifically thank Giles Anthony and Soil-Tech for their dedication to planting and maintaining the Las Vegas Wash revegetation sites. Keiba Crear has been a central figure in advocating for rigorous monitoring and proper maintenance of the Las Vegas Wash and I thank you. Thank you to Seth Shanahan, Patty Emery, and Adriana Picazo-Perez who reviewed this document, provided invaluable comments and assisted in final editing. Seth Shanahan also co-developed some of the front matter of this report and the framework which the vegetation monitoring program follows. Finally, I would like to thank the 29 members of the Las Vegas Wash Coordination Committee, as well as the members of the Research and Environmental Monitoring Study Team for continuing to support this program and the implementation of the Las Vegas Wash Comprehensive Adaptive Management Plan.

Las Vegas Wash Vegetation Monitoring Report, 2008-2012

Table of Contents

| | | | Page No. |
|-----------------|-------------------|--|----------|
| Abstract | | | ii |
| Acknowle | dgements | | iii |
| Table of C | Contents | | iv |
| List of Tal | bles | | vii |
| List of Fig | gures | | ix |
| 1.0 INTR | ODUCTIO | N | 1 |
| 1.1 | Backgroun | nd | 1 |
| 1.2 | Purpose ai | nd Scope | 1 |
| 1.3 | Need for R | Revegetation and Vegetation Monitoring | 2 |
| 1.4 | Program H | Funding | 2 |
| | | 8 | |
| 2.0 MATI | ERIALS AN | ND METHODS | 4 |
| 2.1 | Maior Site | | |
| | 2.1.1 | DU Wetlands No. 2 Weir | 5 |
| | 2.1.2 | Lower Narrows and Homestead Weirs | 5 |
| | 2.1.3 | Upper Diversion Weir and East Bypass Channel | 5 |
| | 2.1.4 | Clark County Water Reclamation District | 6 |
| | | U U | |
| 3.0 RESU | LTS AND I | DISCUSSION | 7 |
| 3.1 | Bostick W | eir | |
| | 3.1.1 | Bostick | |
| | 3.1.2 | Bostick Islands | 20 |
| | 3.1.3 | Bostick North | 20 |
| | 3.1.4 | Bostick South | 21 |
| | 3.1.5 | Downstream Bostick North | 21 |
| | 3.1.6 | Downstream Bostick South | 22 |
| | 3.1.7 | Downstream Bostick South Emergent | |
| | 3.1.8 | Upstream Bostick North | 23 |
| | 3.1.9 | Upstream Bostick North Bank | 23 |
| | 3.1.10 | Upstream Bostick North Emergent | 24 |
| | 3.1.11 | Upstream Bostick South – Non-wetland | 24 |
| | 3.1.12 | Upstream Bostick South – Wetland | 25 |
| | 3.1.13 | Upstream Bostick South Bank | |
| 3.2 | Calico Rid | ge Weir | 26 |
| | 3.2.1 | Calico | |

Page No.

| | 3.2.2 | Downstream Calico North | |
|-----|------------|---|----|
| | 3.2.3 | Downstream Calico South – Non-wetland | |
| | 3.2.4 | Downstream Calico South – Wetland | 33 |
| | 3.2.5 | Upstream Calico Emergent | 33 |
| | 3.2.6 | Upstream Calico North – Non-wetland | 33 |
| | 3.2.7 | Upstream Calico North – Wetland | 34 |
| | 3.2.8 | Upstream Calico South – Non-wetland | 34 |
| | 3.2.9 | Upstream Calico South – Wetland | 35 |
| 3.3 | Clark Cou | nty Water Reclamation District | 35 |
| | 3.3.1 | Clark County Water Reclamation District – Non-wetland | |
| | 3.3.2 | Clark County Water Reclamation District – Wetland | 41 |
| 3.4 | Cottonwoo | od Cells | 41 |
| | 3.4.1 | Cottonwood Cell 1 | 41 |
| | 3.4.2 | Cottonwood Cell 2 | 44 |
| | 3.4.3 | Cottonwood Cell 3 | 44 |
| | 3.4.4 | Cottonwood Cell North | 44 |
| | 3.4.5 | Cottonwood Cell North Soil Stockpile | 45 |
| 3.5 | Demonstra | ation Weir | 46 |
| | 3.5.1 | Upstream Demonstration South – Non-wetland | 49 |
| | 3.5.2 | Upstream Demonstration South – Wetland | 49 |
| 3.6 | DU Wetla | nds No. 2 Weir | 51 |
| | 3.6.1 | DU Wetlands No. 2 Emergent | 55 |
| | 3.6.2 | DU Wetlands No. 2 North | 55 |
| | 3.6.3 | DU Wetlands No. 2 South | 56 |
| 3.7 | Historic L | ateral Weir | 57 |
| | 3.7.1 | Downstream Historic Lateral Passive Wetland | 57 |
| | 3.7.2 | Upstream Historic Lateral North – Non-wetland | 57 |
| | 3.7.3 | Upstream Historic Lateral North – Wetland | 59 |
| | 3.7.4 | Upstream Historic Lateral North South | 61 |
| | 3.7.5 | Upstream Historic Lateral Passive Wetland | 61 |
| | 3.7.6 | Upstream Historic Lateral South | 62 |
| | 3.7.7 | Upstream Historic Lateral South Bank – Non-wetland | 62 |
| | 3.7.8 | Upstream Historic Lateral South Bank – Wetland | 62 |
| | 3.7.9 | Upstream Historic Lateral South Upper Plateau | 63 |
| | 3.7.10 | Upstream Historic Lateral South Upper Plateau 2 | 64 |
| • • | 3.7.11 | Upstream Historic Lateral South Soil Stockpile | 64 |
| 3.8 | Lower Na | rrows and Homestead Weirs | 64 |
| | 3.8.1 | Lower Narrows and Homestead Emergent | 64 |
| | 3.8.2 | Lower Narrows and Homestead North | |
| 3.0 | 3.8.3 | Lower Narrows and Homestead South 1 | 68 |
| 3.9 | Monson a | nd Visitor Center Weirs | 68 |
| | 3.9.1 | Downstream Monson North – Non-wetland | |
| | 3.9.2 | Downstream Monson North – Wetland | 73 |
| | 3.9.3 | Downstream Monson South – Non-wetland | 73 |

Page No.

| | 3.9.4 | Downstream Monson South – Wetland | 75 |
|-----|----------------|--|-----|
| | 3.10 Pabco Roa | ad Weir | 75 |
| | 3.10.1 | Downstream Pabco North | 76 |
| | 3.10.2 | Downstream Pabco North Bank | |
| | 3.10.3 | Downstream Pabco South | 79 |
| | 3.10.4 | Downstream Pabco South Upper Bank | 79 |
| | 3.10.5 | Downstream Pabco South Upper Plateau | 79 |
| | 3.10.6 | Pabco North – Non-wetland | |
| | 3.10.7 | Pabco North – Wetland | 82 |
| | 3.10.8 | Pabco South – Non-wetland | 83 |
| | 3.10.9 | Pabco South – Wetland | 83 |
| | 3.10.10 |) Upstream Pabco North | |
| | 3.10.11 | Upstream Pabco South | |
| | 3.10.12 | 2 Upstream Pabco South Upper Plateau | |
| | 3.11 Powerline | Crossing Weir | |
| | 3.11.1 | Downstream Powerline North Bank | |
| | 3.11.2 | Downstream Powerline South Bank | |
| | 3.11.3 | Powerline South Bank | |
| | 3.11.4 | Upstream Powerline North Bank | |
| | 3.11.5 | Upstream Powerline North Emergent | |
| | 3.11.6 | Upstream Powerline North Plateau | 90 |
| | 3.11.7 | Upstream Powerline North Wetland | 93 |
| | 3.11.8 | Upstream Powerline South Bank | 94 |
| | 3.11.9 | Upstream Powerline South Plateau | 94 |
| | 3.12 Rainbow | Gardens Weir | 95 |
| | 3.12.1 | Rainbow Islands | 95 |
| | 3.12.2 | Upstream Rainbow North Bank | 95 |
| | 3.12.3 | Upstream Rainbow North Passive Wetland | |
| | 3.12.4 | Upstream Rainbow South Bank | 101 |
| | 3.12.5 | Upstream Rainbow South Emergent | |
| | 3.12.6 | Upstream Rainbow South Plateau | 101 |
| | 3.13 Site 108 | | 101 |
| | 3.14 Site 111 | | 106 |
| | 3.15 Upper Div | version Weir | |
| | 3.15.1 | Downstream Upper Diversion Emergent | 109 |
| | 3.15.2 | Downstream Upper Diversion North | 112 |
| | 3.15.3 | Downstream Upper Diversion Shelves | 112 |
| | 3.15.4 | Upper Diversion Island | 112 |
| | 3.15.5 | Upper Diversion Island Emergent | 116 |
| | 3.15.6 | Upstream Upper Diversion Emergent | 116 |
| | 3.15.7 | Upstream Upper Diversion South | 116 |
| | 3.15.8 | Upper Diversion Island South | 117 |
| | | | |
| 4.0 | RECOMMENI | DATIONS | 117 |

| | | Page No. |
|-----|------------------|----------|
| 5.0 | LITERATURE CITED | |

List of Tables

| Table 1. | Acreage of revegetation sites per funding source | 4 |
|-----------|---|-----|
| Table 2. | Change in cumulative acreage monitored and number of monitoring areas from 20 |)08 |
| | to 2012 | 6 |
| Table 3. | Updated scientific names for plants found along the Las Vegas Wash since 2008 | 7 |
| Table 4. | Mitigation requirements and wetland areas established as of 2012 | 8 |
| Table 5. | Physical characteristics of Bostick Weir revegetation sites in 2008-2012 | .15 |
| Table 6. | Vegetation monitoring results for Bostick Weir revegetation sites in 2008-2012 | .19 |
| Table 7. | Physical characteristics of Calico Ridge Weir sites in 2008-2012 | .28 |
| Table 8. | Vegetation monitoring results for Calico Ridge Weir revegetation sites in | |
| | 2008-2012 | .31 |
| Table 9. | Physical characteristics of Clark County Water Reclamation District revegetation | |
| | sites in 2008-2012 | .35 |
| Table 10. | Vegetation monitoring results for Clark County Water Reclamation District | |
| | revegetation sites in 2010-2012 | .39 |
| Table 11. | Physical characteristics of Cottonwood Cell revegetation sites in 2008-2012 | .41 |
| Table 12. | Vegetation monitoring results for Cottonwood Cell revegetation sites in | |
| | 2008-2012 | .43 |
| Table 13. | Physical characteristics of Demonstration Weir revegetation sites in 2008-2012 | .48 |
| Table 14. | Vegetation monitoring results for Demonstration Weir revegetation sites in | |
| | 2008-2012 | .48 |
| Table 15. | Physical characteristics of DU Wetlands No. 2 Weir revegetation sites in | |
| | 2008-2012 | .53 |
| Table 16. | Vegetation monitoring results for DU Wetlands No. 2 Weir revegetation sites in | |
| | 2010-2012 | .53 |
| Table 17. | Physical characteristics of Historic Lateral Weir revegetation sites in 2008-2012 | .59 |

Page No.

| Table 18. | Vegetation monitoring results for Historic Lateral Weir revegetation sites in |
|-----------|---|
| | 2008-2012 |
| Table 19. | Physical characteristics of Lower Narrows and Homestead Weirs revegetation sites |
| | in 2008-2012 |
| Table 20. | Monitoring data for Lower Narrows and Homestead Weirs revegetation sites in |
| | 2012 |
| Table 21. | Physical characteristics of Monson and Visitor Center Weirs revegetation sites in |
| | 2008-2012 |
| Table 22. | Vegetation monitoring results for Monson and Visitor Center Weirs revegetation |
| | sites in 2008-2012 |
| Table 23. | Physical characteristics of Pabco Road Weir revegetation sites in 2008-201276 |
| Table 24. | Vegetation monitoring results for Pabco Road Weir revegetation sites in |
| | 2008-2012 |
| Table 25. | Physical characteristics of Powerline Crossing Weir revegetation sites in |
| | 2008-2012 |
| Table 26. | Vegetation monitoring results for Powerline Crossing Weir revegetation sites in |
| | 2008-2012 |
| Table 27. | Physical characteristics of Rainbow Gardens Weir revegetation sites in |
| | 2008-2012 |
| Table 28. | Vegetation monitoring results for Rainbow Gardens Weir revegetation sites in |
| | 2008-2012 |
| Table 29. | Physical characteristics of Site 108 revegetation site in 2008-2012104 |
| Table 30. | Vegetation monitoring results for Site 108 revegetation site and its funding in |
| | 2008-2012 |
| Table 31. | Physical characteristics of Site 111 revegetation site in 2008-2012107 |
| Table 32. | Vegetation monitoring results for Site 111 revegetation site in 2008-2012107 |
| Table 33. | Physical characteristics of Upper Diversion Weir sites in 2008-2012111 |
| Table 34. | Vegetation monitoring results for Upper Diversion Weir sites in 2008-2012114 |

List of Figures

| Figure 1. | Location of the 2012 Las Vegas Wash revegetation sites and the Clark County |
|------------|--|
| | Wetlands Park boundary |
| Figure 2. | Average vegetation cover across all revegetation sites in all years by growing |
| | season |
| Figure 3. | Average vegetation cover across all non-wetland sites in all years by growing |
| | season |
| Figure 4. | Average vegetation cover across all wetland sites in all years by growing season10 |
| Figure 5. | Average survivorship of planted plants across all sites in all years by growing |
| | season10 |
| Figure 6. | Average species richness across all sites in all years by growing season11 |
| Figure 7. | Average species diversity (D) across all sites in all years by growing season12 |
| Figure 8. | Average noxious weed cover across all sites in all years by growing season12 |
| Figure 9. | Average cover composition across all sites in all years by growing season13 |
| Figure 10. | Aerial photograph of 2012 delineated Bostick Weir revegetation sites14 |
| Figure 11. | Average vegetation cover across all Bostick sites from 2008 to 201216 |
| Figure 12. | Average noxious weed cover across all Bostick sites from 2008 to 201216 |
| Figure 13. | Average species richness across all Bostick sites from 2008 to 201217 |
| Figure 14. | Average cover composition across all Bostick sites from 2008 to 201217 |
| Figure 15. | The Bostick revegetation site is over seven acres in size and has maintained high |
| | species richness during 2008-2012 |
| Figure 16. | Creosote bush dominated the Bostick North site during vegetation monitoring in |
| | 2012 |
| Figure 17. | Desert willow in bloom along the Wash |
| Figure 18. | Splitgrass is a common non-native grass in revegetation sites along the Wash22 |
| Figure 19. | Goodding's willow and honey mesquite dominate the Upstream Bostick North |
| | revegetation site in 2012 |
| Figure 20. | Southern cattail is a common wetland species along the Wash |

| Figure 21. | Cat-claw acacia trees with an understory of quailbush at the Upstream Bostick South |
|------------|---|
| | – Non-wetland revegetation site in 201225 |
| Figure 22. | Large honey mesquite with cat-claw acacia and creosote bush at the Upstream |
| | Bostick South Bank revegetation site in 201226 |
| Figure 23. | Aerial photograph of 2012 delineated Calico Ridge Weir revegetation sites27 |
| Figure 24. | Average vegetation cover across all Calico Ridge sites from 2008 to 201228 |
| Figure 25. | Average noxious weed cover across all Calico Ridge revegetation sites from 2008 to |
| | 2012 |
| Figure 26. | Average species richness across all Calico Ridge revegetation sites from 2008 to |
| | 2012 |
| Figure 27. | Average cover composition across all Calico Ridge revegetation sites from 2008 to |
| | 2012 |
| Figure 28. | Calico (center), Downstream Calico South - Non-wetland (lower left), and |
| | Downstream Calico South - Wetland (lower right) revegetation sites during |
| | vegetation monitoring in 2012 |
| Figure 29. | From top to bottom Upstream Calico Emergent, Upstream Calico North - Non- |
| | wetland, and Upstream Calico North - Wetland revegetation sites during vegetation |
| | monitoring in 2012 |
| Figure 30. | Tall whitetop is a common noxious weed found along the Wash |
| Figure 31. | Aerial photograph of 2012 delineated Clark County Water Reclamation District |
| | revegetation sites |
| Figure 32. | Average vegetation cover across both Clark County Water Reclamation District |
| | revegetation sites from 2010 to 2012 |
| Figure 33. | Average species richness across both Clark County Water Reclamation District |
| | revegetation sites from 2010 to 2012 |
| Figure 34. | Average noxious weed cover across both Clark County Water Reclamation District |
| | revegetation sites from 2010 to 2012 |
| Figure 35. | Average cover composition across both Clark County Water Reclamation District |
| | revegetation sites from 2010 to 2012 |

| Figure 36. | Large patches of narrow-leaf dock established on the Clark County Water |
|------------|--|
| | Reclamation District revegetation sites in 201240 |
| Figure 37. | Honey mesquite was the dominant species on both Clark County Water Reclamation |
| | District revegetation sites in 2012 |
| Figure 38. | Aerial photograph of 2012 delineated Cottonwood Cell revegetation sites42 |
| Figure 39. | The original two cottonwood cells are dominated by large cottonwood trees designed |
| | to be nurseries for future revegetation efforts |
| Figure 40. | Cottonwood seedlings self-established on Cottonwood Cell 3 in 201245 |
| Figure 41. | High survivorship of planted plans was documented in 2012 at Cottonwood Cell |
| | North46 |
| Figure 42. | Average vegetation cover across both Demonstration Weir revegetation sites from |
| | 2008 to 2012 |
| Figure 43. | Average species richness across both Demonstration Weir revegetation sites from |
| | 2008 to 2012 |
| Figure 44. | Average cover composition across both Demonstration Weir revegetation sites from |
| | 2008 to 2012 |
| Figure 45. | Aerial photograph of 2012 delineated Demonstration Weir revegetation sites50 |
| Figure 46. | Upstream Demonstration South - Non-wetland (left) and Wetland (right) are located |
| | near the new Well's Trailhead of the Clark County Wetlands Park51 |
| Figure 47. | Aerial photograph of 2012 delineated DU Wetlands No. 2 Weir revegetation |
| | sites |
| Figure 48. | Average species richness across all DU Wetlands No. 2 Weir revegetation sites from |
| | 2010 to 2012 |
| Figure 49. | Average vegetation cover composition across all DU Wetlands No. 2 Weir |
| | revegetation sites from 2010 to 2012 |
| Figure 50. | Actively planted and passively introduced vegetation has successfully established |
| | within the DU Wetlands No. 2 Emergent revegetation site |
| Figure 51. | Desert saltbush dominated the DU Wetlands No. 2 North revegetation site in |
| | 2012 |

Page No.

| Figure 52. | Aerial photograph of 2012 delineated Historic Lateral Weir revegetation sites58 |
|------------|---|
| Figure 53. | Mature cottonwood trees dominant older revegetation sites such as Upstream |
| | Historic Lateral North – Non-wetland |
| Figure 54. | Honey mesquite, cat-claw acacia, and desert broom dominate the Upstream Historic |
| | Lateral South Bank – Non-wetland revegetation site in 201263 |
| Figure 55. | The Upstream Historic Lateral Upper Plateau 2 revegetation site is adjacent to a |
| | housing development along the southern border of the Clark County Wetlands |
| | Park65 |
| Figure 56. | Aerial photograph of 2012 delineated Lower Narrows and Homestead Weirs |
| | revegetation sites |
| Figure 57. | American and California bulrush planted within the Wash channel as part of the |
| | Lower Narrows and Homestead Emergent revegetation site |
| Figure 58. | A Clark County Wetlands Park trail is being installed adjacent to the Lower Narrows |
| | Homestead South 1 revegetation site in 2012 |
| Figure 59. | Aerial photograph of 2012 delineated Monson and Visitor Center Weirs |
| | revegetation sites |
| Figure 60. | Average total cover across all Monson and Visitor Center Weirs revegetation sites |
| | from 2008 to 2012 |
| Figure 61. | Average noxious weed cover across all Monson and Visitor Center Weirs |
| | revegetation sites from 2008 to 2012 |
| Figure 62. | Average species richness across all Monson and Visitor Center Weirs revegetation |
| | sites from 2008 to 201272 |
| Figure 63. | Average cover composition across all Monson and Visitor Center Weirs revegetation |
| | sites from 2008 to 2012 |
| Figure 64. | Large trees such as Goodding's willow line the banks of the Monson and Visitor |
| | Center Weirs |
| Figure 65. | Aerial photograph of delineated Pabco Road Weir revegetation sites |
| Figure 66. | Mist grass provides an understory for honey mesquite at the Downstream Pabco |
| | North revegetation site |

| Figure 67. | Large cottonwoods trees dominate the 12-year-old Downstream Pabco South |
|------------|---|
| | revegetation site |
| Figure 68. | Pabco North – Non-wetland after quailbush was thinned in 2012 |
| Figure 69. | Honey mesquite trees dominated the Pabco South - Non-wetland revegetation site in |
| | 2012 |
| Figure 70. | Large trees dominate the Upstream Pabco South revegetation site in its eleventh |
| | growing season |
| Figure 71. | Average total cover across all Powerline Crossing Weir revegetation sites from 2008 |
| | to 2012 |
| Figure 72. | Average survivorship across all Powerline Crossing Weir revegetation sites in their |
| | first two growing seasons |
| Figure 73. | Average noxious weed cover across all Powerline Crossing Weir revegetation sites |
| | from 2008 to 2012 |
| Figure 74. | Average species richness across all Powerline Crossing Weir revegetation sites from |
| | 2008 to 2012 |
| Figure 75. | Average cover composition across all Powerline Crossing Weir revegetation sites |
| | from 2008 to 2012 |
| Figure 76. | Aerial photograph of 2012 delineated Powerline Crossing Weir revegetation |
| | sites |
| Figure 77. | The size of Upstream Powerline North Emergent has almost doubled since |
| | establishment while species richness has decreased |
| Figure 78. | Quailbush and fourwing saltbush dominate the Upstream Powerline North Plateau |
| | revegetation site in 201294 |
| Figure 79. | Aerial photograph of 2012 delineated Rainbow Gardens Weir revegetation sites96 |
| Figure 80. | Average total cover across all Rainbow Gardens Weir revegetation sites from 2008 |
| | to 2012 |
| Figure 81. | Average species richness across all Rainbow Gardens Weir revegetation sites from |
| | 2008 to 2012 |

Page No.

| Figure 82. | Average noxious weed cover across all Rainbow Gardens Weir revegetation sites |
|------------|---|
| | from 2008 to 2012 |
| Figure 83. | Average cover composition across all Rainbow Gardens Weir revegetation sites |
| | from 2008 to 2012 |
| Figure 84. | Fourwing saltbush and globernallow are two species hydroseeded on the Upstream |
| | Rainbow North Bank revegetation site |
| Figure 85. | Goodding's and sandbar willow along with seep willow at the Rainbow Islands |
| | revegetation site in 2012101 |
| Figure 86. | Aerial photograph of Site 108 with 2012 delineations based on funding source103 |
| Figure 87. | A large area of alkali sacaton in front of honey mesquites at Site 108 in 2012104 |
| Figure 88. | Aerial photograph of 2012 delineated Site 111 revegetation site108 |
| Figure 89. | A wide variety of plants are found at Site 111 in 2012109 |
| Figure 90. | Average total cover across all Upper Diversion Weir revegetation sites from 2008 |
| | to 2012 |
| Figure 91. | Average species richness across all Upper Diversion Weir revegetation sites from |
| | 2008 to 2012 |
| Figure 92. | Average cover composition across all Upper Diversion Weir revegetation sites from |
| | 2008 to 2012 |
| Figure 93. | Aerial photograph of 2012 delineated Upper Diversion Weir revegetation sites113 |
| Figure 94. | Wetland vegetation has passively established along the Downstream Upper |
| | Diversion Emergent revegetation site |
| Figure 95. | Honey mesquite with an understory of quailbush at the Upper Diversion Island |
| | revegetation site in 2012 |

1.0 INTRODUCTION

1.1 Background

To evaluate water quality issues in the Las Vegas Wash (Wash), Las Vegas Bay, and Lake Mead, the Southern Nevada Water Authority (SNWA) assembled a citizen advisory committee in 1997. The result was the establishment of the Las Vegas Wash Coordination Committee (LVWCC), now a 29-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). Activities have been continuously implemented since then to implement the goals of the CAMP, including constructing erosion control structures (weirs) in the stream channel and armoring the banks of the stream with rock. After erosion control facilities are built, wetland, riparian, and non-wetland vegetation are planted to help further protect the Wash from erosion, as well as to improve the ecosystem's function and value.

Wetland and riparian ecosystems are relatively rare in the Mojave Desert. The Wash is the most substantial riparian area in the Las Vegas Valley and the primary drainage channel for the 1,600 square-mile watershed. It is just one of few areas in Southern Nevada that support extensive wetland and riparian systems. Others include the Colorado River, Virgin River, Muddy River, and Meadow Valley Wash. These wetland and riparian areas provide important functions in the landscape. Functions include floodwater storage, fish and wildlife habitat, water quality polishing, and sediment retention. Non-wetland areas also provide important functions such as wildlife habitat, reducing impacts from flood events, and erosion control.

The revegetation program is a critical component of the overall plan to protect and enhance the Wash. Plants help prevent erosion binding loose soil particles on the surface and in deep subsurface horizons with their roots, thereby acting as soil anchors during scouring events (i.e., floods). In addition, revegetation benefits a variety of wildlife species that occur along the Wash, and potentially provides a habitat for new species or species formerly found there to establish or reestablish. A comprehensive revegetation program is needed due to the Wash not historically being a riverine system; therefore, it does not have an abundance of source plants native to these conditions. Moreover, during its transitional period, exotic species such as salt cedar (*Tamarix ramosissima*) successfully established in the area and became the dominant species. As a result, significant time and effort in planning, implementing, and monitoring are required to ensure the revegetation program is successful in restoring the Wash to a natural-type condition.

