# DRAINAGE CANAL VEGETATION MANAGEMENT PLAN FOR THE CITY OF JONESBORO

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## Executive Summary

Vegetation management in urban environments, specifically within drainage canal systems, has multiple implications for storm water management, storm water control, flooding and human dimensions. This project assessed 51 drainage canal sites within the greater City of Jonesboro limits, focused on the 8 FEMA designated drainage canals (and an additional non-evaluated drainage canal system) and described the dominant type, percentage aerial cover of vegetation (both woody and non-woody species) and bank materials for each evaluated site. A total of 94 species were recorded, of which only four species occurred in more than seven drainage basins. Each drainage basin had variable percent covers occupied by each of the vegetation subclasses (trees >5 m; brush <5 m; forbs, grasses and bare-ground) based on prior maintenance history, or age of the drainage reach (i.e. newer sites in the industrial sections of Moore's, Little Bay). Rip-rap which is a typical bank stabilization material was encountered in eight of the nine drainage basins, with the highest percentage of bank rip-rap (80%) occurring in the Christian drainage basin. After addressing the question about vegetation community assemblages at each site, the project aimed to identify species of vegetation conducive for planting that would yield the goals of storm water maintenance (i.e. low-growing stature, good ground cover for bank stabilization, lack of woody debris after senescence). Management recommendations were created for each drainage basin, as determined by the respective vegetation assemblage. Management recommendations also included individual bridge crossings / pilings that could cause storm flow abatement due to large woody debris blockages. Management recommendations included physical maintenance (mowing, cutting, removal), and broad-leaf herbicide applications for the suppression of small woody seedlings. Fire was a management recommendation left out of the final management decisions. While fire is a useful tool for suppressing woody species establishment and encouraging wanted native herbaceous and grass species growth, it is a hazardous tool in an urban drainage setting.

## Introduction

Vegetation management of urban in-stream environments is necessary to benefit both environmental and human based functions. Urban aquatic environments are frequently cited to be impaired with excess sediments, nutrients, bacteria and trace metals. These pollutants have a negative impact on the aquatic system; however, using science-based approaches, non-point source pollutant levels can be reduced, as well as the flow velocity profiles changed, so that sedimentation occurs, reducing total suspended solid loads and improving water quality. Often drainage canals in urban environments are not aesthetically pleasing and adopt connotations of dumping grounds and foul wastewater sites. By carefully implementing vegetative management plans, not only will in-stream environmental benefits be increased, but the aesthetic quality and function of these systems enhanced.

## Project Activities

Project activities were classified into three categories. The first category required intensive field sampling of the vegetation of the drainage canals. The second category required a literature survey describing the vegetation that would be amenable for transplant, and to prevent flooding and erosion problems. The third category would describe a management plan whereby the City of Jonesboro could affect changes in vegetation management and assess the results.

1. Identification and classification of vegetation types and species within drainage canals in Jonesboro. This includes:
    a. Identification of areas with invasive, unwanted canal vegetation.
    b. Identification of areas with the greatest potential for vegetation introduction based on physical parameters (hydrology, geomorphology, and site conditions).
2. Identification of a suite, and generation of a list of facultative wetland vegetation that fits a set of rigorous ecological criteria that can be introduced in the drainage canals; i.e.:
    a. Native and non-invasive non-native
    b. Vegetative propagation
    c. Illustrated environmental benefits
    d. Region specific

e. Robust to withstand management

3. Generation of an aggressive management plan that:
    a. Evaluates the use of individual and integrated management strategies to remove unwanted species and improve in-stream habitats. Management strategies could include:
        i. Herbicides (individual and combination)
        ii. Growth inhibitors
        iii. Mechanical removal
        iv. Native species establishment (planting)
    b. Establishes long-term monitoring plots, upon which successful criteria of establishment (species, density, environmental function) can be based
    c. Incorporates *in situ* water quality testing associated with United States Geological Survey (USGS) gauging stations to identify temporal changes in water quality as a correlate to potentially increasing in-stream environmental functions with vegetation management plans

Category 3(c) would allow USGS scientists or City Engineers to incorporate *in situ* water quality parameters to degrees or types of vegetation within each drainage watershed and potentially infer some correlations or relationships.

## Project Methods

Project methods to accomplish the above mentioned three categories will include the following:

*Objective 1*:

a. Drainage canals will be surveyed for plant species identification
b. Dominant three herbaceous or woody plant species will be identified
c. Line / point surveys will provide species diversity measure of the drainage canals
d. Surveys will provide presence / absence data for vegetative species, as well as percentage basal cover and percent canopy cover of the stream / canal / ditch
e. Initial survey of selected drainage canals in Jonesboro
    i. Survey will initially cover selected representative canals
    ii. 51 sites surveyed within the greater City of Jonesboro (Figure 1)

iii. A minimum of five sites per drainage watershed
iv. Line point surveys will run 100 m, with point surveys every 10 m
v. Point surveys will also describe physical characteristics of water depth, canal width, height and bank constitution
vi. Other points of concern (i.e. trash, potential for culvert blockages) will be noted

*Objective 2*:

a. Literature surveys will generate a list of obligate – facultative wetland vegetative species that can be introduced into Jonesboro drainage canals
b. This list will be based on strict ecological criteria of:
    i. Native to the U.S
    ii. Native to the Lower Mississippi Alluvial Valley
    iii. Native to EPA Region IV
    iv. Documented environmental benefits of nutrient, pesticide or heavy metal assimilation
    v. Propagates vegetatively
    vi. Robust enough to withstand mechanical management actions (i.e., mowing)

*Objective 3*:

a. Management plans will be based on quadrat x treatment x vegetation. Management plans will formulate an experimental design for the assessment of management options
b. Vegetation: un-wanted, invasive vegetation vs. wanted, native wetland vegetation
c. 3 treatments:
    i. Herbicides
    ii. Mechanical control
    iii. Native species establishment
d. The management plan will provide a scientifically rigorous conclusion to the "vegetative health" of drainage canals as well as the projected direction of change to that "health"

## Objective 1 – Results

The intensive survey yielded interesting information between the respective drainage reaches. The nine drainage watersheds that were sampled were: Butler, Christian, Higgin Bottom, Little Bay, Lost, Moores, Murray, Turtle, and Whiteman. From these nine sites a plant list was compiled of all vegetation species encountered. This list was not meant to be an exhaustive list of species diversity, but a list of dominant species encountered in the respective reaches.

