



Vanasse Hangen Brustlin, Inc.

Hillsborough County, FL

Fourth Annual Archie Creek Relocation Mitigation Monitoring Report



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PREPARED FOR
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Introduction

In accordance with the Environmental Protection Commission of Hillsborough County Executive Director's Authorization for Wetland Impacts, October 2000; Florida Department of Environmental Protection Environmental Resource Permit No. 29-01583313-001 and U. S. Army Corps of Engineers Permit No. 199902004 IP-JB, the Archie Creek Relocation and Mitigation was authorized to offset wetland impacts associated with Mosaic Fertilizer, LLC's Riverview Plant Phosphogypsum Stack Expansion.

The construction of the relocated Archie Creek system resulted in the creation of 20.9 acres of mixed wetland hardwoods, 2.0 acres of freshwater marsh, and 26.6 acres of creek/flow-way, for a total of 49.5 acres of created wetland habitat. Mitigation construction was completed in September 2006.

All areas were planted in accordance with applicable permit conditions, with Archie Creek plantings completed in June 2006. Both North and South mitigation areas were planted throughout July and August and into early September. All herbaceous species were two-inch pot or bare root material on three foot centers, with a few areas of higher planting densities. Shrub species were one-gallon pot material installed on five-foot centers, with occasional variations in spatial distribution to conform to localized field conditions. Tree species were planted as three-gallon pot material or equivalent root-ball averaging ten-foot centers. A planting completion report was submitted to all Restoration Reviewing Agency (RRA) members during the RRA meeting on October 12, 2006.

In general, the restored Archie Creek and adjacent mitigation areas will be considered successful when the following criteria are met:

- Areas are dominated by 85% cover of native, desirable species.
- An ecologically significant utilization by wildlife is reflected through scheduled monitoring and other recorded observations.

- Exotic or nuisance species are present at a sufficiently low level to not inhibit the growth and propagation of native species, typically less than 10% cover.
- Piezometer or shallow groundwater well data indicate the presence of sufficient hydrology; the presence of water within 12 inches of the ground surface for a minimum of 30 consecutive days within the growing season.
- Density of trees in forested wetland creation areas is equivalent to that of similar natural systems approximately 400 trees per acre and an indication of active growth of planted trees is present.
- Wetland areas have been inspected by a member of the Department's Environmental Resource Management staff and have been determined to be within the landward extent of the waters of the State pursuant to 62-301 F.A.C.

Required monitoring for mitigation success began with a time-zero report in September 2006, followed by quarterly qualitative monitoring each quarter thereafter, annual quantitative monitoring, and comprehensive annual reporting. This document is the Fourth Annual Mitigation Monitoring Report.

Site & Methods

The Archie Creek Relocation and Mitigation site is located just upstream of tidally influenced Archie Creek adjacent to Mosaic's phosphogypsum stack buffer parcels in Riverview, Hillsborough County, Florida. The site illustrated in **Figure 1** includes a portion of Archie Creek between U.S. Route 41 and Old U.S. Route 41 extending upstream to the original Archie Creek channel. Two created wetland areas adjacent to the relocated channel designated North and South Mitigation Areas, are separated from the channel at low flows but are connected at higher flows through control structures.

Qualitative monitoring consists of quarterly visual inspection of all mitigation areas for installed and naturally recruited plant health, survival, approximate cover, and degree of exotic/nuisance invasion. Annual quantitative monitoring is a more comprehensive assessment as described below for each of the mitigation areas.

North Mitigation Area

The North Mitigation Area, (formerly referred to as *Mitigation Area 2* in permit documents), is a 5.5 acre mixed wetland hardwood creation area (**Figure 2**). Monitoring in this area occurs at a fixed photostation (Photostation 1) and along a permanent transect (Transect A). Herbaceous monitoring includes assessment of species cover by percent aerial contribution in one-square-meter quadrats along this fixed transect. Tree survival and growth is monitored within a tagged subsample along the same transect as a 50-foot wide belt. Trees heights are measured with a stadia rod or folding ruler. Canopy spread and DBH measurements are made on appropriate-sized trees which have recovered from transplant shock and acclimated to on-site hydrology. Water levels are recorded at two-hour intervals within the site by a piezometer-datalogger unit located in the deepest zone of the wetland.