1.2 Purpose and Scope

The purpose of this report is to document the status of SNWA's revegetation efforts along the Wash. Annual reports documenting the details of the comprehensive vegetation monitoring program along the Wash have been published since 2005 (SNWA 2005, Eckberg and Shanahan, 2008 and 2009, Eckberg 2010, Eckberg 2011, and Eckberg 2012). This report will provide a comprehensive look at data from the last five years of monitoring data; 2008 through 2012. Specific attention will be given to 2012 data as it has not been previously reported. In addition, facets of the overall revegetation program since it was initiated in 2000 will also be discussed. In

2012, as in in all previous years, all revegetation sites that the Las Vegas Wash Project Coordination Team (Wash Team) has implemented to date were monitored and are described in this report. The majority of these activities have been conducted on revegetation project sites located within the boundaries of the Clark County Wetlands Park (Wetlands Park; Figure 1). The only exception is the Clark County Water Reclamation District (CCWRD) revegetation sites which are located just north of the Wetlands Park.

1.3 Need for Revegetation and Vegetation Monitoring

Revegetation projects along the Wash are conducted for multiple important reasons. First, much of the wetland revegetation is a compensatory mitigation requirement for 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 United States. Section 404 of the CWA established a program to regulate the discharge of dredged or fill material into waters of the U.S., which 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 that performance criteria can be achieved. The primary criteria are that mitigation areas are reaching functional attributes of a natural wetland system and not necessarily specific numerical criteria.

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 projects. These permits apply to both riparian and non-wetland revegetation projects. NDEP issues stormwater general permits for construction activities such as building erosion control facilities 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)..." The vegetation monitoring described in this report is an important tool to document vegetation cover and achievement of permit conditions.

In addition to permit-required revegetation, revegetation projects are also required by federal and state grants received by SNWA to help fund the erosion control program, as well as ecological enhancement along the Wash. Granting agencies or institutions require that revegetation projects are successful, and 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 methods. Consequently, monitoring results in this report are summarized cumulatively.

1.4 Program Funding

The Wash Capital Improvement Plan (Wash CIP) and state and federal grants are the two major sources of funding for revegetation projects along the Wash. The Wash CIP exclusively funds revegetation activities stipulated in federal or state permits (e.g., wetland permits) obtained by SNWA as part of weir construction. In contrast, grant funds are used to supplement overall revegetation activities. The majority of the revegetation projects implemented along the Wash have been funded through grants (Table 1).



Figure 1. Location of the 2012 Las Vegas Wash revegetation sites and the Clark County Wetlands Park boundary.

In 2008-2012, there were four funding sources for revegetation implementation along the Wash; the Wash CIP, grants from the Bureau of Reclamation (BOR), and the sixth round of the Southern Nevada Public Lands Management Act (SNPLMA). Previous funding also came from grants from the Clark County Multiple Species Habitat Conservation Plan (MSHCP), NDEP, Nevada Division of State Parks (NDSP), and previous rounds of SNPLMA. Vegetation monitoring is made possible by grants from the BOR.

| Funding So | 2000- 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | TOTAL | |
|------------|---------------|--------|-------|-------|-------|-------|-------|--------|
| CAPITAL | LAS VEGAS | 91.50 | 23.59 | | 1.34 | 0.53 | 7.15 | 124.11 |
| FUNDING | WASH CIP | | | | | | | |
| | BOR | | | | | | 8.21 | 8.21 |
| | MSHCP | 8.43 | | | | | | 8.43 |
| | NDEP | 21.76 | 5.44 | 4.01 | | | | 31.21 |
| GRANTS | NDSP | 13.14 | | | | | | 13.14 |
| | SNPLMA IV | 13.31 | | | | | | 13.31 |
| | SNPLMA V | 32.77 | | | | | | 32.77 |
| | SNPLMA VI | | | 34.33 | 27.15 | 69.37 | 6.63 | 137.48 |
| TOTAL | | 181.43 | 29.03 | 38.34 | 28.49 | 69.90 | 21.99 | 368.66 |

Table 1. Acreage of revegetation sites per funding source.

2.0 MATERIALS AND METHODS

Monitoring was conducted between August and October in all years 2008 through 2012. Monitoring methods followed the same guidelines and techniques as in previous years and is described in detail in past reports (Eckberg and Shanahan, 2008, Eckberg 2011). In the most recent monitoring year, there were 43 wetland and 45 non-wetland revegetation sites. Many of the non-wetlands sites were broken up into multiple monitoring areas (Table 2). ArcGIS was used to monitor four of the revegetation sites in 2012 for total cover; these sites did not have data collected regarding species richness, individual species cover, or Wetland Prevalence Index (WPI). Sites are typically 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). However, in 2012, to best report five year data trends, only passively created wetland sites that are very difficult to monitor in the field were monitored using ArcGIS protocols.

All species documented during vegetation monitoring were crosschecked using the Integrated Taxonomic Information System (ITIS; <u>www.itis.gov</u>) to ensure that the scientific name is currently valid. Updates were made to ten of the species found at various monitoring areas along the Wash in 2011 (Table 3). K eeping this information updated ensures that communications regarding plants used and found at the Wash are as current as possible. Common names are not typically changed due to the variability in their use. No new updates to any Wash species were made in 2012.

Wetland Indicator Status which is used to calculate the WPI prior to 2012 was based on information from the United States Department of Agriculture. As of 2012, the Corps has developed a National Wetlands Plant List (Lichvar, 2012) which is required to be used for all reporting to the Corps. Subsequently, this and all future reports will use the indicator status described in this list to calculate WPI.

One new monitoring criterion was added in 2012; site condition, which is a qualitative assessment of how a particular revegetation site is performing. Each site is assigned a number relative to its condition; 1=poor, 2-fair, 3=good, 4= excellent. Condition is based on a variety of factors including overall health of the plants, aesthetic appearance of the area, relative abundance of non-native plant species, and if plants are reaching their expected growth levels.

2.1 Major Sites

As described in the 2003-2007 Vegetation Monitoring Report (Eckberg and Shanahan, 2008), revegetation sites are grouped into broad categories known as "major sites." These sites are typically associated with weirs or some other major landmark or location. Four new major sites were added between 2008 and 2012.

2.1.1 DU Wetlands No. 2 Weir

The DU Wetlands No. 2 W eir is a single-stage weir, using a confined rock riprap type configuration. This weir was completed in 2009 and is located to the east of the Clark County In-Lieu Fee Mitigation Ponds, downstream of the Monson and Visitor Center Weirs. There is also associated bank protection on both sides of the Wash channel upstream and downstream of the weir. There are three revegetation sites associated with this weir; two non-wetland sites (one on each side of the channel), and one wetland site. The wetland site is divided into two monitoring areas, one on each bank.

2.1.2 Lower Narrows and Homestead Weirs

Located between the Calico Ridge Weir and the Demonstration Weir, these two weirs were completed as a single project. Both weirs are single-stage weirs using a rock riprap type configuration. There is also associated bank protection upstream and downstream of each weir, as well as the entire area in between the two weirs. The weirs and bank protection were completed in 2011. There are three non-wetland and one wetland area at this major site. Two of the non-wetland areas were planted in 2011; the third was planted in fall of 2012 and was not monitored as part of this report. The wetland site includes three monitoring areas along the banks and within the Wash channel.

2.1.3 Upper Diversion Weir and East Bypass Channel

There were two components of this project that were completed in 2009. The first component, the Upper Diversion Weir, is a two-stage weir: (1) roller compacted concrete and, (2) confined rock riprap. The concrete portion had a bridge installed above it, which allows pedestrians visiting the Wetlands Park the ability to cross the Wash. This is at the northern-most portion of the Wetlands Park boundary. The second component is the East Bypass Channel. It was constructed to permanently hold approximately 40% of the Wash flow, has three riprap drop sections, and a continuous riprap sidewall. It will be the most upstream weir built by SNWA. There are eight vegetation monitoring areas at this site, four of which are wetlands and four are

non-wetlands. The wetland sites were divided into 18 individual monitoring areas and the non-wetland sites were separated into eight.

2.1.4 Clark County Water Reclamation District

The fourth new major site created since 2007 is also the only non-weir site. In addition, the revegetation site at the CCWRD is the only revegetation site located outside of the Wetlands Park boundary. Located just north of the Wetlands Park and west of the Wash, it includes both wetland and non-wetland areas. This site was cleared of tamarisk in the spring of 2010 and planted the following fall. Totaling just less than 30 acres, the site was divided into 30 monitoring areas, each approximately one-acre in size.

| | Acr | eage | No. Monit Are | No. of Monitoring Areas | | | |
|--------------------------------------|-------|-------|---------------------|-------------------------------|--|--|--|
| Major Site | 2008 | 2012 | 2008 | 2012 | | | |
| Bostick Weir | 21.6 | 24.1 | 13 | 14 | | | |
| Calico Ridge Weir | 17.7 | 13.8 | 10 | 10 | | | |
| CCWRD | - | 29.5 | - | 30 | | | |
| Cottonwood Cells | 1.4 | 9.8 | 2 | 8 | | | |
| Demonstration Weir | 3.4 | 2.6 | 2 | 2 | | | |
| DU Wetlands No. 2 | - | 11.2 | - | 4 | | | |
| Historic Lateral Weir | 15.6 | 43.7 | 6 | 13 | | | |
| Lower Narrows and Homestead Weirs | - | 61.5 | - | 5 | | | |
| Monson and Visitor Center Weirs | 7.7 | 9.0 | 4 | 4 | | | |
| Pabco Road Weir | 18.8 | 38.9 | 12 | 18 | | | |
| Powerline Crossing Weir | 14.2 | 14.6 | 15 | 16 | | | |
| Rainbow Gardens Weir | 7.0 | 11.3 | 4 | 6 | | | |
| Site-108 | 56.1 | 50.3 | 64 | 66 | | | |
| Site-111 | 15.1 | 14.9 | 24 | 24 | | | |
| Upper Diversion Weir | - | 24.4 | - | 24 | | | |
| TOTAL | 178.6 | 359.6 | 156 | 244 | | | |

Table 2. Change in cumulative acreage monitored and number of monitoringareas from 2008 to 2012.

| Common Name | Previous Scientific Name | Current Scientific Name |
|------------------|--------------------------------|--|
| willow baccharis | Baccharis emoryi | Baccharis salicina |
| cat-claw acacia | Acacia greggii | Senegalia greggii |
| cheesebush | Hymenoclea salsola | Ambrosia salsola |
| Mexican tea | Chenopodium ambrosioides | Dysphania ambrosioides |
| honeysweet | Tidestromia oblongifolia | Tidestromia suffruticosa var. oblongifolia |
| alkali aster | Aster subulatus var. ligulatus | Symphyotrichum subulatum var. ligulatum |
| willow weed | Polygonum lapathifolium | Persicaria lapthifolia |
| horseweed | Conyza coulteri | Laennecia coulteri |
| bulrush | Schoenoplectus maritimus | Bolboschoenus maritimus |
| bush seepweed | Suaeda moquinii | Suaeda nigra |

Table 3. Updated scientific names for plants found along the Las Vegas Wash since 2008.

3.0 RESULTS AND DISCUSSION

The following subsections describe vegetation monitoring results for each major site and revegetation site. The data presented will highlight monitoring results from 2008 through 2012, paying special attention to 2012 data not previously reported. Particular data, however, will be presented in terms of growing seasons, including data collected as early as 2003. Vegetation monitoring data collected from 2000 through 2002 will not be presented. In 2003, vegetation monitoring techniques and associated statistical parameters (i.e. cover class) were changed and have remained relatively constant through 2012. Therefore, only those monitoring data collected since 2003 is in a form suitable for comparison to subsequent years.

From 2008 to 2012, three new major sites were monitored and there were a total of 88 new monitoring areas. The acreage of monitored areas more than doubled, increasing by over 181 acres in five years (Table 1). In addition to new revegetation sites, this increase can also be partially attributed to the addition of passively created wetlands that started to form prior to 2008 but were not previously documented during vegetation monitoring. Cumulatively, there have been just less than 89 acres of wetlands created along the Wash, which is slightly more than 37 acres greater than those required by mitigation permits (Table 4).

As of 2012, there were 14 monitoring areas that have been established for 12 growing seasons. Four of these are non-wetland areas and ten are wetlands. These sites were the first to be planted along the Wash, near the Pabco Road and Historical Lateral Weir (the first two permanent erosion control structures). This long-term data is very important to the Wash Team as it provides information on how sites change and what strategies may be used or may need to be revised to encourage successful self-sustaining revegetation sites.

Compiled monitoring data collected since 2003 shows that the revegetation program is achieving its goal of having sites increase in overall plant cover and becoming self-sustaining. The overall cover, averaged across all revegetation sites, has steadily increased over the course of multiple growing seasons (Figure 2). Monitoring data for non-wetland sites outnumber wetland sites in growing seasons one through four but there was an equal amount in the fifth growing season.

| Mitigation Project | Mitigation Permit Number | Mitigation Required | Wetland Area Created* |
|-------------------------------|-----------------------------|------------------------|--------------------------|
| | | (acres) | (acres) |
| Bostick Weir | 200125114 | 7.88 | 15.63 |
| Calico Ridge Weir | 200450004 | 3.8 | 6.41 |
| Clark County Water | SPK-2009-00227-SG | 7.5 | 8.23 |
| Reclamation District | | | |
| Cottonwood Cells [†] | - | - | 2.92 |
| Demonstration Weir | 199825148 | 0.9 | 0.72 |
| DU Wetland No. 2 Weir | 2007-1961-SG | 0.05 | 1.34 |
| Historic Lateral Weir | 199825148 | 4.9 | 17.71 |
| Lower Narrows and | SPK-2008-01417-SG | 6.25 | 5.14 |
| Homestead Weirs | | | |
| Monson and Visitor Center | 200250111 | 4.81 | 1.93 |
| Weirs | | | |
| Pabco Road Weir | 199725375 | 2.2 | 11.79 |
| Powerline Crossing Weir | 200450454 | 4.87 | 2.37 |
| Rainbow Gardens Weir | 200250054 | 1 | 7.34 |
| Upper Diversion Weir | 200550514 | 0.014 | 7.40 |
| Bank Protection Projects | - | 7.06 | - |
| TOTAL | | 51.234 | 88.93 |

* Wetland acreage created in excess of requirement were primarily from passive establishment or to meet grant obligations

† The Cottonwood Cells had no mitigation requirement but did create wetland areas







In growing seasons six through twelve, there were more wetland revegetation sites. This is important when looking at the overall trends of cover for both types of sites. Both types of revegetation sites increase in cover over time. Non-wetland sites increase relatively slowly compared to wetland sites (Figures 3 and 4). There is also a slight drop in the twelfth growing season for non-wetland sites; this is likely a result of only four sites being monitored. Wetland sites, in contrast, increase rapidly and stay at high levels through all growing seasons.



Figure 3. Average vegetation cover across all non-wetland sites in all years by growing season.

Survivorship across all revegetation sites averages above 70% for all growing seasons. Figure 5 shows the trend from growing seasons 1 through 5, averaged across all sites that had this criterion measured. The increasing trend can be attributed to multiple factors. First, many more sites are monitored in the first growing season, with decreasing numbers of sites monitored in subsequent growing seasons. Second, some sites are replanted with additional plants when initial low survivorship rates are detected. Third, dead plants are often difficult to identify in later growing seasons.

Data collected on the cover of individual species provides important data for the overall management of the revegetation program. These data provide information on species richness, species diversity, noxious species cover, and the relative cover of different plant types. There are no overall statistical trends with species richness; however, there are some insights that can be made from Figure 6. The slight decrease after the first two or three growing seasons can be attributed to the reduction or elimination of supplemental irrigation which decreased weed



Figure 4. Average vegetation cover across all wetland sites in all years by growing season.



Figure 5. Average survivorship of planted plants across all sites in all years by growing season.

establishment. The relative constant level of species after the third growing season is a sign that the sites are self-sustaining. The diversity of plants at Wash revegetation sites is measured using the individual species cover as a proxy for their abundance. Using Simpson's Diversity Index (D; Figure 7), diversity has been very consistent as sites age. While individual species may increase or decrease in cover over time (i.e. establishing on the site or experiencing mortality), overall diversity on the site remains constant. The average noxious species cover has remained low through all growing seasons, never increasing above 6.1% (Figure 8). The two spikes in the seventh and tenth growing seasons can be attributed to growth in salt cedar (*Tamarix ramosissima*) at two individual revegetation sites (different sites in each respective growing season). After monitoring detected this growth, the plants were removed which resulted in the decline the next year.

Figure 9 shows the change in the plant type makeup on revegetation sites across the 12 growing seasons that have been monitored. In the first growing season, there is a relative equal balance between plant types with shrubs being the slightly dominant plant type in terms of cover, with an average of 22.0%. It stays constant through the twelfth growing season at 22.1%. By the twelfth growing season, the dominant plant type is trees. This is expected as the growth potential of trees is much higher than any other plant type. The average cover of trees increased from 5.5% to 58.6% from the first to twelfth growing seasons.



Figure 6. Average species richness across all sites in all years by growing season.



Figure 7. Average species diversity (D) across all sites in all years by growing season.



Figure 8. Average noxious weed cover across all sites in all years by growing season.



Figure 9. Average cover composition across all sites in all years by growing season.

3.1 Bostick Weir

Thirteen sites were monitored both in 2012 and 2008 at Bostick Weir (Figure 10; Table 5). Six of these sites were in their eighth growing season and seven in their ninth. The number of wetland versus non-wetland sites was pretty equal with six wetland monitoring areas and seven that were non-wetland. However, the wetland acreage makes up 68.3% of the total revegetation acreage at the Bostick Weir. This division takes into account the Upstream Bostick South revegetation site, which separated in 2006 into separate wetland and non-wetland monitoring areas. The acreage change amongst the sites follows the pattern of most revegetation sites along the Wash in that wetland sites, particularly those within the Wash channel, have higher annual variability than non-wetland sites.

All sites were monitored for all monitoring criteria in 2008 and 2012 and all but one site (Bostick Islands) had all criteria monitored as well. Total cover was monitored in all years on all sites, either through field measurements or with ArcGIS. In 2009 through 2011, field measurements were taken at selected sites following protocols described in the 2008 Las Vegas Wash Vegetation Monitoring Report (Eckberg and Shanahan 2009). The average total cover across all Bostick Weir sites continued to steadily increase from 2008 through 2012 (Figure 11). Ten of the 13 monitoring areas reached the maximum value under the monitoring protocol (75-100%) in 2012 and all sites had the same total cover value in 2011 as in 2012. This is a good sign that most sites have reached their maximum canopy cover.

The average noxious weed cover at Bostick Weir sites remained very low from 2008 to 2012 (Figure 12). At these sites, this suppression of noxious weed growth is more of a result of native species taking up the space that weeds would otherwise establish rather than any maintenance activity. Maintenance activities at older sites are minimal.



Figure 10. Aerial photograph of 2012 delineated Bostick Weir revegetation sites.

| Site Code ¹ | 2012 Growing | | Wetland Status ² | | | | |
|---------------------------|-----------------|------|--------------------------------|------|------|------|---------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | |
| В | 9 | 7.31 | 7.14 | 7.50 | 6.49 | 7.27 | wet |
| BI | 9 | 2.31 | 3.00 | 3.51 | 3.60 | 4.07 | wet |
| BN | 9 | 0.89 | 0.89 | 0.89 | 0.89 | 0.84 | non-wet |
| BS | 8 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | non-wet |
| DBN | 9 | 0.45 | 0.45 | 0.45 | 0.45 | 0.44 | non-wet |
| DBS | 8 | 0.19 | 0.19 | 0.20 | 0.20 | 0.21 | non-wet |
| DBSE | 8 | 0.77 | 0.79 | 0.72 | 0.75 | 0.77 | wet |
| UBN | 9 | 0.52 | 0.52 | 0.53 | 0.54 | 0.56 | non-wet |
| UBNB | 8 | 0.93 | 0.96 | 1.06 | 1.07 | 1.24 | wet |
| UBNE | 8 | 1.54 | 1.57 | 1.61 | 1.62 | 1.65 | wet |
| UBS | 9 | 2.24 | 2.25 | 2.28 | 2.28 | 2.48 | non-wet |
| UBS | 9 | 1.54 | 1.67 | 1.68 | 1.63 | 1.66 | wet |
| UBSB | 8 | 1.84 | 1.84 | 1.85 | 1.85 | 1.78 | non-wet |

¹B=Bostick, BI=Bostick Islands, BN=Bostick North, BS=-Bostick South, 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

²Wetland 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

Table 5. Physical characteristics of Bostick Weir revegetation sites in 2008-2012.

More than 99% of the noxious weed cover in 2012 can be attributed to salt cedar. The only other noxious weed detected was Maltese star-thistle which had a cover value of 0.1% at Bostick.

The average number of species per revegetation site at the Bostick Weir decreased slightly from 2008 to 2012 (Figure 13). The sharp drop in species richness in 2009 can be attributed to only 5 of the 13 sites having species specific criteria monitored in that year. Figure 14 shows how these species break down by plant type and their relative cover across all sites. The dominant plant types in 2008 were trees and graminoids. Shrubs joined these two groups in having close to an equal amount of relative cover in 2012. Like species richness, relative cover data from 2009-2011 is only for those sites monitored in the field. Only 2008 and 2012 have species cover data for all sites.



Figure 11. Average vegetation cover across all Bostick sites from 2008 to 2012.



Figure 12. Average noxious weed cover across all Bostick sites from 2008 to 2012.



Figure 13. Average species richness across all Bostick sites from 2008 to 2012.



Figure 14. Average cover composition across all Bostick sites from 2008 to 2012.

3.1.1 Bostick

Bostick (B) is the revegetation site located on the Bostick Weir itself. This wetland site is the largest site associated with the Bostick Weir and one of the largest wetland sites along the Wash. Monitoring indicates that this site is very stable and self-sufficient. Since 2008, the total cover on the site has remained constant at the highest ranking (75-100%; Table 6). This includes field measurements in 2008, 2010, and 2012. Also, the number of species identified in the field monitoring years remained stable, as well with 36 species identified in each of the three years. No plants were planted on this site; all vegetation on this site was passively established. The dominant species in all three years by a substantial margin was common reed (*Phragmites australis*). This wetland grass species has two haplotypes found along the Wash, one which is native to the region and the other not. There is also a hybrid of these two: it is unclear at this time which type is found at this site. Common reed made up 50% of the cover in 2012. The only other species with greater than 10% cover was sandbar willow (*Salix exigua*), which had a cover value of 26.3%.

The plant dominance on this site is a representation of how wetland sites on or adjacent to erosion control structures are managed along the Wash. The dominant species in 2006 and 2007 on B was Goodding's willow (*Salix gooddingii*). This large tree is a desired species in the Wash. However, its physical structure impacts the function and stability of the weir when growing within the rock riprap. When individual trees are identified to be a problem or potential problem with the weir function, they are removed. At B, this has resulted in the increase in more flexible and rapid establishing species such as common reed.



Figure 15. The Bostick revegetation site is over seven acres in size and has maintained high species richness during 2008-2012.

| Site | 2008 | | | | | 2009 | | 2010 | | | 2011 | | | | 2012 | | | | | |
|-------------------|---------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|
| Code ¹ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| В | 75-100 | 0.6 | 36 | 2.05 | 75-100 | nm | nm | nm | 75-100 | 0.4 | 36 | 1.99 | 75-100 | nm | nm | nm | 75-100 | 1.6% | 36 | 2.22 |
| BI | 75-100 | 0.0 | 5 | 1.51 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 10 | 1.64 | 75-100 | nm | nm | nm | 75-100 | nm | nm | nm |
| BN | 25-50 | 0.0 | 10 | 4.75 | 25-50 | 0.0 | 7 | 4.71 | 25-50 | nm | nm | nm | 25-50 | 0.0 | 6 | 4.73 | 25-50 | 0.0 | 5 | 4.96 |
| BS | 25-50 | 0.5 | 14 | 3.70 | 25-50 | nm | nm | nm | 50-75 | 0.0 | 11 | 3.56 | 75-100 | 0.5 | 12 | 3.68 | 75-100 | 0.1 | 19 | 3.88 |
| DBN | 25-50 | 0.0 | 9 | 4.77 | 25-50 | nm | nm | nm | 25-50 | 0.0 | 10 | 4.93 | 25-50 | nm | nm | nm | 25-50 | 0.0 | 7 | 4.92 |
| DBS | 5-25 | 0.0 | 7 | 4.63 | 25-50 | 0.0 | 10 | 4.64 | 25-50 | 0.0 | 10 | 4.58 | 50-75 | 0.0 | 9 | 4.87 | 50-75 | 0.0 | 7 | 4.73 |
| DBSE | 75-100 | 0.1 | 20 | 1.99 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 24 | 1.96 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 10 | 2.17 |
| UBN | 50-75 | 0.5 | 11 | 3.33 | 75-100 | 2.5 | 11 | 3.17 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 9 | 3.26 | 75-100 | 2.5 | 11 | 3.60 |
| UBNB | 75-100 | 2.5 | 10 | 1.87 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 5 | 1.98 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 6 | 1.90 |
| UBNE | 75-100 | 15.1 | 21 | 2.15 | 75-100 | nm | nm | nm | 50-75 | 2.6 | 10 | 2.05 | 75-100 | 3.0 | 7 | 2.07 | 75-100 | 0.1 | 11 | 1.64 |
| UBS-N | 50-75 | 0.5 | 18 | 3.30 | 75-100 | 0.2 | 21 | 3.76 | 75-100 | 0.0 | 13 | 3.55 | 75-100 | 2.5 | 12 | 3.81 | 75-100 | 0.5 | 15 | 3.39 |
| UBS-W | 75-100 | 0.6 | 39 | 2.15 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 29 | 2.21 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 20 | 2.05 |
| UBSB | 25-50 | 0.1 | 12 | 3.64 | 50-75 | 0.5 | 13 | 3.61 | 75-100 | 0.1 | 15 | 4.08 | 75-100 | 0.0 | 10 | 4.08 | 75-100 | 0.5 | 10 | 3.90 |

¹B=Bostick, BI=Bostick Islands, BN=Bostick North, BS=-Bostick South, DBN=Downstream Bostick North, DBS=Downstream Bostick South, DBN=EDownstream Bostick South, DBN=Upstream Bostick South, UBN=Upstream Bostick North, UBNB=Upstream Bostick North Bank, UBNE=Upstream Bostick North Emergent, UBS=Upstream Bostick South, UBSB=Upstream Bostick South, Bank

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

⁴SR = Species Richness. The number of species identified on the site

 $^{5}WPI =$ Wetland Prevalence Index value. WPI $\leq 2.0 =$ wetland, $2.0 \leq$ WPI $\leq 2.5 =$ likely wetland, $2.5 \leq$ WPI $\leq 3.5 =$ may be wetland, $3.5 \leq$ WPI $\leq 4.0 =$ not likely a wetland, and WPI $\geq 4.0 =$ upland

nm = this attribute was not monitored

Table 6. Vegetation monitoring results for Bostick Weir revegetation sites in 2008-2012.