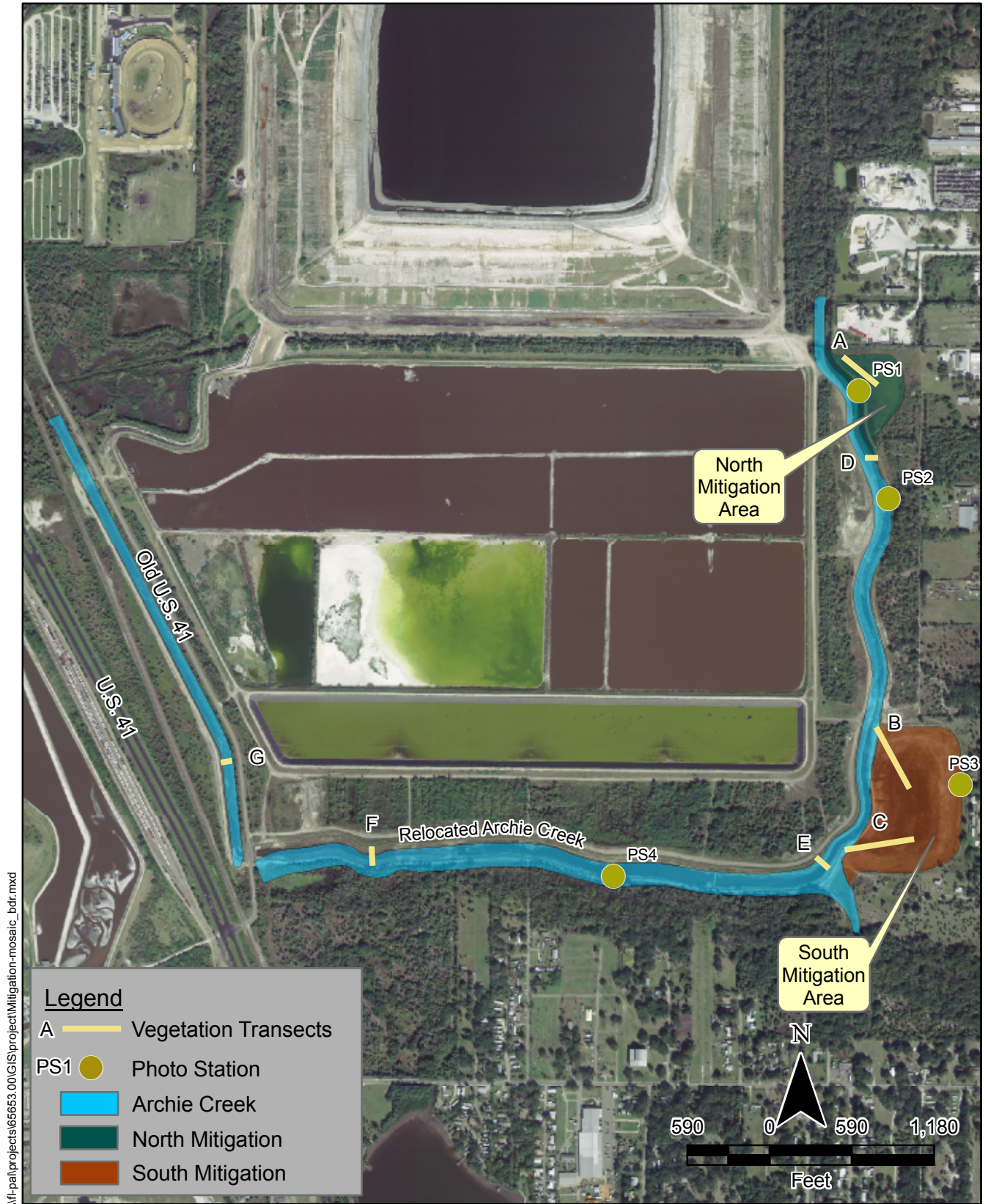


Figure 1
Archie Creek Mitigation Overview

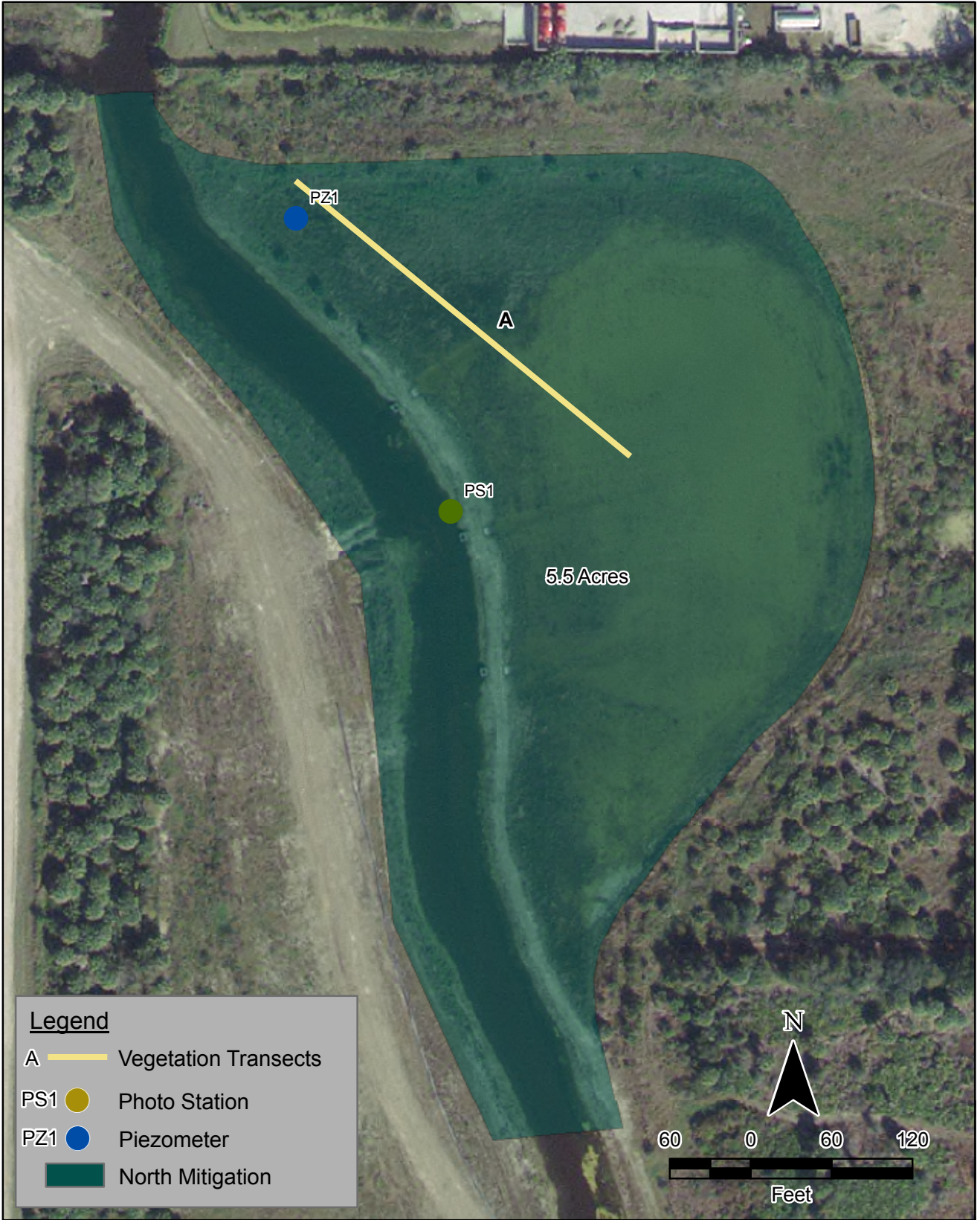


Figure 2
North Mitigation Area

South Mitigation Area

The South Mitigation Area (formerly referred to as *Mitigation Area 5* in permit documents) includes 15.5 acres of created forested swamp as well as a 2.0 acre freshwater marsh area designed for perennial flooding (**Figure 3**). Monitoring for this site employs the same methods described for the North Mitigation Area along two transects (Transects B and C) and a single photostation (Photostation 3). Water levels are recorded at 2-hour intervals within the site by a piezometer-datalogger unit located in the deepest zone of the wetland.

Relocated Archie Creek

The relocated Archie Creek includes 26.6 acres of constructed flow-way maintained as stepped pools by a series of low weirs and a broad-bottomed box culvert under Old U.S. 41, creating three distinct pools. Herbaceous species are monitored within permanent transects for each pool (Transects D, F, and G) consisting of one quadrat near toe-of-slope on each bank. In areas where vegetation is contiguous across the channel a third quadrat is placed approximately mid-stream. These transects are accompanied by photostations (Photostations 2, 4, and 5). Water levels are recorded at 2-hour intervals within the creek channel at the downstream end of the upper pool by a piezometer-datalogger unit located in the channel bottom. Archie Creek monitoring locations are shown in **Figure 1**.

Methods

Herbaceous cover is assessed as multiple layers of herbs allowing for quadrat totals to exceed 100%; values were subsequently converted to relative cover expressed as percent of total aerial contribution to layered cover. Herbaceous quad data are analyzed for dominant species and wetland community composition based on relative contribution to total cover. Relative contribution by species classified by the National Wetlands Inventory (NWI) indicator status list as facultative-wet (FACW) through obligate (OBL) is also calculated for each quadrat, and averaged for transects. Dominant species are determined visually within apparent zones.

Wildlife observations are made during quarterly monitoring events, with observers noting wildlife species and activity.



Figure 3
South Mitigation Area

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Results

The results of all monitoring events are presented herein, including quantitative data from September 2009 through September 2010 as well as relevant observations made during qualitative monitoring events in December 2009, March 2010, and June 2010. Photography from fixed photostations is provided in **Appendix A**.

Hydrology

Surficial aquifer hydrology was recorded on-site by three dataloggers as previously described. **Figure 4** summarizes the water levels relative to ground at piezometer location in inches for the period September 1, 2009 through September 1, 2010. Surface water level trends were similar throughout the mitigation areas with comparable drawdown and rain-event responses. Water levels throughout the site remained elevated above ground level for the entire year at all three piezometer locations, especially at the North Mitigation site.

Calculated hydroperiods as percent of time inundated for the three sites based on 2-hour intervals from September 2009 to September 2010 are as follows: North Mitigation - 100%, South Mitigation - 100%, Archie Creek - 100%. These hydroperiods fall within the range of hydroperiods for a variety of natural wetland systems within Hillsborough County. All three sites exhibited standing water for greater than 30 days during the growing season.

These results indicate the Archie Creek Relocation and Mitigation functions hydrologically as a wetland. The higher water levels recorded for the North Mitigation Area were suspected of causing mortality in the planted tree vegetation and alternative mitigation plans are being explored.

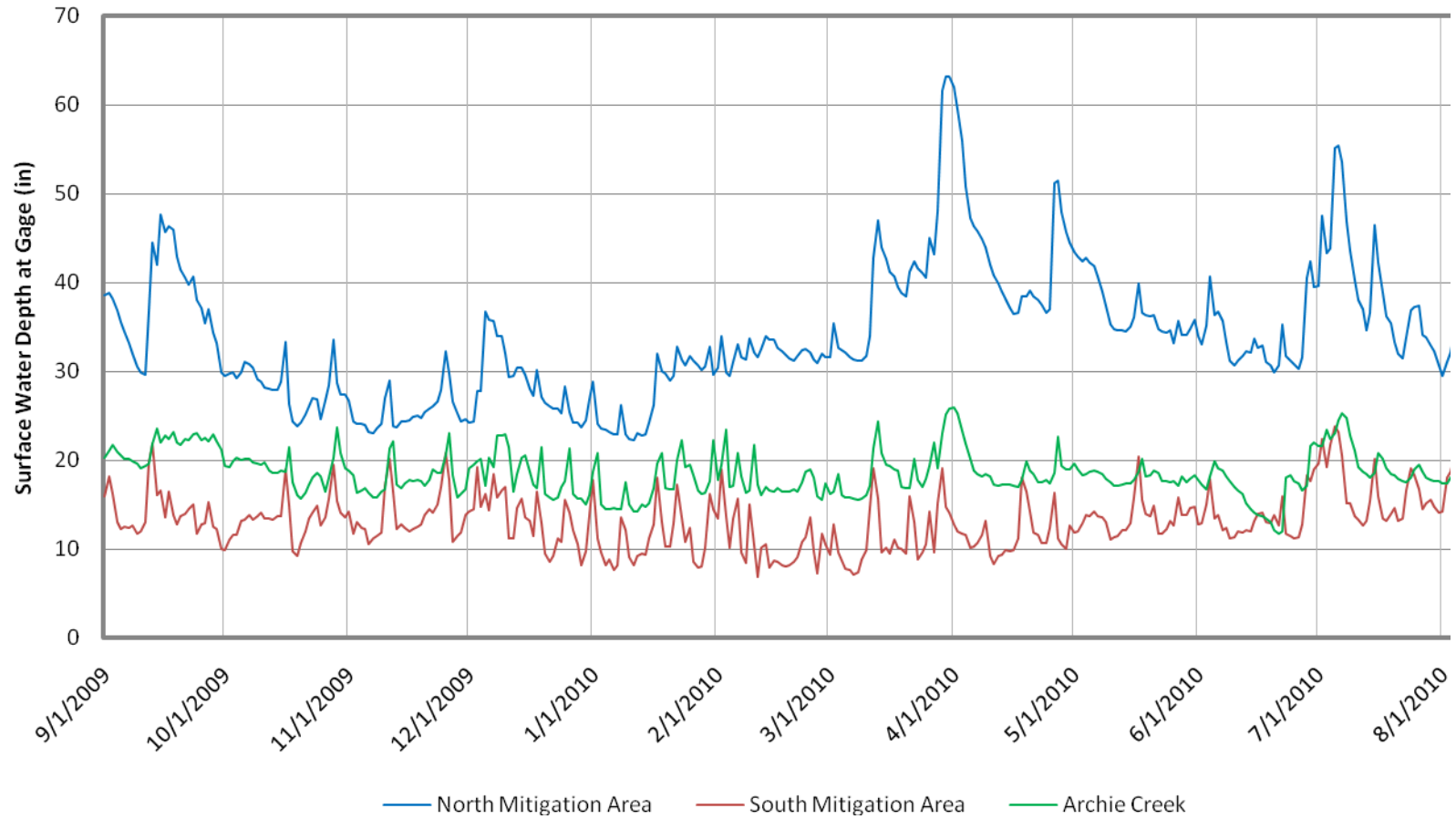


Figure 4
Surface Water Depth in Inches, Relative to Ground Level at Piezometers in Relocated Archie Creek and Adjacent Mitigation Areas, from September 1, 2009 through September 1, 2010

North Mitigation Vegetation

Herbaceous

The herbaceous plant community within the North Mitigation Area may be described as typical marsh vegetation with transitional zones dominated by Carolina willow (*Salix caroliniana*) grading into smartweeds (*Polygonum* spp.) and farther into deep zones dominated by arrowhead (*Sagittaria lancifolia*). Visual estimates of herbaceous cover for the entire wetland have increased from approximately 70% following planting, to about 80% during September 2010.