3.1.2 Bostick Islands

The Bostick Islands (BI) revegetation site is located within the Wash channel upstream of the Bostick Weir. These islands formed passively with sedimentation in the channel as a result of the decreased velocities above the weir. Field monitoring of cover and species specific data has only been done two years in the 2008-2012 timeframe. In 2009, 2011, and 2012, the total cover of the site was determined by using ArcGIS and aerial photography. In all five years the total cover was the maximum 75-100%. There were some plants planted on this site in 2006, but the majority of plants found today are a combination of expansions of those planted plants (clonal reproduction) and passively established plants. This claim is substantiated by the fact the site was only 0.12 acres when planted and is 3.67 acres today.

3.1.3 Bostick North

Bostick North (BN) is located directly north of the Bostick Weir on the bank of the Wash. This non-wetland site is another example of a very stable site in terms of its overall cover. In all monitoring years (2008 to 2012), its total cover fell in the range of 25-50%. This included 2010, where the cover was calculated using ArcGIS. The dominant species in all four monitoring years in the field was creosote bush (*Larrea tridentata*). This species' cover in 2012 was 25-50%, the same as the site as a whole. Creosote bush has experienced a substantial growth since the site's first growing season in 2004 when it had just 0.3%.



Figure 16. Creosote bush dominated the Bostick North site during vegetation monitoring in 2012.

BN has both signs of being a successful site as well as indicators that lead to concern that this site will be sustainable. The continued growth of creosote bush on the site is a good sign that this native shrub will dominate this site for years to come. In 2012, another native plant, honey mesquite (Prosopis glandulosa var. torreyana), has had a relatively constant cover level of 15%. No noxious species have ever been identified on BN, another sign of success. In contrast, the number of species present has steadily declined. In the first monitoring year, 2004, as well as in 2008, there were ten species identified on the site. In 2012, there were only five. The site condition in 2012 was rated a one, the lowest level. This was due to physical condition of the plants. While they have grown in size to provide cover on the site, the health of the plants was poor. This site is very rocky and far from the water table; it is hypothesized that lack of water is the main cause of the health decline in the plants. This hydrologic condition likely also led to the species composition on the site and a WPI of 4.96, the very high end of the WPI scale.

3.1.4 Bostick South

Located directly south of the Bostick Weir, Bostick South (BS) was planted in the fall of 2004. This site's cover has regularly increased over time (Table 6). In 2011 and 2012, it had the highest cover range (75-100%). This increase coincides with the two co-dominant plants on the site; fourwing saltbush (Atriplex canescens var. canescens) and honey mesquite. Both species had a cover of 25-50% in 2012. Only one other species had more than 5% cover in 2012 - desert willow (Chilopsis linearis ssp. arcuata).

Species richness, like cover, has regularly increased Only the first monitoring year, from 2008-2012. 2005, had a higher number of species than 2012, with 24 and 19, respectively. The only noxious species that has ever been identified on the site is salt cedar, with a cover value of just 0.1% in 2012.

3.1.5 Downstream Bostick North

From 2008 t o 2012, D ownstream Bostick North (DBN) had the same total cover in each monitoring year, 25-50%. This includes 2009 and 2011, where the total cover was calculated using ArcGIS. The site is likely at the upper edge of this cover class however. Between 2010 and 2012, two of the three dominant species on the site increased in cover; creosote bush increased from 5-25% to 25-50%, and honey mesquite increased from 1-5% to 5-25%. The third dominant species on the site, fourwing saltbush, had 5-25% cover in both years.

Like BN, DBN is a very dry site. The WPI has Figure 17. Desert willow in bloom along remained very high with an index of 4.93 in 2010 and the Wash. 4.92 in 2012. The hydrological conditions explain the



slow growth rate of the plants on the site. It may also partially explain the 2.00 site condition rating in 2012. The site is considered successful however, as plants continue to increase in cover
and there have never been any noxious species identified there. In fact, only native species were identified in 2012.

3.1.6 Downstream Bostick South

Like BN and DBN, Downstream Bostick South (DBS) is a relatively dry site. In addition to being nearly 150 feet from the Wash channel, it is also on a steep slope which doesn't allow for rainwater to accumulate on the site. Unlike BN and DBN however, DBS has steadily increased in cover over the past five monitoring seasons. In 2008, the total cover was 5-25%, in 2009 and 2010, it was 25-50%, and in 2011 and 2012, the total cover was 50-75%. The growth is consistent with the increasing cover from the three dominant species on the site; fourwing saltbush, honey mesquite, and desert broom (*Baccharis sarothroides*).

The number of species identified at DBS was seven; the same in 2012 as it was in 2008. There were higher numbers identified in the years between - ten species in 2009 and 2010 and nine species in 2011. There were four additional species that were temporarily found on DBS; these are small forbs and a grass that easily establishes on sites when conditions are good but just as easily die off when conditions are less favorable. These were flattop buckwheat (*Eriogonum deflexum* var. *deflexum*), salt heliotrope (*Heliotropium curassavicum*), Russian thistle (*Salsola tragus*), and splitgrass (*Schismus barbatus*). No noxious weeds have ever been documented at DBS.



Figure 18. Splitgrass is a common non-native grass in revegetation sites along the Wash.

3.1.7 Downstream Bostick South Emergent

Like most wetland sites. Downstream Bostick South Emergent (DBSE) has had very high total vegetative cover since establishment. From 2008-2012, the total cover has remained at 75-100%, the maximum cover class. Total cover was calculated using field observations in 2008, 2010, and 2012, while ArcGIS was used in 2009 a nd 2011. Species richness in 2012 dropped substantially from the previous two field monitoring years; from 20 and 24 in 2008 and 2010, respectively, to just 10 in 2012. Of the 14 species found in 2010 but not 2012, only one had more than 1% cover in

2012; bulrush (*Bolboschoenus maritimus*), which had 1-5% cover. The decrease in this species' contribution to the total cover was made up by the increase in cover by common reed which increased from 2-25% cover in 2010 to 50-75% in 2012.

3.1.8 Upstream Bostick North

Upstream Bostick North (UBN) has increased in cover to the maximum cover class of 75-100%. The last monitoring year it fell below this level was in 2008 when it was 50-75%. This site is categorized as non-wetland; however, the WPI based on the plants found there has been below 3.5 (may be a wetland) for each monitoring year from 2008-2011. In 2012, the WPI was 3.6. This is because while most of the site is on a bank, the southern edge touches the bank of the Wash channel. This has allowed some riparian trees such as Goodding's willow and Cottonwoods (*Populus fremontii*) to do well here. To further illustrate this site's dichotomy, the two dominant plants on the site are Goodding's willow which has a wetland indicator ranking of 2 and honey mesquite which is a 5.



Figure 19. Goodding's willow and honey mesquite dominate the Upstream Bostick North revegetation site in 2012.

3.1.9 Upstream Bostick North Bank

At just over an acre in size, Upstream Bostick North Bank (UBNB) is a wetland site upstream of UBN adjacent to the Wash channel. In every year of monitoring, the total cover has been determined to be 75-100% (2009 and 2011 were done with ArcGIS). While the total cover has remained constant, species richness has decreased. In 2008, there were ten species found on the site and only six were identified in 2012. This decline is even more substantial when you consider there were 17 species identified in 2006. Like most sites that see a decline in species, those that are no longer present on the site never had more than 1% cover. The dominant species in every year since monitoring began has been common reed, which had 50-75% cover in 2012.

3.1.10 Upstream Bostick North Emergent

Upstream Bostick North Emergent (UBNE), a wetland site, had substantial earthwork done in early 2012. This site is located at the crest of the Bostick Weir. Soil had deposited in this area to such an extent that it was impacting the designed function of the weir. It was anticipated that there would be substantial impact to the vegetation on the site, at least in the short term. However, the vegetation community appears to have responded quickly and effectively.

The total cover for the site remained at 75-100%, where it has been since first monitored. The number of species increased slightly. This was expected due to new open areas allowing for establishment of new plants. Also as expected, the soil removal included the removal of all Goodding's willow on the site, which has not re-established. Instead, southern cattail (*Typha domingensis*) has increased tremendously. In 2008, southern cattail had a cover value of 1-5% and was not identified on the site in 2010 or 2011, but in 2012, the cover class had increased to 25-50%. One factor that was not expected was that there was little change in the vegetative cover provided by common reed. Because of its invasive nature, it was expected that common reed would fill in all open space on the site. However, its cover class remained unchanged compared to the two previous years at 50-75%.

3.1.11 Upstream Bostick South – Nonwetland

The non-wetland Upstream Bostick South (UBS-N) has been a stable site for many years and shows many signs of being successful. The site has had a total cover of 75-100% since 2009. The species richness in the past five years has fluctuated but has also been relatively stable; there were 18 species identified in 2008 and 15 i n 2012. The highest number of species identified in the past five years was 21 in 2009. Despite the modest fluctuation of species, the WPI has also remained stable with an index of 3.30 in 2008 and 3.39 in 2012. The dominant species in 2012 was quailbush, which was the co-dominant species from 2009 to 2011. The last year a different species covered more area than quailbush was in 2008 when screwbean mesquite species. One item of concern on the site is the decline in honey mesquite cover; in



(*Prosopis pubescens*) was the dominant Figure 20. Southern cattail is a common wetland species species. One item of concern on the site along the Wash.

2008, it had a total cover of 1-5%, in 2009 and 2010, it increased to 5-25%, in 2011, it increased again to 25-50%. In 2012, however, the cover decreased back down to 1-5%. There was visible stress observed on both honey and screwbean mesquites on the site. Although the cause is not

certain, perhaps the improvements to water flow across the Bostick Weir have inadvertently decreased the available water in non-wetland areas adjacent to the channel.

3.1.12 Upstream Bostick South – Wetland

Adjacent to UBS-N is Upstream Bostick South-Wetland (UBS-W). Like UBS-N, UBS-W has been a v ery stable site and can be described as being successful. Since the site has been monitored as a separate site from UBS-N in 2006, UBS-W has had the highest possible total cover ranking of 75-100%. In 2009 and 2011, the total cover was monitored using ArcGIS, therefore no specific species information was collected. However, the trend of species richness is declining on the site. In 2008, the number of species was at its highest, 39. By 2010, the number of species decreased to 29, and in the most recent monitoring, it fell to just 20. This can be partially explained by the success of the remaining plants. None of the plants that have been extirpated from the site ever had a total cover greater than 1%. The growth of the remaining plants likely crowded out these small patches, often individual plants. The dominant species in 2012 was common reed, which has been either the dominant or co-dominant species on this site since monitoring began. Common reed grows and reproduces very quickly and its invasive characteristics are likely to blame for much of the species lost on this site.



Figure 21. Cat-claw acacia trees with an understory of quailbush at the Upstream Bostick South – Non-wetland revegetation site in 2012.

3.1.13 Upstream Bostick South Bank

Located to the south of UBS-N, Upstream Bostick South Bank (UBSB) sits at a slightly higher elevation than UBS-N. This site has steadily increased in cover since monitoring began. In the past five years, cover increased from 25-50% in 2008 to 75-100% in 2010 and has remained at this maximum level. Unlike most sites, the steady increase in cover cannot be attributed to the growth of a single species; rather multiple species have experienced modest but increased growth trends that have led to the site's overall success. The two co-dominant species on the site are honey and screwbean mesquite, both with 25-50% cover. In addition, quailbush and catclaw acacia both had cover values of 5-25%. These four species make up the bulk of the cover. The six remaining species on the site have less than 5% cover and four have less than 1%.



Figure 22. Large honey mesquite with cat-claw acacia and creosote bush at the Upstream Bostick South Bank revegetation site in 2012.

3.2 Calico Ridge Weir

The same sites monitored at the Calico Ridge Weir in 2008 were monitored in 2012 (Figure 23; Table 7). There was one additional site, Downstream Calico Emergent (DCE), which was monitored exclusively in 2010. This passively created wetland site was inundated by the backwaters created by the Lower Narrows Weir in 2011 and no longer exists. The nine sites that have been monitored in all years consist of five wetland sites and four non-wetland. In 2012, all nine sites were in their eighth growing season and made up 13.89 acres of the total revegetation along the Wash. All of the sites were planted in 2005.



Figure 23. Aerial photograph of 2012 delineated Calico Ridge Weir revegetation sites.

| Site Code ¹ | 2012 Growing | | Acreage for | Each Monit | oring Year | | Wetland Status ² | |
|---------------------------|-----------------|------|-------------|------------|------------|------|--------------------------------|--|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | | |
| С | 9 | 1.34 | 1.55 | 1.61 | 1.62 | 1.60 | wet | |
| DCN | 9 | 1.05 | 1.05 | 0.64 | 0.64 | 0.65 | non-wet | |
| DCS | 9 | 5.08 | 5.05 | 2.68 | 2.28 | 2.01 | non-wet | |
| DCS | 9 | 1.06 | 1.16 | 1.12 | 0.81 | 0.26 | wet | |
| UCE | 9 | 2.78 | 2.61 | 2.75 | 2.69 | 2.81 | wet | |
| UCN | 9 | 2.11 | 2.11 | 2.06 | 2.02 | 1.98 | non-wet | |
| UCN | 9 | 0.39 | 0.50 | 0.73 | 0.74 | 0.84 | wet | |
| UCS | 9 | 3.19 | 3.19 | 2.94 | 2.94 | 2.87 | non-wet | |
| UCS | 9 | 0.73 | 0.77 | 0.76 | 0.62 | 0.76 | wet | |

¹C=Calico, DCN=Downstream Calico North, DCS=Downstream Calico South, UCE=Upstream Calico Emergent, UCN=Upstream Calico North, UCS=Upstream Calico South

²Wetland 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

Table 7. Physical characteristics of Calico Ridge Weir sites in 2008-2012.

Total cover for the Calico Ridge Weir sites in 2012 ranged from 25-50% to 75-100%, with the average total cover being 69.2% when weighted by size (Figure 24). This is the highest total cover across all monitoring years, up from 64.2% in 2008. All sites were monitored in the field in 2008, 2010, a nd 2012. Three sites were monitored in the field in 2009 and five in 2011. Noxious weed cover has remained very low across these sites. The highest percentage of cover was in 2008 (the fourth growing season), and noxious weeds covered an average 2.1% of the sites (Figure 25).



Figure 24. Average vegetation cover across all Calico Ridge sites from 2008 to 2012.



Figure 25. Average noxious weed cover across all Calico Ridge revegetation sites from 2008 to 2012.

The most recent monitoring year documented the second lowest average species richness across Calico Ridge sites with 9.56 (Figure 26). Only 2009 had lower species richness at 7.67. However, this can be explained as a result of only three sites being field monitored that year. That is not the case with the current year's data. There was a large drop in the number of species recorded at Upstream Calico Emergent (UCE), declining from 22 species in 2011 to just 8 in 2012. Cover composition of Calico Ridge sites in early growing seasons were dominated by shrubs which have transitioned into more even distribution amongst trees, shrubs, and grasses (Figure 27).

3.2.1 Calico

Calico (C) is the wetland revegetation site located on top of the Calico Ridge Weir itself (Figures 23 and 28). There were portions of the site that were planted in 2005, but much of the area has passively established. The site was divided into two monitoring areas on the north and south side of the Wash and has always had the highest cover ranking for monitoring (75-100%) since monitoring began in 2006. Species richness however, has declined over the past few years (Table 8). In 2008, the total number of species on the site was 20; in 2010, it dropped to just eight species and just one more species was detected in 2012. The site was not field monitored in 2009 or 2011. The dominant species in all years has been common reed, which has an aggressive nature, and may be the reason for a decline in the total number of species. The species with the second highest contribution to the total cover in all monitoring years has been salt cedar; it had a total cover of 2.5% in 2012.



Figure 26. Average species richness across all Calico Ridge revegetation sites from 2008 to 2012.



Figure 27. Average cover composition across all Calico Ridge revegetation sites from 2008 to 2012.

| Site | | 2008 | | | | 2009 |) | | 2010 | | | 2011 | | | | 2012 | | | | |
|-------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|------------|------------------|--------|------------------|---------|------------------|--------|------------------|------------|------------------|--------|------------------|
| Code ¹ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| С | 75-100 | 7.1 | 20 | 2.04 | 75-100 | nm | nm | nm | 75- 100 | 0.3 | 8 | 1.99 | 75-100 | nm | nm | nm | 75- 100 | 2.5 | 9 | 1.95 |
| DCN | 50-75 | 0.5 | 11 | 4.83 | 25-50 | 0.5 | 7 | 4.95 | 25-50 | 0.1 | 9 | 4.84 | 5-25 | 0.0 | 8 | 4.19 | 25-50 | 0.0 | 7 | 4.03 |
| DCS-N | 25-50 | 2.5 | 9 | 4.81 | 5-25 | nm | nm | nm | 25-50 | 0.5 | 9 | 4.90 | 5-25 | 2.5 | 11 | 4.78 | 25-50 | 0.5 | 18 | 4.80 |
| DCS- W | 75-100 | 2.5 | 14 | 2.06 | 75-100 | nm | nm | nm | 75- 100 | 2.5 | 12 | 2.03 | 75-100 | nm | nm | nm | 75- 100 | 2.5 | 7 | 2.10 |
| UCE | 75-100 | 2.6 | 26 | 2.17 | 75-100 | nm | nm | nm | 75- 100 | 0.0 | 4 | 1.84 | 75-100 | 1.0 | 22 | 1.80 | 75- 100 | 0.0 | 8 | 1.92 |
| UCN- N | 50-75 | 0.5 | 13 | 4.62 | 25-50 | 0.1 | 6 | 4.98 | 50-75 | 0.1 | 9 | 4.96 | 25-50 | 0.5 | 12 | 4.89 | 50-75 | 0.5 | 8 | 4.76 |
| UCN- W | 75-100 | 2.5 | 10 | 1.79 | 75-100 | nm | nm | nm | 75- 100 | 0.0 | 10 | 1.45 | 75-100 | nm | nm | nm | 75- 100 | 2.5 | 7 | 2.06 |
| UCS-N | 50-75 | 0.0 | 14 | 4.22 | 50-75 | 0.1 | 17 | 4.91 | 25-50 | 0.0 | 10 | 4.30 | 50-75 | 0.0 | 12 | 4.78 | 50-75 | 0.0 | 10 | 4.72 |
| UCS- W | 75-100 | 0.5 | 21 | 2.19 | 75-100 | nm | nm | nm | 75- 100 | 0.1 | 13 | 2.13 | 75-100 | nm | nm | nm | 75- 100 | 2.5 | 12 | 2.33 |

¹B=Bostick, BI=Bostick Islands, BN=Bostick North, BS=-Bostick South, DBN=Downstream Bostick North, DBS=Downstream Bostick South, DBSE=Downstream Bostick South, DBN=Upstream Bostick North, UBNB=Upstream Bostick North Bank, UBNE=Upstream Bostick North Emergent, UBS=Upstream Bostick South, UBSB=Upstream Bostick South Bank

 $^{2}TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas$

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

⁴SR = Species Richness. The number of species identified on the site

 5 WPI = Wetland Prevalence Index value. WPI ≤ 2.0 =wetland, $2.0 \leq$ 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 ≥ 4.0 = upland nm = this attribute was not monitored

Table 8. Vegetation monitoring results for Calico Ridge Weir revegetation sites in 2008-2012.



Figure 28. Calico (center), Downstream Calico South – Non-wetland (lower left), and Downstream Calico South – Wetland (lower right) revegetation sites during vegetation monitoring in 2012.

3.2.2 Downstream Calico North

Downstream Calico North (DCN) is a non-wetland site almost adjacent to the north side monitoring area of C with just a small bank protected by rip-rap separating the two (Figure 23). DCN, like many non-wetland sites, has consistently had smaller total cover rankings than wetland sites. In the 2008-2012 timeframe, it has had three years with 25-50% cover, one year with 50-75% cover, and one year with 5-25% cover. The inconsistent total cover values mirror closely with the cover from the dominant species on the site, fourwing saltbush. Both the total cover and fourwing saltbush cover increased in 2012 after a decline in 2011.

In 2010, the size of DCN was reduced from 1.05 acres to 0.64 acres. This was a result of construction activities at the Lower Narrows Weir; however, the majority of this lost acreage was later revegetated once constructed activities concluded.

3.2.3 Downstream Calico South – Non-wetland

The non-wetland component of Downstream Calico South (DCS-N) like DCN is located adjacent to the bank protection alongside the Calico Ridge Weir (Figures 23 and 28). Also like DCN, it is at a much higher elevation which is why it has predominantly non-wetland vegetation. In the fall of 2011, vegetation was planted to the south of DCS-N as part of the Lower Narrows and Homestead Weir. With this newly planted area, irrigation was applied, much of which oversprayed onto DCS-N. As a result, many new species established themselves on DCS-N and the total cover also increased. Species richness increased from 11 species in 2011 to 18 in 2012, the

highest that has ever been documented. All of the new species had less than 1% cover except for shadscale (*Atriplex confertifolia*), which had a cover value of 1-5%. Total cover increased from 5-25% in 2011 to 25-50% in 2012. DCS-N has had oscillating total cover values alternating between 5-25% and 25-50% since 2008, including 2009 where total cover was calculated using ArcGIS and it was determined to be 5-25%.

3.2.4 Downstream Calico South – Wetland

Downstream Calico South – Wetland (DCS-W) is located downstream of the C revegetation site along the southern bank of the Wash (Figures 23 and 28). DCS-W has been substantially impacted by the Lower Narrows Weir. The backwater created by the weir has inundated much of the vegetation, causing die-off and decreasing the overall size of the area. Like most wetland sites, DCS-W grew in size with sedimentation and the passive establishment of plant material, along with the growth of planted material. It reached its largest size in 2010 at 1.12 acres. After the Lower Narrows Weir was completed in 2011, the size decreased to 0.81 acres and decreased again in 2012 to just 0.26 acres. There has also been a large drop in species richness with just seven species recorded in 2012 (down from 14 in 2008).

The total cover has always been 75-100% since monitoring began in 2006. The vast majority of the vegetation on the site is common reed, which also had a total cover of 75-100% in 2012. This is a sharp change from 2010 where the dominant species was Goodding's willow with 50-75% cover; sandbar willow had a cover of 25-50%, and common reed had a cover of just 5-25%. In 2012, neither Goodding's nor sandbar willow were documented on the site.

3.2.5 Upstream Calico Emergent

Upstream Calico Emergent (UCE) is located between the Calico Ridge Weir and the Bostick Weir (Figures 23 and 29). It was a passively created island that formed as sediments were deposited in the backwater behind the Calico Ridge Weir. The dominant plant on this island since monitoring began in 2006 has been Goodding's willow. However, the overall plant makeup and the species richness have been quite variable over the past five years. In 2008, species richness was at its highest with 26, declined to just 4 in 2010, up to 22 in 2011, and down again to just 8 in 2012. This is likely due to its location in the middle of the Wash channel. It will be impacted more than most sites by flooding. First, flooding will remove any small forbs that do not have extensive root systems and possibly remove many larger plants (depending on the strength of the storm surge). Second, the floods will deposit sediment which provides a substrate for establishment and growth of plants in subsequent growing seasons.

3.2.6 Upstream Calico North – Non-wetland

The non-wetland Upstream Calico North (UCN-N) is a relatively dry site located between DBN and DCN (Figures 23 and 29). The majority of the vegetation is located along the bank sloping down towards the bank protection along the Wash. The dominant species on the site has always been fourwing saltbush. The total cover has gone back and forth between 50-75% and 25-50% since 2008 and in 2012, it was again 50-75%. This total cover is one of the highest of established non-wetland sites. The WPI is also one of the highest of all revegetation sites, with all recordings being higher than 4.6. In 2009, the WPI was 4.98 (the maximum value is 5.0) with salt cedar being the only species found on the site with a WPI lower than 5.0 (3.0).



Figure 29. From top to bottom: Upstream Calico Emergent, Upstream Calico North – Non-wetland, and Upstream Calico North – Wetland revegetation sites during vegetation monitoring in 2012.

3.2.7 Upstream Calico North – Wetland

The Upstream Calico North – Wetland (UCN-W) site has been a pretty consistent site across the past five growing seasons (Table 8). Like many established wetland sites, the total cover has been 75-100% each year since monitoring began on this site in 2006. The species richness has also been very consistent: between seven and ten species have been recorded each year that the site has been monitored in the field. In the 2008-2012 timeframe, the site was monitored for total cover using ArcGIS twice – in 2009 and 2011. The dominant species in all years of monitoring at the site has been common reed. In 2012, the second most prevalent species in terms of cover was sandbar willow at 5-25%. The five remaining species all had cover values of 1-5%. One species that has declined in cover has been the tule (Schoenoplectus acutus var. occidentalis). In 2008, tule had a cover of 5-25%, in 2010 it increased to 25-50%, but in 2012, it declined to its lowest value of 1-5%. This decline may be a result of the increase in cover by common reed and sandbar willow, both of which are aggressive in their expansion of range and are known to outcompete other species for resources.