Quantitative monitoring along Transect A is summarized in **Tables 1 and 2** for 2009 and 2010, respectively. During this period total cover within quadrats decreased from 81.38% to 40.75%, but relative contribution by wetland species National Wetland Inventory rankings FACW through OBL was relatively stable at 97.50%. Species richness within this transect increase from 8 species in 2009 to 9 species in 2010 and is characteristic of early succession stages in created wetlands. Reduced coverage of vegetation along the transect is likely the result of sustained elevated water levels throughout the past years, which caused mortality within the transitional zone. However, adequate cover of herbaceous species throughout the wetland was observed visually.

This monitoring event revealed significant contributions to cover from naturally recruited species with important contributors such as dotted smartweed (*Polygonum punctatum*).

Exotic species present on-site and scheduled for targeted herbicide removal include bermudagrass (*Cynodon dactylon*). Potential nuisance species present but not currently targeted for removal include Carolina willow. This species currently provides important structure and organic formation functions within the mitigation area and will be targeted only if growth and aerial cover inhibit growth and spread of other desirable species.

Trees

Tree survival within the North Mitigation Area was visually estimated at approximately 40%; quantitative subsample counts within Transect A indicated 52% survival. Survival for all planted species decreased from 2009 to 2010 and experienced negative growth both in average height (-1.81%) and average cover (-11.71%) over the last year as shown in **Table 3**. Mortality was particularly observed in red maple (*Acer rubrum*) and many of the surviving trees showed signs of stress in the form of leaf wilt. The primary cause of this mortality is

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Table 1
Summary of Herbaceous Data for North Mitigation Area,
Transect A, in 2009

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
AQ1	128	100	Redtop panicgrass	<i>Panicum rigidulum</i>	FACW	3	2.3
			Carolina willow	<i>Salix caroliniana</i>	OBL	70	54.7
			California bulrush	<i>Schoenoplectus californicus</i>	OBL	2	1.6
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	3	2.3
			Water hyssop	<i>Bacopa monnieri</i>	OBL	50	39.1
AQ2	70	100	Redtop panicgrass	<i>Panicum rigidulum</i>	FACW	25	35.7
			Carolina willow	<i>Salix caroliniana</i>	OBL	30	42.9
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	10	14.3
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	5	7.1
AQ3	63	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	3	4.8
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	60	95.2
AQ4	105	100.0	Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	30	28.6
			Carolina willow	<i>Salix caroliniana</i>	OBL	75	71.4
AQ5	53	100.0	Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	3	5.7
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	50	94.3
AQ6	70	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	70	100.0
AQ7	80	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	80	100.0
AQ8	82	100.0	Swamp sawgrass	<i>Cladium jamaicense</i>	OBL	2	2.4
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	80	97.6
Transect Averages	81.38	100.00					

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Table 2
Summary of Herbaceous Data for North Mitigation Area,
Transect A, in 2010

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
AQ1	10	90.0	Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	20.0
			Swamp sawgrass	<i>Cladium jamaicense</i>	OBL	1	10.0
			Soft rush	<i>Juncus effusus</i>	FACW	1	10.0
			Water hyssop	<i>Bacopa monnieri</i>	OBL	2	20.0
			Carolina willow	<i>Salix caroliniana</i>	OBL	2	20.0
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	1	10.0
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	1	10.0
AQ2	10	90.0	Redtop panicgrass	<i>Panicum rigidulum</i>	FACW	3	30.0
			Carolina willow	<i>Salix caroliniana</i>	OBL	2	20.0
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	2	20.0
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	20.0
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	1	10.0
AQ3	40	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	30	75.0
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	10	25.0
AQ4	14	100.0	Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	3	21.4
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	1	7.1
			Carolina willow	<i>Salix caroliniana</i>	OBL	10	71.4
AQ5	42	100.0	Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	4.8
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	40	95.2
AQ6	60	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	60	100.0
AQ7	60	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	60	100.0
AQ8	90	100.0	Swamp sawgrass	<i>Cladium jamaicense</i>	OBL	10	11.1
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	80	88.9
Transect Averages	40.75	97.50					

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Table 3
Summary of Tree Data for North and South Mitigation Areas

<i>North Mitigation Area</i>		<i>Height</i> 2009 (in)	<i>Height</i> 2010 (in)	<i>Growth</i> (Height)	<i>Cover</i> 2009 (in ²)	<i>Cover</i> 2010 (in ²)	<i>Growth</i> (Cover)
Species							
Red maple	<i>Acer rubrum</i>	63.69	63.45	-0.37%	348.36	305.02	-12.44%
Pop ash	<i>Fraxinus caroliniana</i>	56.90	55.05	-3.25%	247.29	220.16	-10.97%
American elm	<i>Ulmus americanum</i>	*	*	*	*	*	*
AVERAGE FOR NORTH MITIGATION AREA:		60.29	59.25	-1.81%	297.82	262.59	-11.71%
<i>South Mitigation Area</i>							
Species							
Red maple	<i>Acer rubrum</i>	56.05	65.41	16.71%	532.70	685.80	28.74%
Buttonbush	<i>Cephalanthus occidentalis</i>	48.18	48.33	0.30%	984.60	815.65	-17.16%
Pop ash	<i>Fraxinus caroliniana</i>	103.13	101.00	-2.06%	1121.66	2169.27	93.40%
Bald cypress	<i>Taxodium distichum</i>	65.69	84.52	28.65%	513.68	571.57	11.27%
American elm	<i>Ulmus americanum</i>	76.16	73.42	-3.60%	883.92	628.72	-28.87%
AVERAGE FOR SOUTH MITIGATION AREA:		69.84	74.53	8.00%	807.31	974.20	17.48%

* No individuals of this species were observed in the transect during this monitoring event.

believed to be the continuously elevated water levels within the site. American elm (*Ulmus americana*) was not observed within the transect as it was in previous years, presumably due to mortality. Carolina willow recruited into the northern and eastern portions of the site and will contribute significantly to interim canopy cover as the forested component of this mitigation area develops.

South Mitigation Vegetation

Herbaceous

The herbaceous plant community within the South Mitigation Area may be described as typical shallow marsh vegetation, with transitional zones dominated by cordgrasses (*Spartina* spp.), transitional wetland herbs, and inundation-tolerant, non-native grasses. Deeper zones grade into a well-developed interior dominated by arrowhead and spikerushes (*Eleocharis* spp.). Visual estimates of herbaceous cover for the entire wetland were approximately 70% during 2010.

Quantitative monitoring along Transect B is summarized in **Tables 4** and **5** for 2009 and 2010, respectively. During this period total cover within the quadrats decreased from 72.33% to 58.00%, while relative contribution by wetland species decreased from 40.56% to 34.30%. Species richness decreased from 14 species in 2009 to 10 species during the 2010 quantitative monitoring event.

Quantitative monitoring along Transect C is summarized in **Tables 6** and **7** for 2009 and 2010, respectively. During this period total cover within quadrats decreased from 66.75% to 40.75%, but relative contribution by wetland species increased with 65.27% of the quadrat area covered by a plant community composed of primarily of wetland species. This corresponds with an increase in species richness from 8 to 9 species.

Most of the desirable coverage in the South Mitigation Area was contributed by planted species but a contribution of cover from naturally recruited species was also noted, including winged lythrum (*Lythrum alatum*) and duckweed (*Lemna minor*).

Exotic species present on-site and scheduled for targeted herbicide removal include torpedograss (*Panicum repens*), rattlebox (*Sesbania punicea*), bermudagrass, and alligatorweed (*Alternanthera philoxeroides*). Potential nuisance species present but not currently targeted for removal include Carolina willow and barnyardgrass (*Echinochloa crusgalli*). These species currently provide important structure and organic formation functions within the mitigation area and will be targeted only if growth and aerial cover inhibit growth and spread of other desirable species.

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Table 4
Summary of Herbaceous Data for South Mitigation
Area, Transect B, in 2009

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
BQ1	122	24.6	Sand cordgrass	<i>Spartina bakeri</i>	FACW+	30	24.6
			Wax myrtle	<i>Myrica cerifera</i>	FAC+	90	73.8
			Red maple	<i>Acer rubrum</i>	FAC	2	1.6
BQ2	85	64.7	Sand cordgrass	<i>Spartina bakeri</i>	FACW+	50	58.8
			Meadowbeauty	<i>Rhexia</i> sp.	FACW	5	5.9
			Goldenrod	<i>Solidago fistulosa</i>	FAC+	3	3.5
			Flatsedge	<i>Cyperus</i> sp.	NI	2	2.4
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	25	29.4
BQ3	76	72.4	Mexican primrose-willow	<i>Ludwigia octovalvis</i>	OBL	10	13.2
			Sand cordgrass	<i>Spartina bakeri</i>	FACW+	30	39.5
			Frogfruit	<i>Phyla nodiflora</i>	FACW	10	13.2
			Meadowbeauty	<i>Rhexia</i> sp.	FACW	5	6.6
			Flatsedge	<i>Cyperus</i> sp.	NI	1	1.3
BQ4	95	0	Bermudagrass	<i>Cynodon dactylon</i>	FACU	20	26.3
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	95	100.0
BQ5	88	3.4	Bermudagrass	<i>Cynodon dactylon</i>	FACU	85	96.6
			Mexican primrose-willow	<i>Ludwigia octovalvis</i>	OBL	1	1.1
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	2.3
BQ6	85	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	60	70.6
			Torpedograss	<i>Panicum repens</i>	FACW-	25	29.4
BQ7	100	100.0	Pickerelweed	<i>Pontedaria cordata</i>	OBL	10	10.0
			Knotted spikerush	<i>Eleocharis interstincta</i>	OBL	30	30.0
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	60	60.0
BQ8	0	0					
BQ9	0	0					
Transect Averages	72.33	40.56					

NI Insufficient information is available to determine an indicator status. NWI National Wetlands Inventory

Mosaic Archie Creek Restoration Site

Table 5
Summary of Herbaceous Data for South Mitigation
Area, Transect B, in 2010

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
BQ1	120	16.7	Sand cordgrass	<i>Spartina bakeri</i>	FACW+	20	16.7
			Wax myrtle	<i>Myrica cerifera</i>	FAC+	98	81.7
			Red maple	<i>Acer rubrum</i>	FAC	2	1.7
BQ2	68	45.6	Sand cordgrass	<i>Spartina bakeri</i>	FACW+	25	36.8
			Saltmarsh aster	<i>Symphotrichum subulatum</i>	OBL	1	1.5
			Winged lythrum	<i>Lythrum alatum</i>	FACW+	5	7.4
			Red maple	<i>Acer rubrum</i>	FAC	2	2.9
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	35	51.5
BQ3	68	26.5	Winged lythrum	<i>Lythrum alatum</i>	FACW+	5	7.4
			Saltmarsh aster	<i>Symphotrichum subulatum</i>	OBL	1	1.5
			Sand cordgrass	<i>Spartina bakeri</i>	FACW+	10	14.7
			Frogfruit	<i>Phyla nodiflora</i>	FACW	2	2.9
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	50	73.5
BQ4	25	20.0	Torpedograss	<i>Panicum repens</i>	FACW	5	20.0
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	20	80.0
BQ5	30	0.0	Bermudagrass	<i>Cynodon dactylon</i>	FACU	30	100.0
BQ6	103	100.0	Winged lythrum	<i>Lythrum alatum</i>	FACW+	8	7.8
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	90	87.4
			Torpedograss	<i>Panicum repens</i>	FACW-	5	4.9
BQ7	108	100.0	Duckweed	<i>Lemna minor</i>	OBL	8	7.4
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	100	92.6
BQ8	0	0					
BQ9	0	0					
Transect Averages	58.00	34.30					