3.2.8 Upstream Calico South – Non-wetland

Another revegetation site that has been pretty consistent over the past five years has been Upstream Calico South-Non-wetland (UCS-N). The total cover in 2008 was the same in 2012, 50-75%. The only year that the total cover was different was 2010 when it was determined to be 25-50%. Species richness in 2008 was 14 species, with a slight decline in 2012 to just 10. In 2009, 17 species were documented. Since monitoring began, the dominant species has been

fourwing saltbush. Tall whitetop (*Lepidium latifolium*; Figure 30) was the only noxious species documented from 2008 to 2012. It had a cover value of 0.1% in 2009.

3.2.9 Upstream Calico South – Wetland

Upstream Calico South - Wetland (UCS-W) stretches across approximately 800 feet of the southern bank of the Wash, adjacent to DBSE upstream and C downstream. The total cover of UCS-W has consistently been 75-100%. despite the dominant vegetation being quite variable. In 2012, there were 21 species identified with three species having 25-50% cover; common reed, sandbar willow, and Goodding's willow. There were also two species that had 5-25% (Pluchea arrowweed cover:



Figure 30. Tall whitetop is a common noxious weed found along the Wash.

sericea) and Fremont's cottonwood. In 2012, only common reed and sandbar willow had 25-50% cover; Goodding's willow, Fremont's cottonwood, arrowweed, and quailbush all had 5-25% cover.

3.3 Clark County Water Reclamation District

The revegetation area located at the Clark County Water Reclamation District (CCWRD) is the only one outside of the boundaries of the Wetlands Park (Figure 31). This site is not associated with any erosion control structure. The land was provided by CCWRD to SNWA for the sole purpose of revegetation and includes both wetland and non-wetland areas (Tables 9 and 10; Figure 31). Approximately four acres of non-wetland revegetation was funded by a grant from NDEP, while the remainder was funded by the SNPLMA Round 5 grant. The site was planted as part of a volunteer Green-Up event on October 17, 2009.

| Site Code ¹ | 2012 Growing | | Acreage fo | r Each Moi | nitoring Yea | ar | Wetland Status ² |
|---------------------------|-----------------|------|------------|------------|--------------|-------|--------------------------------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | _ |
| CCWRD | 3 | n/a | n/a | 17.32 | 22.45 | 22.13 | non-wet |
| CCWRD | 3 | n/a | n/a | 5.81 | 6.77 | 6.79 | wet |

¹CCWRD = Clark County Water Reclamation District

²Wetland 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

Table 9. Physical characteristics of Clark County Water Reclamation District revegetation sites in 2008-2012.



Figure 31. Aerial photograph of 2012 delineated Clark County Water Reclamation District revegetation sites.

The CCWRD site as a whole has been doing very well since planting; total cover has increased from 63.8% in the first monitoring year (2010) to 76.4% in 2012 (Figure 32). Like many sites, species richness has declined, but it remains one of the highest of all revegetation sites along the Wash; 42 species were documented in the most recent monitoring year (Figure 33). Sites with conditions that encourage this high establishment rate also have high noxious weed establishment, and CCWRD had five noxious species on it, which is one of the highest numbers (Figure 34). Cover composition (Figure 35) shows that forb/herb species have dominated the site in all three years, including narrow-leaf dock (*Rumex stenophyllus*), which had a cover of 5.4% in 2012 (Figure 36).



Figure 32. Average vegetation cover across both Clark County Water Reclamation District revegetation sites from 2010 to 2012.

Survivorship was only monitored after the first growing season in 2010. It was higher than the Wash Team's success criteria at 83.9%. This was despite substantial flooding that occurred on the site and displaced much of the originally planted plants. In addition, the subsequent growth of plants on the site and establishment of new species shows that the site is in fact on track to be a successful restoration project.

3.3.1 Clark County Water Reclamation District – Non-wetland

The non-wetland portion of the CCWRD revegetation site (CCWRD-N) makes up the majority of the site; therefore, the monitoring data closely mimics that of the site as a whole. CCWRD-N has had increasing total cover across three years of monitoring (Table 10). The dominant species in 2010 (the first year of monitoring) was salt heliotrope (*Heliotropium curassavicum*). This native groundcover was not planted on the site but established itself in very large patches throughout, reaching a total cover of 13.1%. Salt heliotrope was not the dominant species in subsequent monitoring years but the cover remains high; it was 10.8% in 2012.



Figure 33. Average species richness across both Clark County Water Reclamation District revegetation sites from 2010 to 2012.



Figure 34. Average noxious weed cover across both Clark County Water Reclamation District revegetation sites from 2010 to 2012.

In 2011, the exotic weed Bassia (*Bassia hyssopifolia*) began to take over. It covered 24.7% of the site at the time of monitoring in 2011. Aggressive removal of the plant took place in 2011 and 2012 and there was just 2.7% cover in 2012. Honey mesquite was documented as the

dominant species during the most recent monitoring (Figure 37). This native tree was planted as part of the Green-Up. There were also a few remaining established trees on the site prior to planting. The site more than doubled its cover - from 8.3% in 2011 to 16.8% in 2012.



Figure 35. Average cover composition across both Clark County Water Reclamation District revegetation sites from 2010 to 2012.

| Site Code ¹ | | 201 | 0 | | | 201 | 1 | | 2012 | | | | | |
|------------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|--|--|
| Site Code | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | | |
| CCWRD-N | 66.4 | 2.2 | 49 | 2.54 | 70.5 | 3.0 | 40 | 3.07 | 74.7 | 11.0 | 38 | 2.47 | | |
| CCWRD-W | 55.9 | 0.7 | 30 | 3.73 | 64.1 | 0.9 | 17 | 3.28 | 82.6 | 8.0 | 23 | 3.42 | | |

¹CCWRD-N = Clark County Water Reclamation District - Non-wetland, CCWRD-W = Clark County Water Reclamation District - Wetland

 2 TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species$ Richness. The number of species identified on the site

⁵WPI = Wetland Prevalence Index value. WPI \leq 2.0 =wetland, 2.0 \leq WPI \leq 2.5 = likely wetland, 2.5 \leq WPI \leq 3.5 = may be wetland, 3.5 \leq WPI \leq 4.0 = not likely a wetland, and WPI \geq 4.0 = upland

nm = this attribute was not monitored

Table 10. Vegetation monitoring results for Clark County Water Reclamation District revegetation sites in 2010-2012.



Figure 36. Large patches of narrow-leaf dock established on the Clark County Water Reclamation District revegetation sites in 2012.



Figure 37. Honey mesquite was the dominant species on both Clark County Water Reclamation District revegetation sites in 2012.

3.3.2 Clark County Water Reclamation District – Wetland

The wetland areas of the CCWRD site (CCWRD-W) are intermixed among non-wetland areas (Figure 31). This delineation was done as a result of jurisdictional determinations for projects planned to take place by CCWRD in the future. As a result, the vegetative structure is not that different from CCWRD-N. For example, the dominant species were the same in 2010 through 2012; salt heliotrope, bassia, and honey mesquite, respectively. There were four species found at CCWRD-W that were not found on CCWRD-N in 2012; Goodding's willow, white mesquite (*Prosopis alba*), red-root nutgrass (*Cyperus erythrorhizos*), and bulrush (*Bolboschoenus maritimus*). Except for white mesquite, these species are all common wetland species which provides justification for the wetland delineation.

3.4 Cottonwood Cells

In 2012, three new revegetation sites were established in the Cottonwood Cell area, which brings the total to five sites (Table 11; Figure 38). None of the Cottonwood Cell sites are associated with an erosion control structure. The two existing sites, Cottonwood Cell 1 (CC1) and Cottonwood Cell 2 (CC2) were established as nurseries to be used to collect pole cuttings for future revegetation efforts (Figure 39). The new sites include one new cottonwood dominated area, Cottonwood Cell 3 (CC3) and two non-wetland sites to the north and east of the three cottonwood cells. Due to vast differences in planting years among sites, trend analysis of cover and species data has not been done for Cottonwood Cell sites as it is believed no valuable results could be interpreted from it.

3.4.1 Cottonwood Cell 1

CC1 was planted in 2002 with only cottonwood trees. Although it was originally designed to be a nursery for regular removal of pole cuttings, very little thinning has taken place. As a result, the site is dominated by large cottonwood trees, some close to 60 feet tall. There are, however, many other species that have self-established on the site. Twelve species were documented in 2012 (Table 12). The second most dominant species was sandbar willow, which had a cover of 5-25% in 2012. Goodding's willow was the second most dominant species - in 2008, it had a cover of 50-75%, but then it declined to just 1-5% in 2012. This was due to the removal of trees for an erosion control project north of the site; this project also removed the majority of tamarisk, which also had a cover value of 1-5% in 2012.

| Site Code ¹ | 2012 Growing | | Acreage fo | r Each Mor | nitoring Yea | ar | Wetland Status ² |
|---------------------------|-----------------|------|------------|------------|--------------|------|--------------------------------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | |
| CC1 | 11 | 0.95 | 0.95 | 0.95 | 0.95 | 0.92 | wet |
| CC2 | 8 | 0.43 | 0.49 | 0.49 | 0.49 | 0.53 | wet |
| CC3 | 1 | N/A | N/A | N/A | N/A | 1.47 | wet |
| CCN | 1 | N/A | N/A | N/A | N/A | 5.03 | non-wet |
| CCNS | 1 | N/A | N/A | N/A | N/A | 1.83 | non-wet |

¹CC1 = Cottonwood Cell 1, CC2 = Cottonwood Cell 2, CC3 = Cottonwood Cell 3, CCN = Cottonwood Cell North, CCNS = Cottonwood Cell North Soil Stockpile

²Wetland 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

Table 11. Physical characteristics of Cottonwood Cell revegetation sites in 2008-2012.



Figure 38. Aerial photograph of 2012 delineated Cottonwood Cell revegetation sites.

| Site | Site 2008 | | | | 2009 | | | | 2010 | | | 2011 | | | | 2012 | | | | |
|-------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|
| Code ¹ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ |
| CC1 | 75-100 | 37.5 | 10 | 2.67 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 14 | 2.87 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 12 | 2.80 |
| CC2 | 75-100 | 15.0 | 8 | 2.86 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 16 | 2.89 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 9 | 2.97 |
| CC3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 25-50 | 0.5 | 25 | 2.96 |
| CCN | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 43.6 | 1.9 | 29 | 3.51 |
| CCNS | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 25-50 | 2.5 | 15 | 3.65 |

¹CC1 = Cottonwood Cell 1, CC2 = Cottonwood Cell 2, CC3 = Cottonwood Cell 3, CCN = Cottonwood Cell North, CCNS = Cottonwood Cell North Soil Stockpile

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR$ = Species Richness. The number of species identified on the site

 ${}^{5}WPI = Wetland Prevalence Index value. WPI \le 2.0 = wetland, 2.0 < WPI < 2.5 = likely wetland, 2.5 ≤ WPI < 3.5 = may be wetland, 3.5 ≤ WPI < 4.0 = not likely a wetland, and WPI ≥ 4.0 = upland nm = this attribute was not monitored$

Table 12. Vegetation monitoring results for Cottonwood Cell revegetation sites in 2008-2012.



Figure 39. The original two cottonwood cells are dominated by large cottonwood trees designed to be nurseries for future revegetation efforts.

3.4.2 Cottonwood Cell 2

Like CC1, CC2 was planted exclusively with cottonwood trees in 2005. Also like CC1, there are many other species that established on the site. Nine total species were documented in 2012 (Table 12). Unlike CC1, CC2 has not had many other species have a substantial amount of cover. In 2012, there weren't any other species (other than cottonwood) with a cover value above 5%.

3.4.3 Cottonwood Cell 3

The newest Cottonwood Cell, CC3 (Figure 40), was planted as part of the spring 2012 Green-Up on March 10, 2012. Like the other two cottonwood cells, the only species planted on the site was cottonwoods. During 2012 monitoring, species richness on the site also had similarities to the other cottonwood cells, as many additional species had established on the site. There were a total of 25 species documented, most with 5% or less cover. Two species, quailbush and bassia, had 5-25% cover each.

Unfortunately, cottonwoods were one of the species that had little cover (1-5%). The trees were planted in one-gallon containers only a few inches tall. There were a few storm events over the summer and the site was inundated with sediment and some of the plants were buried. The survival of the planted cottonwoods was 47.1%; however, numerous self-established cottonwoods were observed in the 2012 monitoring. Future monitoring of the success of the self-established plants will determine if additional plantings are necessary.

3.4.4 Cottonwood Cell North

Also planted as part of the spring 2012 Green-Up, the Cottonwood Cell North (CCN) revegetation sites is made up of three areas north and east of the cottonwood cells (Figures 38 and 41). The two easternmost areas were dominated by salt cedar prior to planting. The western area had some salt cedar but had larger amounts of native vegetation. This native vegetation was greatly reduced during the placement of rock rip-rap in between CCN and CC3. This rip-rap is designed to prevent erosion from storm flows coming from the north through desert washes.



Figure 40. Cottonwood seedlings self-established on Cottonwood Cell 3 in 2012.

Seven species were planted on CCN. In 2012, there were 29 species documented on the site. The dominant species was honey mesquite with 20.4% cover - one of the seven species planted on the site. Screwbean mesquite was also planted and had the second highest amount of cover with 5.1%. The total cover was 43.6%. The total cover, as well as cover for each individual species, was derived from a weighted average of cover at each of three monitoring areas. Survivorship was 96.5%, which was very high for the site.

3.4.5 Cottonwood Cell North Soil Stockpile

There were two additional non-wetland areas planted as part of the spring 2012 G reen-Up. These areas were formerly soil stock piles and were at a slightly higher elevation than the other sites so they are considered a separate site - Cottonwood Cell North Soil Stockpile (CCNS). Three species were planted on these areas and they had a 92.6% survival rate after the first growing season. The total cover was 25-50%. This was to be expected as no trees were planted on this site. With the higher elevation, the depth to groundcover would be too great for most trees to be able to establish. The dominant species on the site was desert saltbush (*Atriplex polycarpa*), which was one of the species planted. There were a total of 15 species documented in the 2012 monitoring.



Figure 41. High survivorship of planted plants was documented in 2012 at Cottonwood Cell North.

3.5 Demonstration Weir

There are two revegetation sites associated with the Demonstration Weir (Tables 13 and 14; Figures 45 and 46). Designed to be a temporary erosion control structure, only a small area of land along the south bank of the Wash was allocated for planting. The surrounding area and all areas north of the structure were scheduled to be impacted by future weir construction. These two sites have also been impacted from nearby construction activities. Both sites had minor reductions in their overall acreages due to construction of the Homestead Weir upstream in 2011 and 2012 (Table 12). It is anticipated that further impacts will occur as the construction of the Three Kids Weir, located just downstream of the sites, begins in 2013. The backwater created by the Three Kids Weir is expected to fully submerge the Demonstration Weir.

Total cover for the two Demonstration Weir revegetation sites has remained relatively stable in the past five years with a slight uptick in 2012 (Figure 42). Species richness has also been quite consistent over the past five monitoring years (Figure 43). No species data was collected from either site in 2011. Noxious weed cover has been close to zero or at zero in the four years species data was collected. There was 0.1% in 2008, none in 2009, and 0.25% in both 2010 and 2012. Shrubs and trees are the dominant growth form of plants on the two sites (Figure 44).



Figure 42. Average vegetation cover across both Demonstration Weir revegetation sites from 2008 to 2012.



Figure 43. Average species richness across both Demonstration Weir revegetation sites from 2008 to 2012.

| Site Code ¹ | 2012 Growing | | Acrea | ge for Each Monito | oring Year | | Wetland Status ² |
|---------------------------|-----------------|------|-------|--------------------|------------|------|--------------------------------|
| | Season - | 2008 | 2009 | 2010 | 2011 | 2012 | |
| UDS | 10 | 2.13 | 2.15 | 1.97 | 1.87 | 1.87 | non-wet |
| UDS | 10 | 1.25 | 1.21 | 1.21 | 0.81 | 0.73 | wet |

¹UDS = Upstream Demonstration South

²Wetland 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

Table 13. Physical characteristics of Demonstration Weir revegetation sites in 2008-2012.

| | 2008 2009 | | | | | 2010 | | | | 2011 | | | | 2012 | | | | | | |
|---------------------------|------------------|------------------|-----------------|------------------|------------------|------------------|-----------------|------------------|------------------|------------------|-----------------|------------------|------------------|------------------|-----------------|------------------|------------------|------------------|-----------------|------------------|
| Site Code ¹ | TOT ² | NOX ³ | SR ⁴ | WPI ⁵ | TOT ² | NOX ³ | SR ⁴ | WPI ⁵ | TOT ² | NOX ³ | SR ⁴ | WPI ⁵ | TOT ² | NOX ³ | SR ⁴ | WPI ⁵ | TOT ² | NOX ³ | SR ⁴ | WPI ⁵ |
| UDS-N | 25-50 | 0.1 | 7 | 4.69 | 25-50 | 0.0 | 8 | 4.83 | 25-50 | 0.0 | 8 | 4.15 | 25-50 | nm | nm | nm | 50-75 | 0.5 | 9 | 4.39 |
| UDS- W | 75-100 | 0.1 | 15 | 2.71 | 75- 100 | nm | nm | nm | 75- 100 | 0.5 | 8 | 2.15 | 75- 100 | nm | nm | nm | 75-100 | 0.0 | 9 | 2.50 |

¹UDS-N = Upstream Demonstration South – Non-wetland, UDS-W = Upstream Demonstration South – Wetland

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species$ Richness. The number of species identified on the site

 5 WPI = Wetland Prevalence Index value. WPI ≤ 2.0 =wetland, $2.0 \leq$ 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 ≥ 4.0 = upland nm = this attribute was not monitored

Table 14. Vegetation monitoring results for Demonstration Weir revegetation sites in 2008-2012.



Figure 44. Average cover composition across both Demonstration Weir revegetation sites from 2008 to 2012.

3.5.1 Upstream Demonstration South - Non-wetland

The non-wetland site at Demonstration Weir, Upstream Demonstration South – Non-wetland (UDS-N) has had a very consistent total cover over the past five years. From 2008 to 2011, the total cover has been 25-50%. In 2012, this increased to 50-75%. The site was monitored using ArcGIS in 2011. It is believed that the increase in cover in 2012 was not a result of substantial plant growth but rather the removal of area that had little plant growth on it. The area removed was at the western edge and was impacted by the construction of the Upper Narrows Weir. The acreage decreased by close to one-third of an acre since 2009.

The dominant species on the site is creosote bush, which has been the dominant or co-dominant species there since 2006. There were a total of nine species documented in 2012, including one new species, cheesebush (*Ambrosia salsola*). The only noxious weed ever documented on the site was salt cedar; however, it has never had a cover greater than 1% and its cover was 0.5% in 2012.

3.5.2 Upstream Demonstration South – Wetland

The wetland site at Demonstration Weir, Upstream Demonstration South – Wetland (UDS-W), has also been very consistent in its total cover over the past five years. Each year UDS-W had a total cover of 75-100%. This was despite a reduction of close to a half-acre since 2010 (Table 14). It is anticipated that some of this site will be impacted once construction of the Three Kids Weir is complete. The backwater may inundate some of the vegetation along the eastern and northern edge of the site.



Figure 45. Aerial photograph of 2012 delineated Demonstration Weir revegetation sites.



Figure 46. Upstream Demonstration South – Non-wetland (left) and Wetland (right) are located near the new Well's Trailhead of the Clark County Wetlands Park.

There were nine species documented on the site in 2012. This is down from the all-time high of 15 species in 2008. The co-dominant species on the site in 2012 were screwbean mesquite and Goodding's willow, both species with a cover value of 25-50%. The only noxious species documented on the site has been salt cedar; however, it was not documented on the site in 2012 and has never had more than 1% cover.

3.6 DU Wetlands No. 2 Weir

The DU Wetlands No. 2 Weir was completed in 2009. The three revegetation sites associated with the weir were planted the following year (Figure 47). There are two non-wetland sites which are located on opposite sides of the Wash channel as well as one wetland site. The wetland site includes the banks of the Wash on both sides of the channel, as well as vegetation that has established within the channel itself. The two non-wetland sites have decreased slightly since their original planting in 2010 while the wetland site has almost doubled in size (Table 15). The DU Wetlands No. 2 Weir revegetation sites have been very successful, represented by all three revegetation sites having the maximum cover value in all three years of monitoring (Table 16). As with most revegetation sites and areas, the average species richness has declined in its first three monitoring years/growing seasons (Figure 48). Figure 49 shows that the dominant plant form on these sites are shrubs, primarily desert saltbush and fourwing saltbush. Noxious weeds have not been a concern on these sites with the average noxious weed cover never reaching above 1%.



Figure 47. Aerial photograph of 2012 delineated DU Wetlands No. 2 Weir revegetation sites.

| Site Code ¹ | 2012 Growing Season | Acr | eage for 1 | Wetland Status ² | | | |
|---------------------------|------------------------|------|------------|--------------------------------|------|------|---------|
| | | 2008 | 2009 | 2010 | 2011 | 2012 | |
| DU2E | 3 | n/a | n/a | 0.67 | 0.94 | 1.76 | wet |
| DU2N | 3 | n/a | n/a | 5.82 | 5.85 | 4.67 | non-wet |
| DU2S | 3 | n/a | n/a | 5.85 | 4.68 | 4.73 | non-wet |

¹DU2E = DU Wetlands No. 2 Emergent, DU2N = DU Wetlands No. 2 North, DU2S = DU Wetlands No. 2 South

²Wetland 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

Table 15. Physical characteristics of DU Wetlands No. 2 Weir revegetation sites in 2008-2012.

| Site | 2010 | | | | – – – 2 | 201 | 1 | | $\begin{array}{c} 2012 \\ \text{TOT}^2 \text{NOX}^3 \text{CP}^4 \text{MPI}^5 \end{array}$ | | | | | |
|------|--------|-----|----|------|----------------|-----|----|------|--|-----|----|------|--|--|
| Code | 101- | NOX | SR | WPl | TOT | NOX | SR | WPI | TOT | NOX | SR | WPI | | |
| DU2E | 75-100 | 1.9 | 41 | 2.18 | 75-100 | 1.6 | 29 | 1.72 | 75-100 | 1.7 | 22 | 1.60 | | |
| DU2N | 75-100 | 0.5 | 16 | 3.85 | 75-100 | 0.5 | 12 | 3.86 | 75-100 | 0.1 | 13 | 4.07 | | |
| DU2S | 75-100 | 0.7 | 35 | 3.87 | 75-100 | 0.7 | 23 | 4.05 | 75-100 | 0.2 | 19 | 4.06 | | |

¹DU2E = DU Wetlands No. 2 Emergent, DU2N = DU Wetlands No. 2 North, DU2S = DU Wetlands No. 2 South

 2 TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 5 WPI = Wetland Prevalence Index value. WPI \leq 2.0 = wetland, 2.0 \leq WPI \leq 2.5 = likely wetland, 2.5 \leq WPI \leq 3.5 = may be wetland, 3.5 \leq WPI \leq 4.0 = not likely a wetland, and WPI \geq 4.0 = upland

nm = this attribute was not monitored

Table 16. Vegetation monitoring results for DU Wetlands No. 2 Weir revegetation sites in 2010-2012.



Figure 48. Average species richness across all DU Wetlands No. 2 revegetation sites from 2010-2012.



Figure 49. Average vegetation cover across all DU Wetlands No. 2 Weir revegetation sites from 2010 to 2012.

3.6.1 DU Wetlands No. 2 Emergent

DU Wetlands No. 2 Emergent (DU2E) is made up of both active plantings and vegetation that has passively established along the banks and within the Wash channel adjacent to the DU Wetlands No. 2 W eir. The two banks were planted with pole cuttings of sandbar willow, Goodding's willow, and cottonwoods, as well as transplanted plugs of American bulrush (*Schoenoplectus americanus*), California bulrush (*Schoenoplectus californicus*), and tule (Figure 50). The total cover for this site as well as the cover for individual species is derived by taking weighted average values documented on the north side and those on the south side.

Goodding's willow and southern cattail were the co-dominant species on DU2E in 2012; both species had 37.5% cover. S outhern cattail was the sole dominant species in 2011 and Goodding's willow was the sole dominant species in 2010. D espite the consistent total vegetative cover on the site, species richness has declined substantially from 41 species in the first year of monitoring to just 22 in 2012 (Table 16). Two noxious species were documented in 2012, tall whitetop and salt cedar. O ne additional noxious species, johnsongrass (*Sorghum halepense*) was only identified in 2010.

3.6.2 DU Wetlands No. 2 North

The non-wetland area, DU Wetlands No. 2 North (DU2N), was planted primarily with honey mesquite in the spring of 2010. Desert saltbush was the dominant species on the site (Figure 51). It was hydroseeded at the end of construction of the weir, along with fourwing saltbush and alkali sacaton (*Sporobolus airoides*). D esert saltbush had a cover of 75-100%, and honey mesquite was the second most prevalent species in terms of cover with 5-25%. No other species had a cover over 5%; most had less than 1%. The number of species is just slightly less in 2012 than it was after the first monitoring in 2010, decreasing from 16 to 13.



Figure 50. Actively planted and passively introduced vegetation has successfully established within the DU Wetlands No. 2 Emergent revegetation site.

The decrease in size of over an acre from 2011 to 2012 is largely a result of the southwestern corner of the site being cleared for access by contractors as part of the construction of the DU Wetlands No. 1 Weir in 2012. It was known prior to any clearing that much of the southern portion of the site had a chance of being impacted so no plants were planted in the area. The vegetation removed was either from hydroseeding or had passively established in the area.

3.6.3 DU Wetlands No. 2 South

The DU Wetlands No. 2 South (DU2S) revegetation site was planted on March 20, 2010, as part of a Green-Up. Prior to planting, the site was also hydroseeded with the same seed mixture as DU2N. Two hydroseeded species were the co-dominant species on the site in 2012; desert saltbush and fourwing saltbush, both with a cover of 25-50%. Three of the other 19 species found on the site in 2012 had a cover of 5-25%, with the rest having less than 5%. There have been three noxious weeds documented on the site since 2010. Two were documented in 2012; tall whitetop and silver-leaf nightshade (*Solanum elaeagnifolium*). Salt cedar was documented in 2010 and 2011 but not in 2012.