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Table 6
Summary of Herbaceous Data for South Mitigation
Area, Transect C, in 2009

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
CQ1	65.0	100	Fall panicgrass	<i>Panicum dichotomiflorum</i>	FACW	2	3.1
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	2	3.1
			Knotgrass	<i>Paspalum distichum</i>	OBL	1	1.5
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	60	92.3
CQ2	97.0	2.1	Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	2.1
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	95	97.9
CQ3	100.0	5.0	Bermudagrass	<i>Cynodon dactylon</i>	FACU	95	95.0
			Knotgrass	<i>Paspalum distichum</i>	OBL	3	3.0
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	2.0
CQ4	100.0	0.0	Bermudagrass	<i>Cynodon dactylon</i>	FACU	100	100.0
CQ5	55.0	45.5	Bermudagrass	<i>Cynodon dactylon</i>	FACU	30	54.5
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	25	45.5
CQ6	41.0	87.8	Bermudagrass	<i>Cynodon dactylon</i>	FACU	5	12.2
			Torpedograss	<i>Panicum repens</i>	FACW-	1	2.4
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	35	85.4
CQ7	45.0	100.0	Torpedograss	<i>Panicum repens</i>	FACW-	15	33.3
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	30	66.7
CQ8	31.0	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	10	32.3
			Maidencane	<i>Panicum hemitomon</i>	OBL	2	6.5
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	15	48.4
			Torpedograss	<i>Panicum repens</i>	FACW-	3	9.7
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	1	3.2
Transect Averages	66.75	55.04					

Mosaic Archie Creek Restoration Site

Table 7
Summary of Herbaceous Data for South Mitigation
Area, Transect C, in 2010

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
CQ1	29.0	100.0	Wax myrtle	<i>Myrica cerifera</i>	FAC	10	34.5
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	3	10.3
			Torpedograss	<i>Panicum repens</i>	FACW-	1	3.4
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	15	51.7
CQ2	17.0	41.2	Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	7	41.2
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	10	58.8
CQ3	6.0	16.7	Bermudagrass	<i>Cynodon dactylon</i>	FACU	5	83.3
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	1	16.7
CQ4	4.0	50.0	Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	50.0
			Bermudagrass	<i>Cynodon dactylon</i>	FACU	2	50.0
CQ5	35.0	14.3	Bermudagrass	<i>Cynodon dactylon</i>	FACU	30	85.7
			Duckweed	<i>Lemna minor</i>	OBL	5	14.3
CQ6	90.0	100.0	Arrowhead	<i>Sagittaria lancifolia</i>	OBL	90	100.0
CQ7	70.0	100.0	Water lettuce	<i>Pistia stratiotes</i>	OBL	2	2.9
			Duckweed	<i>Lemna minor</i>	OBL	25	35.7
			Torpedograss	<i>Panicum repens</i>	FACW-	3	4.3
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	40	57.1
CQ8	75.0	100.0	Water lettuce	<i>Pistia stratiotes</i>	OBL	3	4.0
			Duckweed	<i>Lemna minor</i>	OBL	30	40.0
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	30	40.0
			American cupscale	<i>Sacciolepis striata</i>	OBL	5	6.7
			Buttonbush	<i>Cephalanthus occidentalis</i>	OBL	2	2.7
			Torpedograss	<i>Panicum repens</i>	FACW-	3	4.0
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	2	2.7
Transect Averages	40.75	65.27					

Trees

Tree survival within the South Mitigation area was visually estimated at approximately 80%. Three of the five planted tree species exhibited positive growth between September 2009 and September 2010, as summarized in Table 3. The greatest growth was experienced by bald cypress (*Taxodium distichum*) with an average of 28.65% increase in height and an average 11.27% increase in crown cover. Two species, pop ash (*Fraxinus caroliniana*) and American elm (*Ulmus americanum*), experienced a decrease in growth from 2008 to 2009, but still provide adequate coverage to the mitigation area with average covers of 815.65 in² for pop ash and 628.72 in² for elm. Buttonbush (*Cephalanthus occidentalis*) experienced a decrease in average canopy cover, but this trend is likely the result of natural recruitment as many newer recruits were observed and recorded during September 2010. The average growth rate for all tree species in the South Mitigation area for the fourth year of growth is 8.00% in height and 17.48% in crown cover.

Archie Creek Vegetation

The plant community within the relocated Archie Creek varies by species observed from pool to pool, but all pools indicate that the dominant desirable species were those characteristic of developed interior wetland zones, although dense growths of exotic species were observed in some areas. **Tables 8 and 9** summarize species present within Archie Creek quadrats for Transects D, F, and G for 2009 and 2010, respectively. Average cover within the quadrats decreased from 2009 (57.00%) to 2010 (50.38%), but relative cover derived from species classified as FACW through OBL was relatively stable at 97.31% in 2010. Transect D was entirely open water with no vegetation observed within the transect due to elevated water levels in this portion of the creek. Species richness within quadrats decreased from 20 species to 17 species.

Significant colonization by naturally recruited duckweed and denseflower knotweed (*Polygonum densiflorum*) was observed throughout the fourth year of growth.

Exotic species present on-site and scheduled for targeted herbicide control include torpedograss, alligatorweed, and waterhyme (*Hydrilla verticillata*). Potential nuisance species present but not currently targeted for removal include Carolina willow and barnyardgrass. These species currently provide important structure and organic formation functions within the mitigation area, and will be targeted only if growth and aerial cover inhibit growth and spread of other desirable species.

Mosaic Archie Creek Restoration Site

Table 8
Summary of Herbaceous Data for Archie Creek in 2009

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
DQ1	66.0	100.0	Pickerelweed	<i>Pontederia cordata</i>	OBL	60	90.9
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	3	4.5
			Waterhyme	<i>Hydrilla verticillata</i>	OBL	1	1.5
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	1	1.5
			Parrot feather	<i>Myriophyllum aquaticum</i>	OBL	1	1.5
DQ2	41.0	100.0	Duckweed	<i>Lemna minor</i>	OBL	1	2.4
			Pickerelweed	<i>Pontederia cordata</i>	OBL	40	97.6
EQ1	37.0	100.0	Knotted spikerush	<i>Eleocharis interstincta</i>	OBL	7	18.9
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	15	40.5
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	10	27.0
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	5	13.5
EQ2	68.0	100.0	Knotted spikerush	<i>Eleocharis interstincta</i>	OBL	35	51.5
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	2	2.9
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	10	14.7
			Duckweed	<i>Lemna minor</i>	OBL	1	1.5
			Pickerelweed	<i>Pontederia cordata</i>	OBL	20	29.4
FQ1	50.0	98.0	Flatsedge	<i>Cyperus</i> sp.	NI	1	2.0
			Carolina mosquitofern	<i>Azolla caroliniana</i>	OBL	1	2.0
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	15	30.0
			Mexican primrose-willow	<i>Ludwigia octovalvis</i>	OBL	3	6.0
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	5	10.0
			Rattlebox	<i>Sesbania punicea</i>	FAC+	25	50.0
FQ2	92.0	100.0	Waterhyme	<i>Hydrilla verticillata</i>	OBL	1	1.1
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	90	97.8
			Carolina mosquitofern	<i>Azolla caroliniana</i>	OBL	1	1.1
FQ3	27.0	100.0	Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	1	3.7
			California bulrush	<i>Schoenoplectus californicus</i>	OBL	10	37.0
			Marshpennywort	<i>Hydrocotyle umbellata</i>	OBL	1	3.7

Table 8 Cont.

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	10	37.0
			Pickerelweed	<i>Pontederia cordata</i>	OBL	5	18.5
GQ1	94.0	100.0					
			Waterhyme	<i>Hydrilla verticillata</i>	OBL	90	95.7
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	1	1.1
			Torpedoglass	<i>Panicum repens</i>	FACW-	1	1.1
			Fall panicgrass	<i>Panicum dichotomiflorum</i>	OBL	2	2.1
GQ2	88.0	100.0					
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	30	34.1
			Waterhyme	<i>Hydrilla verticillata</i>	OBL	50	56.8
			Saltmarsh aster	<i>Symphyotrichum subulatum</i>	OBL	3	3.4
			Duckweed	<i>Lemna minor</i>	OBL	5	5.7
GQ3	73.0	100.0					
			Waterhyme	<i>Hydrilla verticillata</i>	OBL	10	13.7
			Mexican primrose-willow	<i>Ludwigia octovalvis</i>	OBL	1	1.4
			Climbing hempvine	<i>Mikania scandens</i>	FACW+	50	68.5
			Marshpennywort	<i>Hydrocotyle umbellata</i>	OBL	7	9.6
			Duckweed	<i>Lemna minor</i>	OBL	2	2.7
			Valley redstem	<i>Ammannia coccinea</i>	FACW+	2	2.7
			Southern Umbrellasedge	<i>Fuirena scirpoidea</i>	OBL	1	1.4
Creek Averages	57.00	99.75					

NI Insufficient information is available to determine an indicator status.

Mosaic Archie Creek Restoration Site

Table 9
Summary of Herbaceous Data for Archie Creek in
2010

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
DQ1	0.0	0.0					
DQ2	0.0	0.0					
EQ1	89.0	100.0					
			Duckweed	<i>Lemna minor</i>	OBL	30	33.7
			Knotted spikerush	<i>Eleocharis interstincta</i>	OBL	30	33.7
			Dotted smartweed	<i>Polygonum punctatum</i>	FACW+	1	1.1
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	25	28.1
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	2	2.2
			Torpedograss	<i>Panicum repens</i>	OBL	1	1.1
EQ2	93.0	100.0					
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	3	3.2
			Knotted spikerush	<i>Eleocharis interstincta</i>	OBL	60	64.5
			Marshpennywort	<i>Hydrocotyle umbellata</i>	OBL	5	5.4
			Duckweed	<i>Lemna minor</i>	OBL	10	10.8
			Pickerelweed	<i>Pontederia cordata</i>	OBL	15	16.1
FQ1	80.0	100.0					
			Red ludwigia	<i>Ludwigia repens</i>	OBL	5	6.3
			Dotted smartweed	<i>Polygonum punctatum</i>	OBL	20	25.0
			Pickerelweed	<i>Pontederia cordata</i>	OBL	25	31.3
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	5	6.3
			Saltmarsh aster	<i>Symphyotrichum subulatum</i>	OBL	4	5.0
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	20	25.0
			Rosy camphorweed	<i>Pluchea rosea</i>	FACW	1	1.3
FQ2	138.0	100.0					
			Duckweed	<i>Lemna minor</i>	OBL	60	43.5
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	8	5.8
			Waterhyme	<i>Hydrilla verticillata</i>	OBL	70	50.7
FQ3	96.0	100.0					

Table 9 cont.

Area Name	Total % Coverage	>FAC Relative Cover	Common Name	Scientific Name	Indicator Status	Percent Cover	Relative Cover
			Soft rush	<i>Juncus effusus</i>	FACW	3	3.1
			Denseflower knotweed	<i>Polygonum densiflorum</i>	OBL	75	78.1
			Marshpennywort	<i>Hydrocotyle umbellata</i>	OBL	3	3.1
			Pickerelweed	<i>Pontederia cordata</i>	OBL	15	15.6
GQ1	14.0	100.0					
			Pickerelweed	<i>Pontederia cordata</i>	OBL	3	21.4
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	2	14.3
			Alligatorweed	<i>Alternanthera philoxeroides</i>	OBL	1	7.1
			Duckweed	<i>Lemna minor</i>	OBL	5	35.7
			Waterhyme	<i>Hydrilla verticillata</i>	OBL	2	14.3
			Torpedograss	<i>Panicum repens</i>	FACW	1	7.1
GQ2	31.0	83.9					
			Herb of grace	<i>Bacopa monnieri</i>	OBL	3	9.7
			Marshpennywort	<i>Hydrocotyle umbellata</i>	OBL	5	16.1
			Torpedograss	<i>Panicum repens</i>	FACW	5	16.1
			Dotted smartweed	<i>Polygonum punctatum</i>	OBL	8	25.8
			Arrowhead	<i>Sagittaria lancifolia</i>	OBL	1	3.2
			Sand cordgrass	<i>Spartini bakeri</i>	FACW	3	9.7
			Duckweed	<i>Lemna minor</i>	OBL	1	3.2
			Wax myrtle	<i>Myrica cerifera</i>	FAC	5	16.1
Creek Averages	50.38	97.31					

Wildlife

The following list documents wildlife observed within and around the Archie Creek Relocation and Mitigation sites since monitoring began in 2006.