Like DU2N, DU2S had a reduction in size of over an acre. DU2S's area was reduced in 2011 in preparation for known disturbance from the construction of the DU Wetlands No. 1 Weir. In addition, a small area was cut out of the southern part of the site for the planting of a garden by school children celebrating World Wetland's Day in 2010.



Figure 51. Desert saltbush dominated the DU Wetlands No. 2 North revegetation site in 2012.

3.7 Historic Lateral Weir

The Historic Lateral Weir has some of the oldest revegetation sites along the Wash. Eight of the 11 revegetation sites were created in 2001 and are in their twelfth growing season as of 2012 (Tables 17 and 18; Figure 52). These include sites that were planted as part of the first Green-Up event, as well as two passively created wetlands upstream and downstream of the weir. One new site was planted in March of 2008, and the most recent two were planted in October 2010.

Comprehensive monitoring data for Historic Lateral Weir sites in the first five growing seasons are difficult to justify as being representative. There is no data for the eight older sites as monitoring during these years used methods not convertible to current methods. Furthermore, from growing seasons three thru five (2003 to 2005), four sites were combined into two. These sites were separated into four separate sites (non-wetland and wetland) in 2006 to improve data reporting. Growing seasons 6 through 12 only represent the older sites and can be interpreted as an accurate description of the comprehensive status of revegetation sites at the weir. Likewise, monitoring from 2008 to 2012 includes sites with their first through fifth growing seasons along with the eighth through twelfth seasons, and are not very representative of the trend of vegetation performance on the individual sites.

Another factor to take into consideration when looking at total cover trends across growing seasons is that the newer sites planted at Historic Lateral Weir are all non-wetland sites. These sites typically have longer periods of time needed to reach equilibrium and high levels of vegetative cover. In contrast, the majority of the eight older sites are wetlands and the older non-wetland sites are much closer to the Wash channel than the newer sites.

A new construction project is planned to take place adjacent to the northern border of the Historic Lateral Weir. This expansion will help protect the Wash channel from flood flows coming from the C-1 channel, originating in the City of Henderson. This expansion project will impact some of the passively created wetlands but no impacts are anticipated to actively planted sites.

3.7.1 Downstream Historic Lateral Passive Wetland

As the name implies, the Downstream Historic Lateral Passive Wetland (DHLPW) site was not planted but rather was formed by the passive establishment of vegetation on and near the Historic Lateral Weir. The size of this area increased dramatically from 2011 to 2012 (Table 17). This was not the result of increased plant establishment but rather a decision to include wetlands that may be impacted by future construction. This decision was made to provide a better description of the changing vegetation along the Wash regardless of construction activities.

Due to this site's structure, location, and uncertain future, it has never been monitored in the field. Total cover calculations are performed by ArcGIS. Once the Historic Lateral Expansion project is completed, the monitoring methods for this site will be reevaluated.

3.7.2 Upstream Historic Lateral North – Non-wetland

Upstream Historic Lateral North – Non-wetland (UHLN-N) was planted in 2001 and completed its twelfth growing season in 2012. The total vegetative cover on the site in 2012 was the same


Figure 52. Aerial photograph of 2012 delineated Historic Lateral Weir revegetation sites.

| Site Code ¹ | 2012 Growing | | Wetland Status ² | | | | |
|---------------------------|-----------------|------|--------------------------------|------|-------|-------|---------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | _ |
| DHLPW | 12 | n/a | n/a | n/a | 2.66 | 7.81 | wet |
| UHLN-N | 12 | 4.86 | 4.18 | 4.18 | 4.29 | 4.14 | non-wet |
| UHLN-W | 12 | 1.21 | 1.23 | 1.23 | 1.91 | 1.74 | wet |
| UHLNS | 12 | n/a | n/a | n/a | 1.55 | 1.62 | wet |
| UHLPW | 12 | n/a | n/a | n/a | 3.83 | 4.25 | wet |
| UHLS | 12 | 1.23 | 1.17 | 1.22 | 1.26 | 1.18 | wet |
| UHLSB-N | 12 | 1.19 | 1.19 | 1.18 | 1.18 | 1.21 | non-wet |
| UHLSB-W | 12 | 1.63 | 1.73 | 1.76 | 1.72 | 1.81 | wet |
| UHLSUP | 5 | 5.43 | 5.43 | 5.37 | 5.43 | 5.42 | non-wet |
| UHLSUP2 | 2 | n/a | n/a | n/a | 12.40 | 12.42 | non-wet |
| UHLSSS | 2 | n/a | n/a | n/a | 2.06 | 2.06 | non-wet |

¹DHLPW = Downstream Historic Lateral Passive Wetland, UHLN-N = Upstream Historic Lateral North – Non-wetland, UHLN-W = Upstream Historic Lateral North – Wetland, UHLNS = Upstream Historic Lateral North South, UHLPW = Upstream Historic Lateral Passive Wetland, UHLS = Upstream Historic Lateral South, UHLSB-N = Upstream Historic Lateral South Bank – Non-wetland, UHLSB-W = Upstream Historic Lateral South Bank – Non-wetland, UHLSUP = Upstream Historic Lateral South Upper Plateau, UHLSUP2 = Upstream Historic Lateral South Upper Plateau 2, UHLSSS = Upstream Historic Lateral South Soil Stockpile

²Wetland 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

Table 17. Physical characteristics of Historic Lateral Weir revegetation sites in 2008-2012.

as in 2008 (50-75%). The only year in which the total cover was different in the past five years was 2010; it was calculated to be 75-100% using ArcGIS. This was the only year ArcGIS was used to measure total cover. Given the sporadic location of vegetation throughout the site (Figure 52) and the unique configuration of the site's boundaries, total cover is difficult to determine. It is unclear which method provides the best assessment.

The species richness on UHLN-N was also the same in 2012 as it was in 2008. Unlike total cover, the years monitored in the field were different. In 2009 and 2011, the number of species recorded on the site was 25 and 24, respectively. This minor fluctuation in species richness is symbolic of the site reaching equilibrium and perhaps has reached a sustainable state. Three species had equivalent dominance in terms of cover on the site; quailbush, Fremont's cottonwood (Figure 53), and salt cedar, all with a cover of 5-25% in 2012. No other species had more than 5% cover. In addition to salt cedar, other noxious weeds on the site in 2012 were tall whitetop and silver-leaf nightshade. These other two weeds both had cover less than 1%.

3.7.3 Upstream Historic Lateral North – Wetland

Adjacent to UHLN-N along the banks of the Wash is Upstream Historic Lateral North – Wetland (UHLN-W). UHLN-N and UHLN-W were planted as a single site in 2001. In 2006, the wetland and non-wetland components were separated to provide better monitoring results. The size of the site has increased over the past five years; 1.21 acres in 2008 and 1.75 in 2012. This is common for wetland sites that can have substantial expansion of clonally expanding wetland plants such as common reed.

| Cite Ceda ¹ | 2008 | | | | 2009 | | | | 2010 | | | | 2011 | | | 2012 | | | | |
|------------------------|---------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|
| Site Code | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ |
| DHLPW | - | - | - | - | - | - | - | - | - | - | - | - | 75-100 | nm | nm | nm | 75-100 | nm | nm | nm |
| UHLN-N | 50-75 | 15.6 | 22 | 2.79 | 50-75 | 3.6 | 25 | 2.01 | 75-100 | nm | nm | nm | 50-75 | 5.6 | 24 | 2.82 | 50-75 | 15.6 | 22 | 3.08 |
| UHLN-W | 75-100 | 2.6 | 12 | 2.32 | 75-100 | nm | nm | nm | 75-100 | 0.6 | 31 | 2.40 | 75-100 | nm | nm | nm | 75-100 | 3.5 | 30 | 2.12 |
| UHLNS | - | - | - | - | - | - | - | - | - | - | - | - | 75-100 | 1.1 | 14 | 2.17 | 75-100 | 0.5 | 11 | 2.04 |
| UHLPW | - | - | - | - | - | - | - | - | - | - | - | - | 75-100 | nm | nm | nm | 75-100 | nm | nm | nm |
| UHLS | 75-100 | 0.5 | 10 | 2.42 | 75-100 | nm | nm | nm | 75-100 | 0.6 | 30 | 2.23 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 11 | 2.63 |
| UHLSB-N | 50-75 | 0.6 | 19 | 3.86 | 75-100 | 0.6 | 20 | 3.80 | 50-75 | nm | nm | nm | 75-100 | 0.5 | 20 | 4.14 | 75-100 | 0.5 | 13 | 4.35 |
| UHLSB-W | 75-100 | 2.5 | 12 | 2.18 | 75-100 | nm | nm | nm | 75-100 | 0.1 | 17 | 2.28 | 75-100 | nm | nm | nm | 75-100 | 0.0 | 9 | 2.07 |
| UHLSUP | 50-75 | 3.5 | 38 | 3.53 | 75-100 | 3.1 | 27 | 3.80 | 75-100 | 0.2 | 27 | 4.20 | 75-100 | 0.6 | 30 | 4.40 | 75-100 | 0.6 | 24 | 4.61 |
| UHLSUP2 | - | - | - | - | - | - | - | - | - | - | - | - | 50.8 | 0.5 | 30 | 3.44 | 54.4 | 0.3 | 29 | 4.58 |
| UHLSSS | - | - | - | - | - | - | - | - | - | - | - | - | 5-25 | 0.0 | 8 | 4.17 | 5-25 | 0.5 | 9 | 4.29 |

¹DHLPW = Downstream Historic Lateral Passive Wetland, UHLN-N = Upstream Historic Lateral North – Non-wetland, UHLN-W = Upstream Historic Lateral North – Wetland, UHLSB = Upstream Historic Lateral North South, UHLPW = Upstream Historic Lateral Passive Wetland, UHLS = Upstream Historic Lateral South, UHLSB-N = Upstream Historic Lateral South Bank – Non-wetland, UHLSB-W = Upstream Historic Lateral South Bank – Non-wetland, UHLSB-W = Upstream Historic Lateral South Bank – Wetland, UHLSUP = Upstream Historic Lateral South South Upper Plateau 2, UHLSUP = Upstream Historic Lateral South South

 $^{2}TOT =$ Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species Richness.$ The number of species identified on the site

 5 WPI = Wetland Prevalence Index value. WPI ≤ 2.0 =wetland, 2.0 \leq 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 ≥ 4.0 = upland

nm = this attribute was not monitored

Table 18. Vegetation monitoring results for Historic Lateral Weir revegetation sites in 2008-2012.

Every year that UHLN-W has been monitored as a separate site, the total cover has been 75-100%, including 2009 and 2011 where the total cover was determined using ArcGIS. The three co-dominant species in 2012 were common reed, Goodding's willow, and sandbar willow. Each of these species had a cover of 25-50%. Three noxious weeds were found on the site in the past five years; tall whitetop, johnsongrass, and salt cedar. In 2012, tall whitetop and johnsongrass had a cover of 0.5%, while salt cedar had a cover of 1-5%.

Species richness has varied greatly over the past five years. In 2008, there were just 12 species documented on the site. In 2010, 31 s pecies were documented and there were 30 in 2012. UHLN-W's geographic location is where the Wash curves, making it very susceptible to impacts from flooding. Flooding increases species richness by depositing seeds and plant materials on the site, as well as decreasing some species by physically removing some smaller forbs and other small plants.

3.7.4 Upstream Historic Lateral North South

Prior to 2005, the site currently delineated as Upstream Historic Lateral North South (UHLNS) was part of UHLN-W. Storm events in 2005 caused the flow pattern of the Wash to shift to the north incising the UHLN-W site. This resulted in close to one and one-half acres of the site being shifted to the south side of the Wash. UHLNS was first monitored in 2011 despite being made up of plantings that took place in 2001.

The two years of monitoring UHLNS are very similar. The total cover in both years was 75-100%. The number of species on the site decreased slightly from 14 to 11 in 2011 and 2012, respectively. Goodding's willow was the dominant species in 2012 and was co-dominant along with common reed in 2011. Salt cedar was the only noxious weed on the site in 2012 with 0.5% cover.

3.7.5 Upstream Historic Lateral Passive Wetland

Like DHLPW, Upstream Historic Lateral Passive Wetland (UHLPW) was passively established after the construction of the Historic Lateral Weir was completed. In addition to vegetation establishing as a result of the slower backwater created by the weir, much of the site is adjacent to the Upstream



Figure 53. Mature cottonwood trees dominant older revegetation sites such as Upstream Historic Lateral North – Non-wetland.

Historic Lateral South (UHLS) site and there could have been some encroachment of some of the planted plants from this site. Also like DHLPW, UHLPW has only been monitored for total cover using ArcGIS and has only been monitored in 2011 and 2012. The total cover in both years has been 75-100%. There may be some impact from the Historic Lateral Weir Expansion but it is expected to be much less than those impacts expected at DHLPW.

3.7.6 Upstream Historic Lateral South

Upstream Historic Lateral South (UHLS) was planted as part of one of the first Green-Up events in April of 2001 and was in its twelfth growing season in 2012. Similar to UHLN-N, UHLS has an irregular configuration. Only certain areas were capable of sustaining the planted vegetation; therefore, the monitoring area only includes those planting areas.

The total cover on UHLS has remained the same throughout the 2008-2012 timeframe at 75-100%. This was accomplished despite a high fluctuation in species richness on the site. In 2008, the number of species documented was 10, dramatically increasing to 30 in 2010, and decreasing back to 11 in 2012. Monitoring was conducted by ArcGIS in 2009 and 2011. Like UHLN-W, this site is heavily impacted by flood flows which can both increase and decrease species richness. All of the species that were documented in 2010 but not in 2012 had less than 1% cover in 2010. The dominant species on the site in 2012 has always been present and was planted as part of the Green-Up in 2001 - Fremont's cottonwood with a cover of 25-50%.

3.7.7 Upstream Historic Lateral South Bank – Non-wetland

The Upstream Historic Lateral South Bank – Non-wetland (UHLSB-N) revegetation site was planted in 2001 making the 2012 growing season the twelfth. In the 2008-2012 timeframe, the site varied between 50-75% total cover in 2008 and 2010 and 75-100% total cover in 2009, 2011, and 2012. The total cover was measured using ArcGIS in 2010 and in the field in all other years.

Until the most recent monitoring, species richness had remained relatively consistent. In 2008, there were 19 species documented on the site; 20 were recorded in both 2009 and 2011. In 2012, the number of species declined to 13, the lowest since UHLSB-N was monitored as a separate site in 2006. Only one species identified in 2011 that was not documented in 2012 had greater than 1% cover on the site; sandbar willow had a cover of 1-5% in 2011. Salt cedar was the only noxious weed identified in 2012, with a cover of just 0.5%. The dominant species on the site in 2011 and 2012 has been honey mesquite with a 25-50% cover in both years (Figure 54).

3.7.8 Upstream Historic Lateral South Bank – Wetland

Adjacent to the UHLSB-N site, the Upstream Historic Lateral South Bank – Wetland (UHLSB-W) site was planted at the same time in 2001. Prior to 2006, these two sites were monitored as a single site. Since 2006, UHLSB-W has had the maximum total cover of 75-100%. Monitoring was performed using ArcGIS for total cover in 2009 and 2011. Prior to 2005, the entire site bordered the Wash to the north. The movement of the Wash channel as a result of storm flows resulted in UHLNS moving to the south side of the Wash and the two sites are almost contiguous today.

The number of species found on UHLSB-W has fluctuated in the three field monitoring events that have taken place from 2008-2012. In 2008, there were 12 species documented on the site.



Figure 54. Honey mesquite, cat-claw acacia, and desert broom dominate the Upstream Historic Lateral South Bank – Non-wetland revegetation site in 2012.

This increased to 17 in 2010 and declined again to its lowest level of just 9 species in 2012. The 2012 monitoring took place less than a week after a large storm event; this may have resulted in the loss or decreased visibility of smaller forbs and grasses previously documented on the site. The dominant species on the site was Goodding's willow in 2012 with a cover of 50-75%. There were no noxious species found on the site in 2012.

3.7.9 Upstream Historic Lateral South Upper Plateau

Planted as a Green-Up in the spring of 2008, Upstream Historic Lateral South Upper Plateau (UHLSUP) has been a successful revegetation site through its five years of monitoring. The only year that the site had 50-75% cover was in 2008; each year since has had 75-100% cover. Previously dominated by salt cedar, UHLSUP is not directly associated with the Historic Lateral Weir. Instead, salt cedar located just upstream of the weir was removed specifically for this revegetation project.

As with the majority of revegetation sites, species richness has declined since the initial establishment period. In the 2008 monitoring which took place approximately six months after planting, there were 38 species documented. This high number was likely due to the intense irrigation that takes place on all non-wetland revegetation sites in the first growing season. The most recent monitoring had 24 species documented. This is still a relatively high number of species for a non-wetland site in its fifth growing season. Irrigation has not been applied to the site since 2009.

The dominant species on UHLSUP is fourwing saltbush with 25-50% cover. It has been the dominant or co-dominant species on the site since 2009. In 2008, the dominant species was alkali sacaton, but it had just 0.5% cover in 2012. Three noxious weeds have been documented on the site; tall whitetop, johnsongrass, and salt cedar. Only tall whitetop and salt cedar were documented in 2012 with cover values of 0.1% and 0.5%, respectively.

3.7.10 Upstream Historic Lateral South Upper Plateau 2

The Upstream Historic Lateral South Upper Plateau 2 (UHLSUP2; Figure 55) revegetation site borders UHLSUP to the east and west. Like UHLSUP, UHLSUP2 was cleared of a monoculture of salt cedar for the sole purpose of revegetation. UHLSUP2 was planted during the fall 2010 Green-Up. Because the site is over 12.4 acres, it has been divided into three monitoring areas. The total cover and the cover of each species is the weighted average of the values within each of the three areas.

Across the two years that UHLSUP2 has been monitored, there has been very little change. In 2011, total cover was 50.8%, increasing slightly to 54.4% in 2012. Species richness also stayed very close with 30 s pecies documented in 2011 and 29 i n 2012. There were six species documented in 2011 that were not found in 2012 and five new species documented in 2012. The dominant species in 2011 was fourwing saltbush with 22.9% cover, but in 2012, it had just 6.3% cover. Creosote bush was the dominant species in 2012 with 24.8% cover, but it only had 8.0% cover in 2011.

3.7.11 Upstream Historic Lateral South Soil Stockpile

The Upstream Historic Lateral South Soil Stockpile (UHLSSS) revegetation site was planted along with UHLSUP2 at the fall 2010 Green-Up. It is separated from UHLSUP2 due to the topographical differences between the two. UHLSSS was not vegetated in recent years. As the name implies, it was used as a stockpile for soil and rip-rap for use in construction activities along the Wash.

UHLSSS was planted with just three species. There were eight species documented in 2011 and nine in 2012. The two co-dominant species in 2012 were fourwing saltbush and desert saltbush with 5-25% cover, both of which were planted. All of the other plants on the site had less than 1% cover.

3.8 Lower Narrows and Homestead Weirs

The Lower Narrows and Homestead Weirs were completed in 2011 and the first revegetation sites were planted that same year (Figure 56; Table 19). Therefore, there is only one year of monitoring data for the three established revegetation sites (Table 20). One additional non-wetland site was planted after 2012 monitoring was completed. In addition, there will be additional plantings within the wetland site throughout 2013 to meet permit requirements.

3.8.1 Lower Narrows and Homestead Emergent

The only wetland revegetation site associated with the Lower Narrows and Homestead Weirs, Lower Narrows and Homestead Emergent (LNHE) includes vegetation along both banks and within the Wash channel. The two banks and the channel were monitored separately and then a weighted average of species and total cover was calculated for the site's data.



Figure 55. The Upstream Historic Lateral Upper Plateau 2 revegetation site is adjacent to a housing development along the southern border of the Clark County Wetlands Park.

Banks were planted with pole cuttings of sandbar and Goodding's willow and Fremont's cottonwood, as well as transplanted plugs of American and California bulrush. A merican and California bulrush were also planted in the Wash channel itself in areas where sedimentation created small sandbars (Figure 57).

| Site Code ¹ | 2012 Growing | | • | Wetland Status ² | | | |
|---------------------------|-----------------|------|------|--------------------------------|------|-------|---------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | |
| LNHE | 1 | n/a | n/a | n/a | n/a | 3.11 | wet |
| LNHN | 1 | n/a | n/a | n/a | n/a | 51.02 | non-wet |
| LNHS1 | 1 | n/a | n/a | n/a | n/a | 7.33 | non-wet |

¹LNHE = Lower Narrows Homestead Emergent, LNHN = Lower Narrows Homestead North, LNHS1 = Lower Narrows Homestead South 1

²Wetland 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

Table 19. Physical characteristics of Lower Narrows and Homestead Weirs revegetation sites in 2008-2012.



Figure 56. Aerial photograph of 2012 delineated Lower Narrows and Homestead Weirs revegetation sites.



Figure 57. American and California bulrush planted within the Wash channel as part of the Lower Narrows and Homestead Emergent revegetation site.

The site measures just over two acres and the total cover of vegetation was 75-100%. Permits for the construction of the weirs require 6.25 acres of wetlands to be created to mitigate the wetlands lost. To meet this goal, additional plantings will take place in 2013. The majority of the plant cover came from California bulrush, which had a cover of 55.1%. Twenty-one species (in addition to the five planted) were documented on the site for a total of 26. This included two noxious weeds; tall whitetop and salt cedar. Both species had less than 1% cover.

3.8.2 Lower Narrows and Homestead North

The single non-wetland revegetation site on the north side of the Lower Narrows and Homestead Weirs is Lower Narrows and Homestead North (LNHN). This site, like most non-wetland sites associated with weirs, was hydroseeded once construction of the weirs was completed. There were no additional plantings at LNHN. Irrigation was installed to germinate and establish the hydroseeded plants and encourage other native species to establish in the area as well.

The dominant species at LNHN is desert saltbush at 50-75% coverage, which was one of the three species hydroseeded. The other two hydroseeded species, fourwing coverage saltbush and alkali sacaton had cover in the range of 1-5%. The total cover for the site matched that of desert saltbush at 50-75%. Six additional species self-established on the site, making the total number of species nine. This included salt cedar with 0.1% cover.

| Site Code ¹ | | | 2012 | |
|------------------------|---------|------------------|-----------------|------------------|
| Site Code | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| LNHE | 75-100 | 0.1 | 26 | 1.27 |
| LNHN | 50-75 | 0.1 | 9 | 3.94 |
| LNHS1 | 75-100 | 0.0 | 13 | 4.82 |

¹LNHE = Lower Narrows Homestead Emergent, LNHN = Lower Narrows Homestead North, LNHS1 = Lower Narrows Homestead South 1

 2 TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species Richness.$ The number of species identified on the site

 ${}^{5}WPI = Wetland Prevalence Index value. WPI \leq 2.0 = wetland, 2.0 < WPI < 2.5 = likely wetland, 2.5 \leq WPI < 3.5 = may be wetland, 3.5 \leq WPI < 4.0 = not likely a wetland, and WPI \geq 4.0 = upland$

nm = this attribute was not monitored

Table 20. Monitoring data for Lower Narrows and Homestead Weirs revegetation sites in 2012.

3.8.3 Lower Narrows and Homestead South 1

The first non-wetland area planted on the south side of the Lower Narrows and Homestead Weirs, Lower Narrows and Homestead South 1 (LNHS1; Figure 58), was planted at the Green-Up in the fall of 2011. LNHS1 was also hydroseeded in the spring of 2011 once construction of the weirs was completed. A second non-wetland area adjacent to LNHS1 was planted in the fall of 2012 after monitoring had taken place.

The total cover for LNHS1 in its first monitoring year was the maximum (75-100%). The majority of the plant cover came from fourwing saltbush, one of the three hydroseeded species. Desert saltbush, alkali sacaton, and creosote bush all had 1-5% cover. The remaining nine species all had cover values less than 1%. The WPI indicates just how xeric LNHS1 is with a rating of 4.82, one of the highest along the Wash.

3.9 Monson and Visitor Center Weirs

There are four revegetation sites associated with the Monson and Visitor Center Weirs (Figure 59; Table 21). These sites were planted as part of the third Green-Up event in the fall of 2002. The overall vegetative cover on these sites has increased steadily since their planting (Table 22). In the past five years, the weighted average of total cover has increased substantially (Figure 60). There was a sudden increase in the cover of noxious weeds in 2012; two sites had substantial amounts of salt cedar documented (Figure 61).

Species richness across the four revegetation sites at Monson and Visitor Center has remained consistent with only a six species difference between the highest and lowest years (Figure 62). The lowest year, 2011, came when only the two non-wetland sites were monitored in the field and no species information was collected from the wetland sites, which typically have a higher number of species. Figure 63 shows that these sites are dominated by shrubs and trees such as quailbush and Goodding's willow (Figure 64) with very few grasses and forb/herbs.



Figure 58. A Clark County Wetlands Park trail is being installed adjacent to the Lower Narrows Homestead South 1 revegetation site in 2012.

| Site Code ¹ | 2012 Growing | | Acreage f | for Each Mo | nitoring Yea | r | Wetland Status ² |
|---------------------------|-----------------|------|-----------|-------------|--------------|------|--------------------------------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | |
| DMN-N | 10 | 2.90 | 2.95 | 2.96 | 2.97 | 4.05 | non-wet |
| DMN-W | 10 | 1.11 | 1.16 | 1.22 | 1.22 | 1.23 | wet |
| DMS-N | 10 | 3.12 | 3.17 | 3.17 | 3.06 | 3.01 | non-wet |
| DMS-W | 10 | 0.53 | 0.57 | 0.57 | 0.57 | 0.70 | wet |

 $\label{eq:model} ^1DMN-N = Downstream Monson North - Non-wetland, DMN-W = Downstream Monson North - Wetland, DMS-N = Downstream Monson South - Non-wetland, DMS-W = Downstream Monson South - Wetland = Downstream Monson North - Wetland = Downstream North - Wetland = Dow$

²Wetland 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

Table 21. Physical characteristics of Monson and Visitor Center Weir revegetation sites in 2008-2012.