Fulvous Whistling-Duck (<i>Dendrocygna bicolor</i>)	Muscovy Duck (<i>Cairina moschata</i>)
Anhinga (<i>Anhinga anhinga</i>)	Great Blue Heron (<i>Ardea herodias</i>)
Great Egret (<i>Ardea alba</i>)	Snowy Egret (<i>Egretta thula</i>)
Little Blue Heron (<i>Egretta caerulea</i>)	Tricolor Heron (<i>Egretta tricolor</i>)
Reddish Egret (<i>Egretta rufescens</i>)	Cattle Egret (<i>Bubulcus ibis</i>)
Green Heron (<i>Butorides virescens</i>)	White Ibis (<i>Eudocimus albus</i>)
Yellow-crowned Night-Heron (<i>Nyctanassa violacea</i>)	Glossy Ibis (<i>Plegadis falcinellus</i>)
Roseate Spoonbill (<i>Platalea ajaja</i>)	Wood Stork (<i>Mycteria americana</i>)
Turkey Vulture (<i>Cathartes aura</i>)	Osprey (<i>Pandion haliaetus</i>)
Red-shouldered Hawk (<i>Buteo lineatus</i>)	Limpkin (<i>Aramus guaraunav</i>)
Mourning Dove (<i>Zenaida macroura</i>)	Barn Owl (<i>Tyto alba</i>)
Blue Jay (<i>Cyanocitta cristata</i>)	Common moorhen (<i>Gallinula choropus</i>)
Green treefrog (<i>Hyla cinerea</i>)	Cuban treefrog (<i>Osteopilus septentrionalis</i>)
Pig frog (<i>Rana grylio</i>)	Brown anole (<i>Anolis sagrei</i>)
Florida softshell (<i>Apalone ferox</i>)	Common snapping turtle (<i>Chelydra serpentina</i>)
American alligator (<i>Alligator mississippiensis</i>)	Channeled apple snail (<i>Pomacea canaliculata</i>)
Mottled duck (<i>Anas fulvigula</i>)	Red-winged blackbird (<i>Agelaius phoeniceus</i>)
Black-crowned night heron (<i>Nycticorax nycticorax</i>)	River otter (<i>Lontra Canadensis</i>)

Wading birds were regularly observed perching and foraging within the relocated creek and mitigation areas, often concentrated near the spreader weirs and control structures. The channeled apple snail (*Pomacea canaliculata*) has colonized the entire site, but predation by wading birds appears to have significantly reduced the initial snail population. Limpkins (*Aramus guarauna*) and wood storks (*Mycteria Americana*) were directly observed consuming snails, and numerous empty shells are obvious along the shallow edges of relocated Archie Creek.

All of the wading bird species present are provided some degree of state protection as species of special concern, while the wood stork is listed as endangered by both state and federal agencies.

Extensive utilization of the relocated creek and mitigation areas by protected wading birds should be considered ecologically significant for this coastal freshwater system. Wading bird and other wildlife utilization is expected to continue as on-site vegetation matures.

4

Summary

All sites are exhibiting wetland hydrology consistent with that of natural wetlands within Hillsborough County primarily driven by surface water flows and direct precipitation inputs.

While percent aerial vegetative cover for both North and South Mitigation areas have been visually estimated near the permit target of 85%, transect data reveal sparse patches typical of mid-transitional zones within the created mitigation areas. Undesirable species also continue to contribute to relative cover in many transitional quadrats. The contribution of undesirable species is not uniform across transects or wetlands, and this condition is expected to improve with continued maintenance and organic accumulation and natural recruitment as the herbaceous community matures. While plant species may change based on future climate variation, cover density and relative contribution by desirable wetland species is not expected to change significantly.

Continued maintenance consisting of nuisance and exotic species control via targeted herbicide treatment has been successful in reducing overall exotic species cover, maintaining a level below those listed in applicable permits, except in some transitional zones within the South Mitigation area and some sections along the western portions of Archie Creek.

Tree species in the North Mitigation area continue to experience observable mortality believed to be due to elevated water levels persistent within the mitigation area. Tree species in the South Mitigation area exhibited greater than 90% survival within tagged subsamples, corresponding closely to visual estimates of overall survival, and exhibited notable positive growth.

Ecologically significant wildlife utilization, primarily by wading birds, has been documented throughout the site.

In summary, all components of the Archie Creek Relocation and Mitigation sites are trending towards mitigation site success based on the fourth year of monitoring, with the exception of tree growth in the North Mitigation area and exotic species coverage in some areas. To insure survival of the trees in the North Mitigation area, it is believed water levels must decrease during the dry season. Continued treatment should control the exotic species populations within the target areas.

A fifth annual monitoring report will be provided subsequent to the September 2011 annual monitoring event and will include observations from the preceding four quarterly qualitative events.

Evaluations are underway to identify those areas potentially meeting the success criteria of the applicable permits. In the event that selected areas satisfy the success specifications, Mosaic will seek the appropriate agency confirmation.

Appendix A – Photostation Photographs

**Archie Creek
Annual Mitigation Area Monitoring Report**

**North Mitigation Area
September 2010**



PS1 Looking South 2010



PS1 Looking Southeast 2010

**Archie Creek
Annual Mitigation Area Monitoring Report**

**North Mitigation Area
September 2010**



PS1 Looking East 2010



PS1 Looking Northeast 2010

**Archie Creek
Annual Mitigation Area Monitoring Report**

**Archie Creek East
September 2010**



PS2 Looking North 2010



PS2 Looking South 2010

**Archie Creek
Annual Mitigation Area Monitoring Report**

**South Mitigation Area
September 2010**



PS3 Looking Southwest 2010



PS3 Looking Northwest 2010

**Archie Creek
Annual Mitigation Area Monitoring Report**

**South Mitigation Area
September 2010**



PS3 Looking West 2010

**Archie Creek
Annual Mitigation Area Monitoring Report
Riverview
Archie Creek South
September 2010**



PS4 Looking West 2010



PS4 Looking East 2010



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