Figure 59. Aerial photograph of 2012 delineated Monson and Visitor Center Weirs revegetation sites.



Figure 60. Average total cover across all Monson and Visitor Center Weirs revegetation sites from 2008 to 2012.



Figure 61. Average noxious weed cover across all Monson and Visitor Center Weirs revegetation sites from 2008 to 2012.



Figure 62. Average species richness across all Monson and Visitor Center Weirs revegetation sites from 2008 to 2012.



Figure 63. Average cover composition across all Monson and Visitor Center Weirs revegetation sites from 2008 to 2012.

3.9.1 Downstream Monson North – Non-wetland

With the construction of the Upper Diversion Weir and East Bypass Channel, Downstream Monson North – Non-wetland (DMN-N) ended up being on a n island in between the two channels (Figure 59). In 2012, the size of the site increased by about an acre. This was a result of annual delineation expanding the site to include vegetation that likely established itself from the source population.

The total cover at DMN-N has increased substantially in the 2008-2012 timeframe. In 2008, the total cover was 25-50%, increasing to 50-75% in 2009. In each year from 2010 to 2012, the total cover has been 75-100%. The dominant species in 2008 and 2009 was fourwing saltbush, while the dominant species in the past three years has been quailbush, with a cover of 50-75% in all three years. Only six species were documented in 2012. This is down from 10 in 2008 and 11 in 2009, which was the highest it has ever been. Salt cedar on DMN-N had a cover ranch of 1-5% in 2012.

3.9.2 Downstream Monson North – Wetland

Prior to 2006, DMN-N and Downstream Monson North – Wetland (DMN-W) were monitored as a single site. Since DMN-W has been monitored as a separate site, it has consistently had the highest total cover range possible, 75-100%. In 2009 and 2011, the total cover was determined using ArcGIS, therefore no species specific data were collected.

There were 18 species documented in 2012; this is down from the highest number documented of 24 in 2008 but higher than the 17 in 2010. An item of concern is the high amount of noxious weeds on the site, specifically salt cedar. Salt cedar was one of the dominant plants on the site with 25-50% cover. This is equal to the cover of southern cattail, a native species. No other plant had more than 5% cover. Another noxious weed, tall whitetop, had a cover of 1-5%. Previously, the dominant plant on the site was Goodding's willow. In 2010, Goodding's willow had a cover of 50-75%, which declined substantially to just 1-5% in 2012. It is unclear what caused this sharp decline. Future monitoring will confirm if this was an isolated event or if measures need to be taken to decrease the impact of invasive species on the site.

3.9.3 Downstream Monson South - Non-Wetland

Downstream Monson South – Non-Wetland (DMS-N) is bordered to the west by the Wetlands Park's Nature Preserve. This has resulted in Wetlands Park staff maintaining the site slightly differently than most revegetation sites along the Wash. For example, plants are thinned and pruned to provide a better visitor experience when walking on the adjacent trails, something that is rarely done in other sites.

Despite more regular maintenance, the total cover on the site has increased over the past five years. In 2008 and 2009, the total cover was 25-50%. In 2010, 2011, and 2012, the total cover was 50-75%. The total cover was measured using ArcGIS in 2010. The number of species has stayed the same over the past four years at ten (not monitored in 2010). In 2008, the number of species was 13. T hree species in 2012 were equally dominant in terms of cover; quailbush, honey mesquite, and screwbean mesquite.

| | 2008 | | | | 2009 | | | | 2010 | | | | 2011 | | | | 2012 | | | | |
|-----------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|---------|------------------|--------|------------------|--|
| Site Code | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | |
| DMN-N | 25-50 | 2.5 | 10 | 4.39 | 50-75 | 0.5 | 11 | 4.39 | 75-100 | 0.5 | 7 | 3.79 | 75-100 | 2.5 | 7 | 3.46 | 75-100 | 2.5 | 6 | 3.77 | |
| DMN-W | 75-100 | 15.5 | 24 | 1.96 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 17 | 1.98 | 75-100 | nm | nm | nm | 75-100 | 40.0 | 18 | 2.00 | |
| DMS-N | 25-50 | 0.5 | 13 | 3.76 | 25-50 | 2.5 | 10 | 3.88 | 50-75 | nm | nm | nm | 50-75 | 2.5 | 10 | 3.58 | 50-75 | 2.5 | 10 | 3.68 | |
| DMS-W | 75-100 | 15.0 | 12 | 2.31 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 12 | 2.03 | 75-100 | nm | nm | nm | 75-100 | 38.0 | 16 | 2.46 | |

¹DMN-N = Downstream Monson North – Non-wetland, DMN-W = Downstream Monson North – Wetland, DMS-N = Downstream Monson South – Wetland

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species Richness.$ The number of species identified on the site

 ${}^{5}WPI = Wetland Prevalence Index 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 wetland, 2.5 < WPI < 3.5 = may be wetland, 3.5 < WPI < 4.0 = not likely a wetland, and WPI > 4.0 = upland wetland, 3.5 < WPI < 4.0 = not likely a wetland, and WPI > 4.0 = upland wetland, 3.5 < WPI < 4.0 = not likely a wetland, and WPI > 4.0 = upland wetland, 3.5 < WPI < 4.0 = not likely a wetland, and WPI > 4.0 = upland wetland, 3.5 < WPI < 4.0 = not likely a wetland, and WPI > 4.0 = upland wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 <$

nm = this attribute was not monitored

Table 22. Vegetation monitoring results for Monson and Visitor Center Weirs revegetation sites in 2008-2012.



Figure 64. Large trees such as Goodding's willow line the banks of the Monson and Visitor Center Weirs.

3.9.4 Downstream Monson South – Wetland

Downstream Monson South – Wetland (DMS-W) is bordered by the DMS-N revegetation site to the west and the Wash to the east. Like the revegetation sites on the north side of Monson and Visitor Center Weirs, DMS-N and DMS-W were monitored as a single site prior to 2006. Since 2006, DMS-W has had the maximum cover of 75-100%.

Species richness has increased over the 2008-2012 timeframe. There were 12 species documented in 2008 and 2010 and 16 species in 2012. There was no field monitoring in 2009 and 2011. As with DMN-W, there is a large amount of salt cedar on the site. Salt cedar is a co-dominant species along with common reed, with a cover of 25-50%. There is also no clear reason why salt cedar has become so prevalent on this site.

3.10 Pabco Road Weir

Along with the Historic Lateral Weir, some of the revegetation sites at the Pabco Road Weir were planted as part of the first and second Wash Green-Ups and are in the eleventh and twelfth growing seasons as of the monitoring conducted in 2012 (Table 23). Also, like Historic Lateral Weir revegetation sites, there were additional sites planted since 2001 and comparison among sites by years which overlap multiple growing seasons is difficult and may lead to more confusion rather than insight into site success. There were a total of 12 revegetation sites as of 2012 at the Pabco Road Weir (Figure 65).

Having some of the oldest revegetation sites, many areas at the Pabco Road Weir have had a longer time to be evaluated to see if the best monitoring data are being collected. As a result, many sites have either been combined together or separated in order to best understand the overall status of the restoration work being conducted on these sites and how they relate to other areas along the Wash. In addition, some sites have been replanted. While small additional plantings don't warrant much change in terms of monitoring, when entire sites are replanted, the growing season is reset to one for the purposes of this report.

| Site Code ¹ | 2012 Growing | | r | Wetland Status ² | | | |
|---------------------------|-----------------|------|------|--------------------------------|-------|------|---------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | |
| DPN | 4 | n/a | 9.66 | 9.66 | 9.44 | 9.39 | non-wet |
| DPNB | 1 | n/a | n/a | n/a | n/a | 0.53 | non-wet |
| DPS | 12 | 3.35 | 3.20 | 3.60 | 3.46 | 3.49 | wet |
| DPSUB | 2 | n/a | n/a | n/a | 0.86 | 0.84 | non-wet |
| DPSUP | 2 | n/a | n/a | n/a | 10.09 | 9.93 | non-wet |
| PN-N | 12 | 3.45 | 3.39 | 3.20 | 3.22 | 3.31 | non-wet |
| PN-W | 12 | 0.80 | 0.80 | 0.80 | 0.84 | 0.72 | wet |
| PS-N | 12 | 1.08 | 1.06 | 1.07 | 1.03 | 1.07 | non-wet |
| PS-W | 12 | 0.24 | 0.27 | 0.24 | 0.21 | 0.24 | wet |
| UPN | 7 | 3.00 | 2.96 | 2.96 | 2.84 | 2.84 | wet |
| UPS | 11 | 4.94 | 5.05 | 4.93 | 4.66 | 4.57 | wet |
| UPSUP | 11 | 1.97 | 1.97 | 1.98 | 2.04 | 2.06 | non-wet |

¹DPN = 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-N = Pabco North – Non-wetland, PN-W = Pabco North – Wetland, PS-N = Pabco South – Non-wetland, PS-W = Pabco South – Wetland, UPN = Upstream Pabco North, UPS = Upstream Pabco South, UPSUP = Upstream Pabco South Upper Plateau

²Wetland 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

Table 23. Physical characteristics of Pabco Road Weir revegetation sites in 2008-2012.

To the south of the Pabco Road Weir, a new trailhead was built in 2012. The Pabco Trailhead will bring many new visitors to this portion of the Wetlands Park. With this increase in pedestrian, bicycle, and equestrian usage, the potential for impact to revegetation sites is greater. Increased observation of these sites will be done to ensure any negative impact is limited as much as possible. Another potential future impact is the Sunrise Mountain Weir. This proposed weir will be located upstream of all revegetation sites but may still have some impact during construction as well as with changes in the hydrologic regime in the area.

3.10.1 Downstream Pabco North

Downstream Pabco North (DPN) is one of the newer sites at the Pabco Road Weir. DPN was planted in March of 2009 as a volunteer Green-Up event. At over 9.5 acres (Table 23), this site was one of the larger Green-Ups. This was the first revegetation site planted with funds from SNPLMA Round VI grant funding. Prior to planting, DPN contained a monoculture of salt cedar. The invasive species was cleared specifically for revegetation; it was not associated with any construction project.



Figure 65. Aerial photograph of delineated Pabco Road Weir revegetation sites.

Prior to the Green-Up, plugs of inland saltgrass (*Distichlis spicata*) and mist grass (*Muhlenbergia asperfolia*) were transplanted to the site from the Wetlands Park Nature Preserve (Figure 66). As part of the Green-Up, in addition to traditional container plants, DPN was the first revegetation site to have volunteers apply broadcast seeds across the site. Seeded plants included desert marigold (*Baileya multiradiata*), brittle bush (*Encelia farinosa*), and sunflower (*Helianthus annuus*).

All of the planted and seeded plants at DPN were still present on the site as of the 2012 monitoring. All of the seeded plants had less than 1% cover. While these species are smaller than most and will never have substantial amount of cover, such low cover may represent that this technique was unsuccessful. This technique has not been attempted at other sites, so comparison is not available to see if this result was specific to DPN or not. The overall site has been successful in the four years since planting. After the first growing season in 2009, the total cover was 50-75%; this has increased to 75.1% in 2012 (Table 23). DPN is divided into three monitoring areas; the total cover and species cover is the weighted average of values collected from each area.

The two co-dominant species on the site in 2012 w ere honey and screwbean mesquite, both of which were planted. The transplanted inland saltgrass was the dominant species in 2009 with 25-50% cover. This had diminished to just 2.1% in 2012. After the 2010 growing season, the intensive irrigation subsided, and the prevalence of inland saltgrass began to



Figure 66. Mist grass provides an understory for honey mesquite at the Downstream Pabco North revegetation site.

shrink immediately after. Only one of the 24 species documented in 2012 was a noxious weed - salt cedar with a cover of 1.4%. Johnsongrass and tall whitetop had previously been documented on the site but had not been recorded since 2008 and 2011, respectively.

3.10.2 Downstream Pabco North Bank

South of DPN is Downstream Pabco North Bank (DPNB). DPNB was originally planted in 2011 but bank protection was installed over the revegetation site in 2012. The site was replanted in the spring of 2012. As a result, 2012 is considered its first growing season. The majority of plants planted on the site were honey mesquite, which was also the dominant species in its first

monitoring year. The cover of mesquites was 5-25%, which was also the total cover for the site. Thirteen additional plants were documented in 2012, none of which were noxious weeds.

3.10.3 Downstream Pabco South

Across the Wash from DPN and DPNB is one of the oldest revegetation sites on the Wash, Downstream Pabco South (DPS). Planted in 2001, DPS was in its twelfth growing season in 2012. Monitoring in 2012 took place after large rain events disturbed much of the site. The flooding on the site likely uprooted many smaller plants and deposited sediment on ot hers making accurate species richness accounts difficult. As a result, 2012 saw the lowest number of species recorded on DPS with just 12 species. Since 2008, the lowest previous number of species was 21 in 2011 (Table 24).

Four out of the past five years had the total cover of DPS at 75-100%. In 2010, the total cover was just 50-75%. The majority of the vegetative cover in all years comes from the dominant species on the site, Fremont's cottonwood. From 2010 to 2012, Fremont's cottonwood has had a consistent cover of 50-75%. The only noxious weed identified in 2012 was salt cedar, with a cover of 0.5%.

3.10.4 Downstream Pabco South Upper Bank

Downstream Pabco South Upper Bank (DPSUB) was planted as part of the spring 2011 Green-Up just to the south of DPS. The vegetation was planted on soil that was placed on top of bank protection. There were five species planted on the site. In 2011, after the first growing season, there were seven species identified on the site. This increased three-fold in 2012 to 21 species. There was 80.1% survival after the first growing season and 100% survival was documented after the second. The increase in survivorship can be attributed to using randomized transects for sampling, as well as difficulty in observing some dead plants if all vegetative material has been removed by wind or flooding

The total cover on DPSUB in 2012 was 50-75%, up from 25-50% in 2011. Most of the vegetative cover in both years has come from alkali sacaton with 5-15% and 25-50% cover in 2011 and 2012, respectively. The only noxious weed observed on the site was silver-leaf nightshade which was only found in 2012 and had a cover of just 0.1%.

3.10.5 Downstream Pabco South Upper Plateau

The other area planted during the spring 2011 Green-Up was Downstream Pabco South Upper Plateau (DPSUP), located across the access road to the south of DPSUB. In 2012, the new Pabco Trailhead was built to the west of this site and the main access road to this area of the Wetlands Park was installed to the south. It is expected that many visitors will be visiting this part of the Wetlands Park in upcoming years and DPSUP will be one of the first revegetation sites they see.

Because DPSUP is a large revegetation site at around ten acres (Table 23), it was divided into two monitoring areas. There were 13 species planted on the site during the Green-Up. However, only 12 of these species were documented in the two monitoring events that have taken place so far. Nevada ephedra (*Ephedra nevadensis*) was not documented. As with many newly planted

| Site | | 2008 | | | | | 2010 | | | | 2011 | | | 2012 | | | | | | |
|-------------------|---------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|---------|------------------|--------|------------------|
| Code ¹ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| DPN | - | - | - | - | 62.5 | 1.7 | 40 | 3.26 | 68.6 | 0.1 | 25 | 3.31 | 62.5 | 0.6 | 26 | 3.68 | 75.1 | 1.4 | 24 | 3.98 |
| DPNB | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5-25 | 0.0 | 14 | 4.29 |
| DPS | 75-100 | 0.1 | 25 | 2.73 | 75-100 | nm | nm | nm | 50-75 | 0.3 | 32 | 2.74 | 75-100 | 0.3 | 21 | 2.81 | 75-100 | 0.5 | 12 | 2.81 |
| DPSUB | - | - | - | - | - | - | - | - | - | - | - | - | 25-50 | 0.0 | 7 | 2.82 | 50-75 | 0.1 | 21 | 3.48 |
| DPSUP | - | - | - | - | - | - | - | - | - | - | - | - | 50-75 | 2.6 | 37 | 3.65 | 75-100 | 2.1 | 34 | 4.24 |
| PN-N | 25-50 | 0.1 | 18 | 3.65 | 75-100 | 2.5 | 22 | 3.48 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 11 | 3.09 | 50-75 | 2.5 | 16 | 3.84 |
| PN-W | 75-100 | 2.5 | 14 | 2.34 | 75-100 | nm | nm | nm | 75-100 | 2.6 | 25 | 2.34 | 75-100 | 2.6 | 25 | 2.20 | 75-100 | 0.1 | 21 | 2.47 |
| PS-N | 25-50 | 0.1 | 12 | 4.37 | 25-50 | nm | nm | nm | 75-100 | 0.1 | 20 | 4.43 | 75-100 | 0.0 | 22 | 4.04 | 50-75 | 0.5 | 14 | 4.66 |
| PS-W | 75-100 | 2.5 | 17 | 2.20 | 75-100 | nm | nm | nm | 75-100 | 0.6 | 18 | 2.05 | 75-100 | 0.5 | 10 | 1.99 | 75-100 | 0.5 | 7 | 1.97 |
| UPN | 50-75 | 3.6 | 23 | 2.13 | 75-100 | 3.6 | 28 | 2.16 | 75-100 | nm | nm | nm | 75-100 | 5.2 | 28 | 2.06 | 75-100 | 17.6 | 22 | 2.16 |
| UPS | 85.2 | 0.8 | 32 | 2.03 | 87.5 | nm | nm | nm | 83.3 | 2.2 | 26 | 2.56 | 85.4 | 6.3 | 23 | 2.94 | 84.8 | 3.7 | 18 | 2.56 |
| UPSUP | 50-75 | 0.0 | 8 | 3.69 | 75-100 | nm | nm | nm | 75-100 | 0.1 | 11 | 3.91 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 11 | 3.49 |

¹DPN = Downstream Pabco North, DPNB = Downstream Pabco North Bank, DPS = Downstream Pabco South, DPSUB = Downstream Pabco South Upper Plateau, PN-N = Pabco North – Non-wetland, PN-W = Pabco North – Non-wetland, PS-N = Pabco South – Non-wetland, PS-W = Pabco South – Wetland, UPN = Upstream Pabco North, UPS = Upstream Pabco South, UPSUP = Upstream Pabco South, UPS

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species Richness.$ The number of species identified on the site

⁵WPI = Wetland Prevalence Index 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 24. Vegetation monitoring results for Pabco Road Weir revegetation sites in 2008-2012.



Figure 67. Large cottonwood trees dominate the 12-year-old Downstream Pabco South revegetation site.

sites, multiple additional species have self-established on the site. There were a total of 37 and 34 species identified in 2011 and 2012, respectively. Three noxious weeds have been identified on the site; tall whitetop (only found in 2011,) silver-leaf nightshade, and salt cedar. Only salt cedar had more than 1% cover with 2.5% in 2011 and 1.6% in 2012.

Survivorship percentage of planted plants was monitored in both years since the planting of the site. In 2011, survivorship was 94.2%. It slightly decreased to 87.7% in 2012, still above the Wash Team's success criteria of 75%. The total cover was 75-100% in 2012, up from 50-75% in its first monitoring year. These high total cover values can be expected with high species richness. The dominant species in 2012 was honey mesquite with 25-50% cover. Honey mesquite was co-dominant with desert willow in 2011. Both species had 5-15% cover that year.

3.10.6 Pabco North – Non-Wetland

Pabco North – Non-wetland (PN-N) was one of the many sites planted as part of the first Green-Up in 2001. As of the most recent monitoring in 2012, the site was in its twelfth growing season. Total cover on the site has gone up and down in the 2008-2012 timeframe. In 2008, the total cover was 25-50%. The cover increased to 75-100% from 2009-2011, with 2010's data coming from ArcGIS. Total cover in 2012 was 50-75%. The most recent decrease can be attributed to removal of quailbush on the site in 2012. Large individual quailbush were removed to improve flood flows across the site, as well as to allow other plants opportunity to increase in size (Figure 68). The two co-dominant species on the site were honey and screwbean mesquites which had 25-50% cover. The quailbush that had substantial thinning in 2012 still had 5-25% cover, down from the 25-50% it had in 2011. A total of 16 species were documented, up from 11 in 2011. Two species were documented for the first time in 2012; honey sweet (*Tidestromia suffruticosa* var. *oblongifolia*) and desert mistletoe (*Phoradendron californicum*). Desert mistletoe is a native hemiparisite that attaches to mesquites. Salt cedar is the only noxious weed identified in the past five years; it had 1-5% cover in 2012.



Figure 68. Pabco North – Non-wetland after quailbush was thinned in 2012.

3.10.7 Pabco North – Wetland

Pabco North – Wetland (PN-W) was planted in conjunction with PN-N in 2001. It is located along the bank of the Wash with parts of the site within the edge of the Wash channel itself. PN-W has had the maximum cover of 75-100% in every monitoring year. The vegetative cover is co-dominated by two species; Fremont's cottonwood and common reed. Fremont's cottonwood contribute to the cover by their large growth while common reed is continually spreading rhizomatically into the Wash and along the banks. Both species had cover of 25-50% in 2012.

There were 21 species found on PN-W in 2012, up from just 14 species in 2008. Although five noxious weed species have been identified on the site, only two have been documented in the past five growing seasons; salt cedar and tall whitetop. Only salt cedar was found in 2012 with a cover of 0.1%. The WPI was at its highest value in the past five years at 2.47 in the most recent monitoring season. This can be attributed to the decline in two riparian species; sandbar and Goodding's willow. Both species have declined in cover over the past few growing seasons and the WPI has reflected this change. Some of the loss may be attributed to sediment and

vegetation being removed from the Wash channel, although this was likely minimal. The more prevalent cause is unknown.

3.10.8 Pabco South – Non-Wetland

Located west of DPS and north of the new Pabco Trailhead, Pabco South – Non-wetland (PS-N) was also planted in the spring 2001 Green-Up. The cover on PS-N has fluctuated over the past five monitoring years. In 2008 and 2009, the total cover was 25-50%. Total cover was measured using ArcGIS in 2009. This increased substantially to 75-100% in both 2010 and 2011. Cover decreased in 2012 down to 50-75%. The increase is likely due dramatic growth of multiple species between 2008 and 2010 including the dominant species, honey mesquite growing from 5-25% cover in 2008 to 25-50% in 2010 (Figure 69) and creosote bush increasing from 1-5% to 5-25% in the same timeframe. The decrease in the most recent monitoring is less clear, although many of the species with smaller cover values did decrease. The actual cover of the site is likely near the border of the two ranges; 75%.

There were 14 species identified on the site in 2012. This is up from 12 in 2008 but down from 20 and 22 in 2010 and 2011. Some of this decline can be attributed to the fact that PS-N was monitored after storm flows came through the site, likely uprooting many smaller plants. Only one noxious weed has been found in the past five years; salt cedar with a cover of 0.5% in 2012.



Figure 69. Honey mesquite trees dominated the Pabco South – Non-wetland revegetation site in 2012.

3.10.9 Pabco South – Wetland

Pabco South – Wetland (PS-W) was planted along with PS-N in 2001. Additional plantings took place along newly installed bank protection in 2011 adjacent and downstream of the original site. These additional plantings increased the size of the site by 0.3 a cres. Like most of the

revegetation sites on the south side of the Pabco Road Weir, monitoring took place after storm events caused flooding on the sites.

The total cover on PS-W has remained at 75-100% in every year of monitoring. This is despite a decline in species richness. In 2008, the number of species on the site was 17. The site was monitored by ArcGIS in 2009, so no species data is available. Species richness in 2010 was similar to 2008 at 18. The number of species declined in 2011 to 10 and again in 2012 to 7. The most recent decrease could have been a result of the flooding as none of the 11 species lost since 2010 had more than 0.1% cover in 2010. One species no longer found on the site since 2010 is the noxious weed tall whitetop. Salt cedar was identified in 2012 with 0.5% cover. The dominant species on the site every year since 2008 has been Goodding's willow with 25-50% cover in 2012.

3.10.10 Upstream Pabco North

Upstream Pabco North (UPN) is the only revegetation site located on the north side of the Wash upstream of the Pabco Road Weir. It is bordered to the south by the Wash and by a large stand of salt cedar to the north and west. It was originally planted in 2001; however, the site was reconfigured in 2006 to assist in flood conveyance. This resulted in the site becoming less hydric so it was replanted with appropriate species. Therefore, for the purposes of monitoring and reporting, the first growing season for UPN has been reset to 2006. This makes 2012 the seventh growing season.

In 2008, the total cover for UPN was 50-75%. For each year since, the total cover has been 75-100%. Vegetation was monitored in 2010 using ArcGIS so no species specific data was collected. Species richness on the site was 23 in 2008. It increased to 28 in both 2009 and 2011 and in 2012, it decreased to its lowest number of species since 2006; 22. There were three species tied with the highest level of cover in 2012; sandbar, Goodding's willow, and common reed. All three of these species had 25-50% cover.

There were three noxious weeds identified on UPN in 2012. Maltese star-thistle (*Centaurea melitensis*) had just 0.1% cover, tall whitetop had 1-5% cover, and salt cedar had a cover of 5-25%. Due to UPN's proximity to the large salt cedar stand to the north and west, it is likely that there will always be infiltration of the species on the site until the stand is removed. The Sunrise Mountain Weir, currently proposed upstream of the Pabco Road Weir, will likely remove the majority of the salt cedar. If this proposed weir is constructed, it may also impact the revegetation site itself, though not a substantial area.

3.10.11 Upstream Pabco South

Upstream Pabco South (UPS) is made up of four monitoring sites. The original UPS was a smaller site, but in earlier monitoring years, there was inconsistency in monitoring and the site formerly known as Upstream Pabco South Lower Plateau was included with UPS. As a result, UPS and the lower plateau were combined into the new UPS for all monitoring results after 2006. The lower plateau and three segments of the original UPS make up the four monitoring areas within the site.

The total cover on UPS has consistently been above 80% in the 2008-2012 timeframe (Table 24; Figure 70). The dominant species in all years (except 2008) has been Fremont's cottonwood with cover values between 45 and 46%. In 2008, Fremont's cottonwood had just 10.9% cover and the dominant species was sandbar willow with 44.6% cover. Sandbar willow was the second most dominant species in 2012 with 21.4% cover. Three noxious weeds were identified on the site in 2012; tall whitetop and silver-leaf nightshade each with 0.1% cover and salt cedar with 3.4% cover.

Species richness on UPS has steadily declined over the past five years. The 2008 monitoring resulted in 31 species being identified. From 2010 to 2012, that number has declined to 26, 23, and finally 18 in the most recent monitoring. While some of the most recent decline can be attributed to monitoring taking place after the fall 2012 flooding, the steady decline indicates that there may be something else taking place, although most species no longer found on the site never had more than 1% cover in any given year.



Figure 70. Large trees dominate the Upstream Pabco South revegetation site in its eleventh growing season.

3.10.12 Upstream Pabco South Upper Plateau

Upstream Pabco South Upper Plateau (UPSUP) was planted along with UPS at the spring 2002 Green-Up on F ebruary 23, 2002, and was in its eleventh growing season as of the 2012 monitoring. UPSUP's planting layout is unlike any other revegetation site along the Wash. Due to irrigation practices used at the time of planting (i.e. bubblers), the plant layout is similar to that of an orchard. The majority of plants, including all planted plants, are in rows similarly spaced

from each other. UPSUP is bordered to the south and west by large a monoculture stand of salt cedar.

The total cover on the site was 50-75% in 2008 and 75-100% in all subsequent years. Cover was determined using ArcGIS in 2009 and 2011. The dominant species in terms of cover in 2012 was screwbean mesquite, which has been the dominant or co-dominant species on the site each year since 2003. There were 11 species identified in 2012. This is the same number of species as in 2010 and three more than were identified in 2008. The only noxious weed ever identified on the site was salt cedar which had a cover of 0.5% in 2012.

3.11 Powerline Crossing Weir

The Powerline Crossing Weir is the furthest weir downstream of the Wash within the Wetlands Park. This weir includes a bridge across the Wash, one of only two crossings within the Wetlands Park. All of the sites were planted in 2007 and were in their sixth growing season as of the most recent monitoring in 2012. The largest two non-wetland sites were planted as part of the spring 2007 Green-Up. The remaining non-wetland sites and all wetland sites were planted later that same year.



Figure 71. Average total cover across all Powerline Crossing Weir revegetation sites from 2008 to 2012.

The overall trend of cover on Powerline Crossing Weir sites increased steadily in their first three growing seasons with some fluctuation in the past two monitoring years (Figure 71). With the majority of sites and acreage being non-wetland (Table 25), the growth is on pace with the majority of other sites. The increased growth in the past three growing seasons is encouraging after low survivorship numbers (Figure 72). Highly saline soils are prevalent throughout all of the non-wetland sites stunting plant establishment and growth. Salt cedar and tall whitetop have been the only two noxious weeds found at the Powerline Crossing area (Figure 73). The trend of

species richness across the nine sites has been declining over the past five years with 2012 having the lowest (Figure 74). The majority of these species have been shrubs in the most recent monitoring years (Figure 75).

| Site Code ¹ | 2012 Growing | | Acreage f | for Each Mo | nitoring Yea | r | Wetland Status ² |
|---------------------------|-----------------|------|-----------|-------------|--------------|------|--------------------------------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | |
| DPLNB | 6 | 0.30 | 0.30 | 0.29 | 0.28 | 0.31 | wet |
| DPLSB | 6 | 0.25 | 0.25 | 0.25 | 0.24 | 0.24 | wet |
| PLSB | 6 | 0.62 | 0.38 | 0.56 | 0.54 | 0.54 | non-wet |
| UPLNB | 6 | n/a | n/a | 0.60 | 0.60 | 0.61 | non-wet |
| UPLNE | 6 | 0.72 | 0.87 | 0.91 | 0.95 | 1.04 | wet |
| UPLNP | 6 | 4.01 | 4.03 | 4.03 | 4.03 | 4.10 | non-wet |
| UPLNW | 6 | 0.13 | 0.14 | 0.14 | 0.25 | 0.33 | wet |
| UPLSB | 6 | 0.25 | 0.38 | 0.43 | 0.45 | 0.64 | wet |
| UPLSP | 6 | 7.89 | 8.34 | 8.05 | 8.05 | 6.82 | non-wet |

¹DPLNB = Downstream Powerline North Bank, DPLSB = Downstream Powerline South Bank, 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

²Wetland 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





Figure 72. Average survivorship across all Powerline Crossing Weir revegetation sites in their first two growing seasons.



Figure 73. Average noxious weed cover across all Powerline Crossing Weir revegetation sites from 2008 to 2012.



Figure 74. Average species richness across all Powerline Crossing Weir revegetation sites from 2008 to 2012.



Figure 75. Average cover composition across all Powerline Crossing Weir revegetation sites from 2008 to 2012.

3.11.1 Downstream Powerline North Bank

One of two revegetation sites downstream of the Powerline Crossing Weir (Figure 72), Downstream Powerline North Bank (DPLNB) was planted but currently is dominated by plants that established themselves on the site. DPLNB includes vegetation on and around a square concrete structure that was filled with rip-rap. Native emergent and riparian vegetation was planted along the perimeter of the structure. The rip-rap area within the box has had vegetation passively establish there. The two box structures narrow the width of the Wash channel, therefore flood events are very pronounced in this reach, and this has resulted in vegetation along the edges to be repeatedly impacted causing declines in planted emergent vegetation.

The total cover of the site has steadily increased over the past five growing seasons (Table 26). In 2008, the cover was 25-50% and by 2012, the total cover reached 75-100%. Species richness also reached its highest level in 2012 with 25 species. One species not found on the site from 2010 to 2012 was Fremont's cottonwood, which was one of the species planted on the site. Another planted species, tule, had just 1-5% cover compared to 50-75% after its first growing season in 2007. The site has a large amount of salt cedar, covering 5-25% of the site in 2012.

3.11.2 Downstream Powerline South Bank

The other revegetation site downstream of Powerline Crossing Weir is Downstream Powerline South Bank (DPLSB). This site is identical in configuration to DPLNB on the opposite bank of the Wash. There are some similarities and some differences between the two sites. Like DPLNB, DPLSB has steadily increased its cover to 75-100% in 2012. Also like DPLNB, the tule cover has declines substantially to just 1-5% in 2012. Species richness on DPLSB is much lower. The highest number of species since monitoring began was just ten in 2012. Ten species

is the lowest recorded on DPLNB in the past five years. Another commonality is the prevalence of salt cedar. DPLSB has 25-50% cover of salt cedar in 2012, making it the dominant species on the site. There are large stands of salt cedar downstream of both DPLNB and DPLSB on property owned by the city of Los Angeles underneath the power lines. This is the likely source of salt cedar on these revegetation sites.

3.11.3 Powerline South Bank

Powerline South Bank (PLSB) is located above the bank protection and below the access road on the south side of the Wash upstream of the weir. PLSB has never had many species identified on it in the three years it was monitored in the field. There were six species in 2008, five in 2009, and four in 2012; the site was monitored with ArcGIS in 2010 and 2011. The dominant species in all years was quailbush, with 25-50% of the total 50-75% cover in 2012.

3.11.4 Upstream Powerline North Bank

Upstream Powerline North Bank (UPLNB) was originally planted in 2007. However, after the first growing season, the total cover was 0.1%. Only two species were found on the site. As a result, no monitoring took place in 2008 and 2009 because no additional growth took place. The site was hydroseeded in 2010 with fourwing saltbush, desert saltbush, and galleta grass (*Hilaria rigida*) and was subsequently irrigated. An additional five species self-established on the site as a result of the increased water availability, bringing the species richness to eight in 2010. However, the site continued to not perform very well and was only monitored for total cover in 2011 and 2012 using ArcGIS. The site will have full monitoring done in 2013.

3.11.5 Upstream Powerline North Emergent

Upstream Powerline North Emergent (UPLNE) was revegetated on sediment deposited during construction of the weir specifically for emergent plants. The site has almost doubled in size since establishment to just over an acre (Table 25) as a result of sedimentation and plant growth on the site (Figure 77).

While the size of the site has increased on UPLNE, the diversity of species has decreased. In the past five growing seasons, the number of species on the site has decreased from 28 in 2008 to 12 in 2012. While the 12 remaining species are increasing in cover, the result has been the loss of many smaller forbs and grasses on the site. There are three co-dominant species on the site; arrowweed, sandbar willow, and southern cattail, (all native species). All of these species have 25-50% cover. The total cover has been consistent at 75-100% in the past four growing seasons as a result of the consistently high cover from these dominant species as well as a few others with slightly less cover.

3.11.6 Upstream Powerline North Plateau

Upstream Powerline North Plateau (UPLNP) is a non-wetland site that makes up more than a quarter of the total revegetation acreage associated with the Powerline Crossing Weir (Table 25). Due to its large size, the site has been divided into five monitoring areas and a weighted average of cover is used for the site. The site is very dry and also very saline as it is very far from the water table.



Figure 76. Aerial photograph of 2012 delineated Powerline Crossing Weir revegetation sites.

| Site | te 2008 | | | | | 2009 | 2010 | | | | 2011 | l | | 2012 | | | | | | |
|-------------------|------------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|
| Code ¹ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| DPLNB | 25-50 | 0.0 | 10 | 1.27 | 50-75 | 0.0 | 18 | 1.23 | 50-75 | 0.6 | 14 | 2.12 | 50-78 | 2.5 | 12 | 2.77 | 75-100 | 15.0 | 25 | 2.40 |
| DPLSB | 25-50 | 0.1 | 7 | 1.30 | 50-75 | 2.5 | 7 | 1.38 | 50-75 | 15.0 | 6 | 2.55 | 25-50 | 2.5 | 9 | 2.74 | 75-100 | 37.5 | 10 | 2.64 |
| PLSB | 5-25 | 0.0 | 6 | 3.05 | 50-75 | 0.0 | 5 | 2.93 | 25-50 | nm | nm | nm | 25-50 | nm | nm | nm | 50-75 | 0.0 | 4 | 3.07 |
| UPLNB | - | - | - | - | - | - | - | - | 1-5 | 0.1 | 8 | 3.25 | 5-25 | nm | nm | nm | 5-25 | nm | nm | nm |
| UPLNE | 50-75 | 0.6 | 28 | 2.33 | 75-100 | 0.5 | 14 | 2.07 | 75-100 | 0.5 | 16 | 1.86 | 75-100 | 0.5 | 16 | 1.92 | 75-100 | 2.5 | 12 | 1.99 |
| UPLNP | 44.3 | 2.9 | 19 | 4.72 | 36.4 | 0.2 | 17 | 4.83 | 50.2 | 0.2 | 15 | 4.75 | 44.3 | 0.9 | 13 | 3.58 | 53.9 | 0.3 | 13 | 3.80 |
| UPLNW | 75- 100 | 0.1 | 17 | 1.36 | 75-100 | 0.3 | 12 | 1.45 | 75-100 | 1.2 | 14 | 1.93 | 75-100 | nm | nm | nm | 75-100 | 0.5 | 7 | 2.03 |
| UPLSB | 75- 100 | 0.5 | 23 | 1.75 | 75-100 | 0.6 | 17 | 1.86 | 75-100 | 0.1 | 11 | 2.02 | 75-100 | nm | nm | nm | 75-100 | 2.5 | 13 | 1.87 |
| UPLSP | 30.9 | 0.1 | 18 | 4.84 | 43.0 | 2.7 | 11 | 4.21 | 72.1 | 0.0 | 10 | 4.87 | 51.2 | 0.0 | 13 | 4.44 | 60.5 | 0.0 | 7 | 3.85 |

¹DPLNB = Downstream Powerline North Bank, DPLSB = Downstream Powerline South Bank, PLSB = Powerline South Bank, UPLNB = Upstream Powerline North Bank, UPLNE = Upstream Powerline North Plateau, UPLNW = Upstream Powerline North Wetland, UPLSB = Upstream Powerline South Bank, UPLSP = Upstream Powerline South Plateau

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species$ Richness. The number of species identified on the site

 5 WPI = Wetland Prevalence Index value. WPI \leq 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 \geq 4.0 = upland

nm = this attribute was not monitored

 Table 26. Vegetation monitoring results for Powerline Crossing Weir revegetation sites in 2008-2012.



Figure 77. The size of Upstream Powerline North Emergent has almost doubled since establishment while species diversity has decreased.

The total cover in 2012 on UPLNP was 53.9%, its highest value in its six year history (Table 26). While this is relatively low even for non-wetland sites in their sixth growing season, due to its physical characteristics of being very dry and saline, this total cover is encouraging for the site's ultimate success. The number of species on the site has steadily declined over the past five years and was at 13 species in the past two growing seasons. Not surprisingly, the two dominant plants on the site were both saltbushes. Quailbush was the dominant species with 21.7% in 2012 and fourwing saltbush was not far below that with 21.2% (Figure 78).

3.11.7 Upstream Powerline North Wetland

Located upstream and downstream of UPLNE, Upstream Powerline North Wetland (UPLNW) makes up the remaining wetland vegetation on the north bank upstream of Powerline Crossing Weir. Like many wetland sites, the vegetation growth has resulted in regular expansion of the sites acreage over the past five growing seasons (Table 25). In all years of monitoring, the total cover has been 75-100%. Common reed has been the dominant species in 2010 and 2012. Only total cover was monitored in 2011 with ArcGIS. In 2008, the dominant species was tule, which was a native species planted on the site. No tules were identified on the site in 2012. Only seven species were recorded in 2012, the lowest since the site was established.


Figure 78. Quailbush and fourwing saltbush dominant the Upstream Powerline North Plateau revegetation site in 2012.

3.11.8 Upstream Powerline South Bank

All of the vegetation along the Wash's southern bank upstream of the Powerline Crossing Weir is part of the Upstream Powerline South Bank (UPLSB) revegetation site. This wetland site has had the highest total cover value, 75-100%, in each of the past five growing seasons (Table 25). Like many of the other wetland sites associated with the Powerline Crossing Weir, native species that were planted in 2007 have been steadily replaced with other species. Tule was the dominant species in 2008 with 50-75% cover, followed by Fremont's cottonwood with 25-50% cover. In 2012, these species had 1-5% and 5-25% cover, respectively. The area covered by these species has in large part been replaced by common reed which had a cover of 50-75% in 2012.

3.11.9 Upstream Powerline South Plateau

The largest revegetation site at the Powerline Crossing Weir is Upstream Powerline South Plateau (UPLSP). However, the site has been cut by over an acre from construction of trails both by the Wetlands Park and the City of Henderson. Similar to UPLNP, the site is very far from the water table and has high salinity, making plant establishment difficult. This may be the reason for fluctuations in the total cover over the past five growing seasons (Table 25).

Total cover has nearly doubled from 2008 to 2012. The total cover in 2012 was the highest the site has had in the past five years. In addition, 2012 had the lowest species richness in any monitoring year at seven. Also similar to UPLNP, UPLSP's dominant plant species are

fourwing saltbush and quailbush. Fourwing saltbush has been the dominant species in each of the six monitoring years.

3.12 Rainbow Gardens Weir

The Rainbow Gardens Weir is located just upstream of the Powerline Crossing Weir. It is one of three concrete weirs along the Wash. This weir was built using rolled concrete rather than rip rap due to the fact that there are fault lines in the area, as well as a major potable water pipeline located underneath the structure.

All revegetation sites at the Rainbow Gardens Weir are located upstream of the weir (Figure 79). Most of these were planted in 2005; however, some were planted in the spring and some in the fall. Because the growing season takes place in the summer, sites planted in the same calendar year can have different amounts of growing seasons. In addition to the four sites planted in 2005, one additional site was passively created once the weir was completed in 2005. A sixth site was established in 2010.

Given the knowledge of varying growing seasons among sites at the Rainbow Gardens Weir, the overall trend of total cover among sites is increasing as growing seasons progress (Figure 80). Species richness has remained relatively consistent over the past five growing seasons with the exception of 2011 when many sites weren't monitored (Figure 81). Noxious weed cover in 2012 is about half of what it was in 2008 (Figure 82). Most of the species cover on these sites has been shrubs over the past five monitoring years (Figure 83).

3.12.1 Rainbow Islands

Rainbow Islands (RI) was planted in the spring of 2005. The area has increased substantially since it was originally planted from just over two acres in 2006 to over 3.5 acres in 2012 (Table 27). This increase in size is a result of sedimentation upstream of the Rainbow Gardens Weir. Most of the wetland sites that are increasing in size due to sedimentation will increase in cover from the quickly expanding wetland plant species. This includes common reed and sandbar willow. Both of these species have increased from 5-25% cover in 2008 to 25-50% cover in 2012. These species make up the co-dominant species on the site along with Goodding's willow, which had 25-50% cover in 2012 (Figure 85).

The total cover at RI has remained at 75-100% cover in each of the last five years. RI was monitored using ArcGIS in 2011. Species richness has also remained relatively constant, staying between 27 and 35 in each of these years (Table 28). The only two noxious weeds that have been found on the site in the 2008-2012 timeframe are salt cedar and tall whitetop. The cover of noxious weeds has remained low, never reaching above 3% of the site (Table 28).

3.12.2 Upstream Rainbow North Bank

The newest revegetation site at the Rainbow Gardens Weir is Upstream Rainbow North Bank (URNB). URNB was strictly hydroseeded and no potted plants were planted. There were three plant species hydroseeded on the site; fourwing saltbush, globemallow, and galleta grass (Figure 84). Only fourwing saltbush was identified in 2012 and globemallow has not been documented on the site in any of the three years of monitoring. Despite this, the overall cover on the site has regularly increased (Table 27). Increasing growth on the site is due to the two dominant species



Figure 79. Aerial photograph of 2012 delineated Rainbow Gardens Weir revegetation sites.



Figure 80. Average total cover across all Rainbow Gardens Weir revegetation sites from 2008 to 2012.



Figure 81. Average species richness across all Rainbow Gardens Weir revegetation sites from 2008 to 2012.



Figure 82. Average noxious weed cover across all Rainbow Gardens Weir revegetation sites from 2008 to 2012.



Figure 83. Average cover composition across all Rainbow Gardens Weir revegetation sites from 2008 to 2012.

| Site Code ¹ | 2012 Growing Season | | | Wetland Status ² | | | |
|---------------------------|---------------------------|------|------|--------------------------------|------|------|---------|
| | Beuson | 2008 | 2009 | 2010 | 2011 | 2012 | _ |
| RI | 8 | 3.48 | 3.52 | 3.70 | 3.61 | 3.63 | wet |
| URNB | 3 | n/a | n/a | 2.72 | 2.75 | 1.67 | non-wet |
| URNPW | 8 | n/a | n/a | n/a | 1.99 | 2.30 | wet |
| URSB | 7 | 0.15 | 0.14 | 0.13 | 0.13 | 0.15 | non-wet |
| URSE | 8 | 1.33 | 1.52 | 1.40 | 1.41 | 1.48 | wet |
| URSP | 7 | 2.04 | 2.04 | 2.04 | 2.04 | 2.05 | non-wet |

on the site; fourwing saltbush and quailbush, which both had 25-50% cover in 2012.

¹RI = Rainbow Islands, URNB = Upstream Rainbow North Bank, URNPW = Upstream Rainbow North Passive Wetland, URSB = Upstream Rainbow South Bank, URSE = Upstream Rainbow South Emergent, URSP = Upstream Rainbow South Plateau

²Wetland 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

Table 27. Physical characteristics of Rainbow Gardens Weir revegetation sites in 2008-2012.



Figure 84. Fourwing saltbush and globemallow are two species hydroseeded on the Upstream Rainbow North Bank revegetation site.

3.12.3 Upstream Rainbow North Passive Wetland

After the completion of the Rainbow Gardens Weir, the Upstream Rainbow North Passive Wetland (URNPW) began to form. The site is located along the north bank of the Wash and is just below URNB. It has only been monitored for the past two growing seasons - 2011 and 2012 using ArcGIS and no species specific information has been collected. The total cover has been 75-100% in both monitoring years (Table 28).

| Site Code ¹ | – – – 2 | $\begin{array}{c} 2008 \\ TOT^2 NOX^3 SR^4 WPI^5 \end{array}$ | | | $\begin{array}{c c} 2009 \\ TOT^2 & NOX^3 & SP^4 & WPI^5 \end{array}$ | | | | – – – 2 | 2010 |) | | 2011 TOT ² NOX ³ SR ⁴ WPI ⁵ | | | | $\begin{array}{c c} 2012 \\ TOT^2 & NOV^3 & CD^4 & WDI^5 \end{array}$ | | | |
|------------------------|----------------|--|----|------|---|-----|-----------------|------|----------------|------|-----------------|------|--|-----|----|------|---|------|----|------|
| | 1012 | NOX | SR | WPI | 101- | NOX | SR ⁺ | WPI | 101- | NOX | SR ⁺ | WPI | 101- | NOX | SR | WPI | 101- | NOX | SR | WPI |
| RI | 75-100 | 2.6 | 27 | 2.11 | 75-100 | 3.0 | 32 | 1.75 | 75-100 | 2.6 | 35 | 2.26 | 75-100 | nm | nm | nm | 75-100 | 2.6 | 30 | 2.20 |
| URNB | - | - | - | - | - | - | - | - | 5-25 | 0.1 | 15 | 3.43 | 25-50 | 0.5 | 12 | 3.04 | 50-75 | 0.5 | 7 | 3.98 |
| URNPW | - | - | - | - | - | - | - | - | - | - | - | - | 75-100 | nm | nm | nm | 75-100 | nm | nm | nm |
| URSB | 75-100 | 15.0 | 8 | 2.91 | 75-100 | 0.5 | 5 | 2.99 | 75-100 | 2.5 | 2 | 3.00 | 75-100 | nm | nm | nm | 75-100 | 0.0 | 5 | 2.99 |
| URSE | 50-75 | 15.0 | 16 | 1.97 | 75-100 | 2.6 | 21 | 1.93 | 75-100 | 15.0 | 24 | 2.52 | 75-100 | 2.6 | 23 | 2.30 | 75-100 | 17.5 | 23 | 2.56 |
| URSP | 5-25 | 0.0 | 11 | 4.15 | 25-50 | 0.0 | 6 | 4.65 | 25-50 | 0.0 | 12 | 4.92 | 25-50 | 0.0 | 12 | 4.83 | 25-50 | 0.0 | 8 | 4.92 |

¹RI = Rainbow Islands, URNB = Upstream Rainbow North Bank, URNPW = Upstream Rainbow North Passive Wetland, URSB = Upstream Rainbow South Bank, URSE = Upstream Rainbow South Emergent, URSP = Upstream Rainbow South Plateau

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

⁴SR = Species Richness. The number of species identified on the site

 ${}^{5}WPI = Wetland Prevalence Index 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 wetland, 2.5 < WPI < 3.5 = may be wetland, 3.5 < WPI < 4.0 = not likely a wetland, and WPI > 4.0 = upland wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4.0 = not likely a wetland, 3.5 < WPI < 4$

nm = this attribute was not monitored

Table 28. Vegetation monitoring results for Rainbow Gardens Weir revegetation sites in 2008-2012.

3.12.4 Upstream Rainbow South Bank

The Upstream Rainbow South Bank (URSB), one of the smallest revegetation sites, was planted as part of the fall 2005 Green-Up. At the time of planting, the site was less than one-tenth of an acre; as of 2012, it was 0.15 acres (Table 27). Since planting, the dominant species on t he site has been quailbush. In 2012, quailbush had a cover equal to that of the total site, 75-100%. No other species had more than 0.5% cover. All of the noxious weed cover in the past five growing seasons (Table 28) came from salt cedar. No noxious weeds were identified in 2012

3.12.5 Upstream Rainbow South Emergent

The wetland site Upstream Rainbow South Emergent (URSE) was planted in the spring of 2005. Like RI, URSE is dominated by common reed, which had a cover of 25-50% in 2012. Also, like RI and most other wetland sites, vegetation on URSE was able to reach the maximum total cover value under current Figure 85. Goodding's and sandbar willow along with monitoring protocols very quickly (Table 28). Species richness has been very stable in the



seep willow at the Rainbow Islands revegetation site in 2012.

past few years as well. Tall whitetop and salt cedar have both been present on URSE during most monitoring years. While the cover of tall whitetop has remained pretty small, salt cedar has had higher levels, reaching 5-25% in a few years, including 2012. Because salt cedar's cover has fluctuated from 1-5% and 5-25% in the past five years (Table 28), it is assumed that the actual cover is close to 5%.

3.12.6 Upstream Rainbow South Plateau

In the fall of 2005, Upstream Rainbow South Plateau (URSP) was planted as part of a volunteer Green-Up event. URSP is at a higher elevation than the other sites associated with the Rainbow Gardens weir, adjacent to UPLSP. The total vegetative cover on URSP has mirrored the cover of the dominant plant species; creosote bush. In 2008, the total cover and creosote bush cover were 5-25% and increased to 25-50% in each monitoring year since. No other species on the site had more than 0.5% cover and no noxious weeds have been documented in the past five growing seasons.

3.13 Site 108

Site 108 (S108) is the largest contiguous revegetation site along the Wash, nearly double the size of the second largest, CCWRD. Because of this size, the site was planted in four phases, each with a different funding source (Table 29; Figure 86). To best understand the status of plantings at S108 and how the vegetation is changing through growing seasons, monitoring results are

categorized by these four funding sources in addition to the site as a whole. Within these funding areas, the sites are further broken down into 67 monitoring areas.

S108 decreased in its overall size in 2012 by about six acres as a result of construction activities to the north of the site (Table 29). The area lost however, will be replanted as part of the revegetation activities with the two new weirs that were installed. Additional revegetation will take place to the west of the site as well. This new revegetation is expected to be planted in 2014. The construction footprint of the two new erosion control structures is visible in Figure 86.

As a whole, S108 has just over half of its area covered by vegetation as of 2012 (Table 30). This is the midpoint of total cover amounts in the past five years, with two years having higher values and two having lower. The highest total cover was in 2009 with 65.5% which was determined using ArcGIS. Species richness has stayed at similar levels in the past five years staying within the range of 24 to 28 species; there was no species information collected in 2009. The dominant species in three of the four years that species information was collected was alkali sacaton. Quailbush had a slightly higher cover value than alkali sacaton in 2011.

S108 is the only site along the Wash that has Russian olive (*Elaeagnus angustifolia*) present. There are only a couple of individual trees so its impact and cover are minimal. Salt cedar is the only other noxious weed on S108, also with small impact and cover with just 2.7% in 2012.

<u>NDEP</u>- The NDEP funded portion of S108 is the smallest of the four funded areas. It is the only one of the four areas to decrease in cover from 2011 to 2012. While there was a reduction of about an acre and a half from the construction activities, plant performance is the likely cause. The dominant species in 2008, 2010, and 2011 was alkali sacaton but it decreased substantially in 2012 from 20.1% to 12.4%. Most of the alkali sacaton in this area is located south of the construction are a and was likely unaffected (Figure 87). The cover of this species has steadily been declining since 2008. During the same 2011 to 2012 timeframe, honey mesquite increased in cover from 10.1% to 13.2%. This leads to the conclusion that something specific to alkali sacaton is occurring and not the overall plant community.

 \underline{NDSP} – The NDSP funded part of S108 is located on the furthermost west portion of the site. It is the third largest component of the site. This area has had the highest total cover among the four funding areas in each of the past five years (Table 30). Like the NDEP area, the NDSP area is dominated by alkali sacaton with almost 40% cover in 2012. In addition, this area has also had the highest number of species documented on it in each of the four growing seasons in which species information was collected.

<u>SNPLMA IV</u> – The funding area located on the furthermost east portion of the site is SNPLMA IV. Unlike the NDEP and NDSP areas, the SNPLMA IV area has increased in total cover from 2011 to 2012 (Table 30). The 2012 total cover was the highest the site had ever recorded. The growth of arrowweed was primarily responsible for this increase. Arrowweed was the dominant species in 2012 with 20.0% cover, up from just 4.3% in 2011. Two of the 11 species identified in 2012 were noxious weeds; salt cedar and Russian olive. The SNPLMA IV area is the one area where Russian olive is found; it had just 0.01% cover in 2012.



Figure 86. Aerial photograph of Site 108 with 2012 delineations based on funding source.

| Site Code ¹ | 2012 Growing Season | 2002 Acreage for Each Monitoring Year ³ owing eason 2000 | | | | | | | | | |
|---------------------------|---------------------------|---|-------|-------|-------|-------|---------|--|--|--|--|
| | | 2008 | 2009 | 2010 | 2011 | 2012 | _ | | | | |
| S108 | 6-7 | 57.95 | 57.95 | 57.95 | 57.95 | 50.32 | non-wet | | | | |
| NDEP | 7 | 7.75 | 7.75 | 7.75 | 7.75 | 6.26 | non-wet | | | | |
| NDSP | 6 | 13.91 | 13.91 | 13.91 | 13.91 | 12.62 | non-wet | | | | |
| SNPLMA IV | 6-7 | 14.32 | 14.32 | 14.32 | 14.32 | 12.99 | non-wet | | | | |
| SNPLMA V | 6-7 | 18.59 | 20.14 | 20.14 | 20.14 | 17.64 | non-wet | | | | |

¹S108 = Site 108 as a whole, NDEP = Area of Site 108 funded by NDEP, NDSP = Area of Site 108 funded by NDSP, SNPLMA IV = Area of Site 108 funded by SNPLMA IV, SNPLMA V = Area of Site 108 funded by SNPLMA V

²Wetland 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

³There are additional small portions of Site 108 as a whole that are not included in funding area acreage totals

 Table 29. Physical characteristics of Site 108 revegetation site in 2008-2012.

<u>SNPLMA V</u> – The largest funding area at S108 is the one funded by SNPLMA V. Like SNPLMA IV, the SNPLMA V area increased in cover in 2012 from 2011, but unlike SNPLMA IV, the area had higher total cover values in 2009 and 2010. The two dominant species on the site in each of the four years where species information was gathered were quailbush and fourwing saltbush. They have been either the dominant or co-dominant species in each of the four monitoring years. Quailbush and fourwing saltbush had covers of 10.9% and 10.5% in 2012, respectively.



Figure 87. A large area of alkali sacaton in front of honey mesquites at Site 108 in 2012.

| Site Cada ¹ | | 2008 | | | 2009 | | | | 2010 | | | | 2011 | | | | 2012 | | | |
|------------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|
| Sile Code | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| S108 | 47.6 | 0.4 | 28 | 3.58 | 65.5 | nm | nm | nm | 57.3 | 1.5 | 27 | 3.41 | 47.2 | 1.7 | 24 | 3.48 | 51.8 | 2.7 | 25 | 3.38 |
| NDEP | 48.7 | 0.2 | 16 | 3.69 | 81.1 | nm | nm | nm | 58.8 | 0.9 | 19 | 3.60 | 34.0 | 0.8 | 13 | 3.72 | 29.1 | 3.2 | 15 | 4.01 |
| NDSP | 68.5 | 0.4 | 20 | 3.45 | 76.2 | nm | nm | nm | 78.6 | 1.9 | 20 | 3.40 | 71.5 | 3.8 | 16 | 3.43 | 75.1 | 3.8 | 18 | 3.45 |
| SNPLMA IV | 42.2 | 0.6 | 13 | 3.34 | 59.3 | nm | nm | nm | 60.1 | 1.8 | 13 | 3.00 | 50.7 | 1.4 | 10 | 3.20 | 61.8 | 2.8 | 11 | 2.82 |
| SNPLMA V | 35.7 | 0.4 | 15 | 3.95 | 56.5 | nm | nm | nm | 40.1 | 1.2 | 14 | 3.76 | 32.9 | 2.3 | 9 | 3.81 | 38.6 | 1.6 | 11 | 3.75 |

¹S108 = Site 108 as a whole, NDEP = Area of Site 108 funded by NDEP, NDSP = Area of Site 108 funded by NDSP, SNPLMA IV = Area of Site 108 funded by SNPLMA V = Area of Site 108 funded by SNPLMA V

 2 TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

 3 NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

⁴SR = Species Richness. The number of species identified on the site

 5 WPI = Wetland Prevalence Index 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 30. Vegetation monitoring results for Site 108 revegetation site and its funding in 2008-2012.

3.14 Site 111

The third largest revegetation site along the Wash is Site 111 (S111; Table 31). This site was planted in the spring of 2007 by a volunteer group from the Boy Scouts of America. It is a non-wetland site and not directly related or impacted by any erosion control structure (Figure 89). Prior to revegetation, the site was a monoculture of salt cedar. Like other large revegetation sites, S111 was divided into multiple monitoring areas. Twenty-five areas were created and a weighted average of species data is used to represent the total S111 cover and the cover of each species found on the site.

S111 has steadily increased in cover since it was first monitored in 2007 when the total cover was 9.9% just a few months after planting. As of 2012, the total cover is as close to the maximum value it can achieve (Table 32). More than half of the total cover can be attributed to the dominant species, quailbush, and while it is dominant species on the site as a whole, many of the monitoring areas were dominated by various other species. H oney mesquite, fourwing saltbush, and Fremont's cottonwood all have the highest species cover in individual monitoring areas (Figure 88).

Despite being dominated by salt cedar prior to revegetation, the site contained just 0.3% salt cedar total cover in 2012; it was the only noxious weed on the site from 2009-2012. In 2008, giant reed (*Arundo donax*) was documented on the site. It was removed and has not re-established.

3.15 Upper Diversion Weir

The Upper Diversion Weir is the furthest upstream weir along the Wash (Figure 93). It is located at the northernmost border of the Wetlands Park, downstream of the CCWRD property. The Upper Diversion Weir, completed in 2008, splits the Wash flow into two channels; the original channel, which includes the Monson and Visitor Center Weirs, and the East Bypass Channel. The water in the bypass channel reenters the main Wash channel downstream of the Visitor Center Weir. This diversion resulted in the creation of an island. A bridge was constructed on t op of the weir and is one of only two pedestrian crossings over the Wash (Powerline Crossing Weir is the other). R evegetation efforts took place on both sides of the bypass channel downstream of the weir, on the island, and to the west of the weir.

All eight revegetation sites at the Upper Diversion Weir were planted in 2008 and their first monitoring year was in 2009. The average cover, weighted by acreage, was high since the first growing season and stayed at that high level through the most recent monitoring (Figure 90). Species richness, on the other hand, has steadily declined across the major site as a whole (Figure 91). When looking at the Upper Diversion site in its entirety, the WPI values are as expected. The average WPI has stayed within the range of 2.68 and 3.08, right in the middle, meaning it may be a wetland. This is expected because there are four sites that are wetland and four that are not. The majority of the cover on these sites has come from shrubs over the first four monitoring years (Figure 92).

| Site Code ¹ | 2012 Growing Season | | Wetland Status ² | | | | |
|---------------------------|---------------------------|-------|--------------------------------|-------|-------|-------|---------|
| | Scason | 2008 | 2009 | 2010 | 2011 | 2012 | |
| <u>S111</u> | 6 | 15.11 | 15.39 | 15.01 | 15.10 | 14.86 | non-wet |

 1 S111 = Site 111

 2 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

Table 31. Physical characteristics of Site 111 revegetation site in 2008-2012.

| Site Code ¹ | 2008 | | | 2009 | | | | 2010 | | | 2011 | | | | 2012 | | | | | |
|------------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|------------------|
| | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| S111 | 53.2 | 0.2 | 26 | 3.74 | 70.8 | 0.7 | 27 | 3.77 | 79.2 | 1.5 | 24 | 3.54 | 80.0 | 0.6 | 17 | 3.42 | 86.9 | 0.3 | 11 | 3.57 |

 1 S111 = Site 111

²TOT = Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

³NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

⁴SR = Species Richness. The number of species identified on the site

 ${}^{5}WPI =$ Wetland Prevalence Index value. WPI ≤ 2.0 =wetland, 2.0 \leq 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 ≥ 4.0 = upland nm = this attribute was not monitored

Table 32. Vegetation monitoring results for Site 111 revegetation site in 2008-2012.



Figure 88. Aerial photograph of 2012 delineated Site 111 revegetation site.



Figure 89. A wide variety of plants are found at Site 111 in 2012.

3.15.1 Downstream Upper Diversion Emergent

Transplanted emergent vegetation, along with pole cuttings, were planted along the banks of the Eastern Bypass Channel downstream of the Upper Diversion Weir. T his site is called Downstream Upper Diversion Emergent (DUDE). DUDE has grown by more than 2.5 times in the four years it has been monitored (Table 32). This is a result of the fast growth of vegetation on the site encroaching on the center of the channel where no vegetation was actively planted (Figure 94).

The dominant species in all four monitoring years was southern cattail, which has made up nearly half of the total cover. This species was not planted, rather it passively established from a large source population upstream of the site. Southern cattail covered 33.8% in 2012. The site as a whole had a total cover of 75-100% in all four years of monitoring (Table 33). Second in all four years of monitoring was American bulrush, which was one of the species planted. In 2012, American bulrush covered 20.5% of the site.

Species richness increased since the first year of monitoring where it was 25. It decreased since the second monitoring year but remained high (Table 33). There have been three noxious weeds identified on the site; tall whitetop, johnsongrass, and salt cedar. Only johnsongrass and salt cedar were documented in 2012, with a combined cover of just 0.6%.



Figure 90. Average total cover across all Upper Diversion Weir revegetation sites from 2008 to 2012.



Figure 91. Average species richness across all Upper Diversion Weir revegetation sites from 2008 to 2012.



Figure 92. Average cover composition across all Upper Diversion Weir revegetation sites from 2008 to 2012.

| Site Code ¹ | 2012 Growing | | Wetland Status ² | | | | |
|---------------------------|-----------------|------|--------------------------------|-------|-------|-------|---------|
| | Season | 2008 | 2009 | 2010 | 2011 | 2012 | |
| DUDE | 4 | n/a | 1.18 | 2.44 | 2.64 | 3.50 | wet |
| DUDN | 4 | n/a | 10.32 | 10.35 | 10.43 | 10.57 | non-wet |
| DUDS | 4 | n/a | 0.96 | 1.07 | 1.14 | 1.26 | wet |
| UDI | 4 | n/a | 4.98 | 5.07 | 5.06 | 4.88 | non-wet |
| UDIE | 4 | n/a | 0.09 | 0.09 | 0.08 | 0.15 | wet |
| UUDE | 4 | n/a | 0.78 | 2.11 | 2.59 | 3.10 | wet |
| UUDS | 4 | n/a | n/a | n/a | 0.67 | 0.72 | non-wet |
| UDIS | 4 | n/a | n/a | n/a | 0.23 | 0.23 | non-wet |

¹DUDE = 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 = Upper Diversion Island South

²Wetland 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

³There are additional small portions of Site 108 as a whole that are not included in funding area acreage totals

Table 33. Physical characteristics of Upper Diversion Weir sites in 2008-2012.

3.15.2 Downstream Upper Diversion North

Downstream Upper Diversion North (DUDN) was one of the two revegetation sites planted as part of the fall 2008 Green-Up event. DUDN is located east of the Eastern Bypass Channel. The site is non-wetland and has remained at a similar size over the past four growing seasons (Table 32). It has been divided into three areas to allow for more accurate monitoring. A weighted average of results is used for the total DUDN monitoring result.

Eleven species were planted on DUDN as part of the Green-Up; three of these species were also hydroseeded on the site following construction of the weir about three months earlier. Only two additional species were recorded on the site in 2012; salt cedar and bush seepweed (*Suaeda nigra*). One of the planted species, cat-claw acacia, has not been found on the site in the past two monitoring years. There were 100 cat-claw acacias planted on the site. The dominant plant on the site was both planted and hydroseeded, fourwing saltbush, which makes up the vast majority of the plant cover on the site with 71.5%.

3.15.3 Downstream Upper Diversion Shelves

Along the Eastern Bypass Channel, there were six platforms or shelves that were installed to allow for additional riparian plantings. The combination of these six shelves makes up the Downstream Upper Diversion Shelves (DUDS) revegetation site. Each of these shelves is monitored individually and a weighted average of the results is used to compare the site as a whole. Typically, riparian and wetland sites are not hydroseeded as part of the weir construction process. However, due to the fact that these sites were constructed as part of the overall erosion control installation, they were hydroseeded along with the non-wetland areas.

Only two of the three hydroseeded species have been recorded on DUDS; four-wing saltbush and alkali sacaton. Desert saltbush has never been found and alkali sacaton was only found after the first growing season in 2009. In 2012, four-wing saltbush had a cover of 16.3%. This species has been regularly thinned to allow the establishment of riparian and wetland species. The dominant species on the site are more riparian. Seep willow (*Baccharis salicifolia*) and willow baccharis (*Baccharis salicina*) are the two dominant species on the site with cover values of 30.3% and 30.7% in 2012, respectively. Another dominant species on the site is sandbar willow, which was the dominant species in 2009 and 2010, and had 28.3% cover in 2012.

3.15.4 Upper Diversion Island

Upper Diversion Island (UDI) was the second site planted as part of the fall 2008 G reen-Up (Figure 95) and is located downstream of the Upper Diversion Weir and in between the Eastern Bypass Channel and the main Wash channel. It was also hydroseeded with the same species as DUDN and DUDS. Although it was planted at the same time as DUDN, only five species were planted. O nly two of these species were identified in 2012; willow baccharis and honey mesquite. None of the other three species (alkali sacaton, screwbean mesquite, and creosote bush) have been identified in the past two monitoring years.



Figure 93. Aerial photograph of 2012 delineated Upper Diversion Weir revegetation sites.

| Site Cadal | 1 2008 | | | | 2009 | | | | 2010 | | | | 2011 | | | | 2012 | | | |
|------------|------------------|------------------|--------|------------------|---------|------------------|--------|------------------|------------------|------------------|--------|------------------|------------------|------------------|--------|------------------|---------|------------------|--------|------------------|
| Site Code | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT ² | NOX ³ | SR^4 | WPI ⁵ | TOT^2 | NOX ³ | SR^4 | WPI ⁵ |
| DUDE | - | - | - | - | 75-100 | 0.8 | 25 | 1.34 | 75-100 | 0.3 | 36 | 1.32 | 75-100 | 0.6 | 30 | 1.60 | 75-100 | 0.6 | 27 | 1.56 |
| DUDN | - | - | - | - | 80.3 | 0.5 | 22 | 4.77 | 80.2 | 0.5 | 17 | 4.94 | 87.5 | 0.1 | 12 | 4.92 | 80.3 | 0.1 | 12 | 4.91 |
| DUDS | - | - | - | - | 85.4 | 1.9 | 29 | 4.31 | 87.5 | 0.1 | 18 | 3.58 | 79.3 | 2.6 | 20 | 2.64 | 87.5 | 2.3 | 13 | 2.67 |
| UDI | - | - | - | - | 75.8 | 0.3 | 14 | 4.20 | 87.5 | 0.3 | 14 | 3.68 | 70.8 | 0.2 | 14 | 4.29 | 79.2 | 1.8 | 13 | 3.56 |
| UDIE | - | - | - | - | 75-100 | 1.6 | 21 | 2.66 | 75-100 | 0.5 | 14 | 1.32 | 75-100 | 3.1 | 27 | 1.57 | 75-100 | 3.0 | 22 | 1.40 |
| UUDE | - | - | - | - | 75-100 | 1.5 | 29 | 1.22 | 75-100 | 0.1 | 30 | 1.21 | 75-100 | 1.0 | 22 | 1.28 | 75-100 | 5.0 | 19 | 1.47 |
| UUDS | - | - | - | - | - | - | - | - | - | - | - | - | 75-100 | 2.5 | 5 | 1.79 | 75-100 | 0.1 | 5 | 2.59 |
| UDIS | - | - | - | - | - | - | - | - | - | - | - | - | 75-100 | 0.0 | 3 | 4.61 | 75-100 | 0.0 | 2 | 4.25 |

¹DUDE = 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 South, UDIS = Upper Diversion Island South

 $^{2}TOT =$ Total percentage of vegetative cover. Cover class range or weighted average of the midpoint of cover classes if site has multiple monitoring areas

 3 NOX = Noxious weed percentage cover. Sum of cover class midpoint for all noxious weeds identified.

 ${}^{4}SR = Species$ Richness. The number of species identified on the site

 5 WPI = Wetland Prevalence Index value. WPI \leq 2.0 = wetland, 2.0 < WPI \leq 2.5 = likely wetland, 2.5 \leq WPI \leq 3.5 = may be wetland, 3.5 \leq WPI \leq 4.0 = not likely a wetland, and WPI \geq 4.0 = upland

nm = this attribute was not monitored

Table 34. Vegetation monitoring results for Upper Diversion Weir sites in 2008-2012.



Figure 94. Wetland vegetation has passively established along the Downstream Upper Diversion Emergent revegetation site.

The dominant species on UDI in the past four years has alternated between fourwing saltbush and quailbush. Fourwing saltbush was hydroseeded on the site, while quailbush was neither planted nor hydroseeded. In 2012, these two species made up the vast majority of the total site's plant cover with a combined 76.7% of the total 79.2%. Of the remaining 11 species identified in 2012, only salt cedar had more than 1% cover (1.7%). The other two noxious weeds documented in 2012, silver-leaf nightshade and tall whitetop, had cover values of 0.03%.

3.15.5 Upper Diversion Island Emergent

Two small areas along the main Wash channel downstream of the Upper Diversion Weir make up the Upper Diversion Island Emergent (UDIE) revegetation site. There was some planting done on the site of wetland species like American bulrush, but the majority of the site was established passively. Despite the site's relatively small acreage (Table 32), it has had high species richness since the first monitoring year in 2009. The dominant species in the past two



Figure 95. Honey mesquite with an understory of quailbush at the Upper Diversion Island revegetation site in 2012.

growing seasons has been American bulrush, with a cover of 25-50%. In 2012, southern cattails were a codominant species, also at 25-50%. There have been three noxious weeds identified on the site; tall whitetop, johnsongrass, and salt cedar. However, only two (salt cedar and tall whitetop) were found in 2012 with a total cover of 3.0%. In addition. bind weed (Convolvulus arvensis) has been found on the site, a noxious weed in many surrounding states such as California and Arizona.

3.15.6 Upstream Upper Diversion Emergent

The only wetland revegetation site upstream of the Upper Diversion Weir is the backwater created by the weir, which has been named Upstream Upper Diversion Emergent (UUDE). This site was passively established by southern cattails almost immediately after the weir was completed. By the 2009 monitoring, southern cattails covered 75-100% of the site and it has stayed at that level in

every monitoring event since. Some pole plantings were done along the eastern banks of the site with Goodding's willow and Fremont's cottonwood. These species had cover values of 5-25% and 1-5% in 2012, respectively. Of the three noxious weeds found on the site (tall whitetop, johnsongrass, and salt cedar) only tall whitetop and salt cedar were found in 2012. Noxious weed cover in 2012 was the highest ever (Table 34). Although just 5% (which is not currently at a level of concern), it will be watched closely to ensure no negative impact occurs.

3.15.7 Upstream Upper Diversion South

Upstream Upper Diversion South (UUDS) and Upper Diversion Island South (UDIS) are the only two revegetation sites on the south side of the Upper Diversion Weir (geographically west of the weir). These two sites were hydroseeded with the same seed mixture as DUDN, UDI, and DUDS. However, no additional plantings took place at either site. Minimal plant establishment and growth took place in the first two growing seasons, leading to 2011 being the first monitored year. UUDS has five species in both 2011 and 2012. Fourwing saltbush was the only

hydroseeded species found. Quailbush was the dominant species with 50-75% cover on the site. Salt cedar was the only noxious weed found on the site in both years with just 0.1% cover in the most recent monitoring year.

3.15.8 Upper Diversion Island South

UDIS had three species identified in its first monitoring year in 2011 and just two in 2012. Bassia was the third species that was not detected in 2012. Fourwing saltbush and quailbush were the two species found in both years. Fourwing saltbush had a cover of 50-75% in both years, making it the dominant species that had 75-100% total cover. Quailbush had 5-25% cover in 2011 which increased to 25-50% in 2012.

4.0 RECOMMENDATIONS

It is believed that current monitoring techniques and protocols provide an accurate representation of the current status of revegetation sites along the Wash. Providing annual reports on current data and five year comprehensive reports on trends in vegetative characteristics has proved to be a successful model for reporting on the Wash's revegetation program. In addition, the use of ArcGIS has proved invaluable to the success of the vegetation monitoring program. As the number of revegetation sites and monitoring areas increases annually, ArcGIS allows staff to still collect and report on every site while decreasing the intensity of effort on sites in which no major changes are expected.

Many of the recommendations laid out in the 2003-2007 Las Vegas Wash Vegetation Monitoring Report (Eckberg and Shanahan, 2008) have either been implemented or reevaluated:

- (1) WPI methods have been regularly implemented at all revegetation sites and have proved useful in complying with regulations that use similar methods.
- (2) Species richness has been used as an indicator of which species are occupying a site rather than the site's overall success.
- (3) Survivorship is not measured on wetland sites.
- (4) Height measurements were collected in 2010. T his additional component to the monitoring protocol added substantial amounts of time needed to accurately record data on given sites. In addition, the data did not prove to add any significant understanding of the site's success or status. It is not recommended that height measurements be included in the vegetation monitoring protocol for the Wash.
- (5) The schedule of when monitoring currently takes place appears to accurately portray the revegetation site's current status while minimizing unnecessary field monitoring. This includes a minimum of three growing seasons after a site is established. Then ArcGIS is used in alternating years with field measurements once cover has remained consistent for three consecutive growing seasons.

- (6) Advances have come in the control of common reed on many revegetation sites. These include management actions as well as proper use of selective herbicides. These methods have been most effective on newer revegetation sites.
- (7) Despite multiple methods for determining individual revegetation site cover, consistent reporting of results is maintained in order to evaluate methods as well as compare site conditions from year to year.
- (8) ArcGIS measurement of cover on selected sites, as well as annual delineation of all revegetation sites, provides less time-intensive surveying for the Wash Team while simultaneously providing very accurate data.
- (9) All non-wetland revegetation sites associated with weirs are hydroseeded at the completion of construction. These areas are then irrigated along with container plantings. The combination of the two methods has proven to be very successful in terms of site establishment, weed abatement, financial impact, and meeting regulatory obligations.
- (10) In consultation with the Corps., the survivorship criteria for non-wetland areas has been reduced to 75%.
- (11) Management decisions have been adapted to meet specific conditions of revegetation sites and the surrounding terrain. Species chosen for revegetation are chosen on their potential success of establishing the site. This includes using plants found naturally in surrounding areas, taking soil salinity and depth to water measurements on sites to ensure plant requirements and site conditions are compatible, and providing plants the proper irrigation needed to establish and be self-sustaining in the shortest period of time possible.

5.0 LITERATURE CITED

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. 2010. Las Vegas Wash Vegetation Monitoring Report, 2009. Southern Nevada Water Authority. Las Vegas, NV. 48p.

Eckberg, J.R. 2011. Las Vegas Wash Vegetation Monitoring Report, 2010. Southern Nevada Water Authority, Las Vegas, NV. 55p.

Eckberg, J.R. 2012. Las Vegas Wash Vegetation Monitoring Report, 2012. Southern Nevada Water Authority, Las Vegas, NV. 42p.

Lichvar, R. 2012. The National Wetland Plant List. U.S. Army Corps of Engineers, Engineer Research and Development Center ERDC/CRREL TR-12-11.

LVWCC (Las Vegas Wash Coordination Committee). 2000. Las Vegas Wash Comprehensive Adaptive Man agement Plan. Las Vegas Wash Project Coordination Team, Southern Nevada Water Authority, Las Vegas, Nevada.

SNWA (Southern Nevada Water Authority). 2005. Las Vegas Wash vegetation monitoring report, 2002-2003. Southern Nevada Water Authority, Las Vegas, NV. 23p.