**Table 1.** Dominant vegetation species (woody, forb and grass) encountered with surveys within the nine drainage sites in Jonesboro

| Scientific Name | Common Name | Drainage Reach Occurrence |
|---|---|---|
| *Acer negundo* | Box Elder | Christian/Lost/Little Bay |
| *Albizia julibrissin* | Silktree | Chritian/Higgin Bottom |
| *Alternanthera phylloxeroides* | Alligator Weed | Turtle Creek |
| *Ambrosia trifida* | Giant Ragweed | Lost/Butler/Christian/Little Bay/ Moore / Murray/ Turtle Creek / Whiteman |
| *Ampelopsis cordata* | Heart Leaf Pepper Vine | Turtle Creek |
| *Arisaema triphillum* | Jack in the pulpit | Murray |
| *Arundinaria gigantea* | Cane | Turtle Creek |
| *Aster spp.* | Aster / Daisy | Little Bay |
| *Bambusa spp.* | Bamboo | Whiteman |
| *Betula nigra* | River Birch | Christian/Higgin Bottom/ Moore/ Murray/ Whiteman |
| *Bromus spp.* | Bromus | Moore |
| *Brunnuchia ovata* | American Buckwheat Vine | Butler |
| *Campis radicans* | Trumpet Creeper | Butler/Higgin Bottom/ Little Bay / Lost / Moore / Murray / Whiteman |
| *Carex spp.* | Carex | Butler/ Moore |
| *Carpinus spp.* | Hornbeam | Christian |
| *Carya aquatica* | Hickory | Lost/ Murray |
| *Carya illinoinensis* | Pecan | Whiteman |
| *Catalpa bignonioides* | Southern Catalpa | Christian/ Turtle Creek |
| *Celtis occidentalis* | Hackberry | Lost |
| *Celtis laevigata* | Sugarberry | Murray |
| *Cephalanthus occidentalis* | Buttonbush | Murray |
| *Cercis canadensis* | Red Bud | Turtle Creek |
| *Chamaecrista fasciculate* | Partridge Pea | Higgin Bottom |
| *Chasmanthium latifolia* | Indian Wood Oat | Murray/Higgin Bottom/Turtle Creek |

| Scientific Name | Common Name | Drainage Reach Occurrence |
|---|---|---|
| *Commelina spp.* | Dayflower | Lost |
| *Conyza canadensis* | Canadian Horseweed | Little Bay |
| *Coreopsis basalis* | Goldenmane Tickseed | Whiteman |
| *Cynodon dactylon* | Bermuda Grass | Moore |
| *Digitaria spp.* | Digitaria | Moore / Turtle Creek |
| *Diospyros virginiana* | Common Persimmon | Christian |
| *Echindorus spp.* | Burreed | Moore |
| *Echinochloa crus-galli* | Barnyard Grass | Whiteman |
| *Elymus spp.* | Wild Rye Grass | Christian |
| *Equisetum fluviatile* | Water Horsetail | Little Bay |
| *Fraxinus americana* | Ash | Christian / Lost / Moore / Murray |
| *Gleditsia triacanthos* | Honeylocust | Butler/Higgin Bottom/Lost/ Moore/ Turtle Creek / Whiteman |
| *Hippuris vulgaris* | Mare's tail | Lost/Murray |
| *Ilex decidua* | Privet Hedge / Possumhaw | Moore |
| *Iva annua* | Sumpweed | Moore / Turtle Creek / Whiteman |
| *Juglans nigra* | Black Walnut | Murray |
| *Juncus effusus* | Common Rush | Turtle Creek |
| *Lagerstroemia indica* | Crape Myrtle | Whiteman |
| *Leersia oryzoides / hexandra* | Cutgrass | Christian/ Lost / Moore/ Murray / Whiteman |
| *Lespedeza virginica* | Slender Lespedeza | Butler/Higgin Bottom/ Lost/ Moore/ Turtle Creek |
| *Ligustrum sinense* | Chinese Privet | Christian/Higgin Bottom/Moore / Turtle Creek / Whiteman |
| *Liquidambar styraciflua* | Sweetgum | Christian/ Lost / Murray/ Turtle Creek / Whiteman |
| *Lonicera albiflora* | Western Honeysuckle | Butler/Higgin Bottom |
| *Lonicera japonica* | Japanese honeysuckle | Christian / Moore / Murray/ Turtle Creek |
| *Ludwigia peploides* | Floating Water Primrose | Butler/Christian/Higgin Bottom / Lost/ Turtle Creek / Whiteman |
| *Microstegium vemineum* | Mary's Grass | Christian/Lost |
| *Mimosa spp.* | Mimosa | Moore/ Whiteman |
| *Morus rubra* | Red Mulberry | Butler/Higgin Bottom/Lost / Turtle Creek |
| *Panicum spp.* | Panicum | Lost / Moore |
| *Parthenocissus quinquefolia* | Virginia Creeper | Murray |
| *Phytolacca americana / dodecandra* | American Pokeweed | Christian / Lost / Moore / Murray |
| *Plantanus occidentalis* | Sycamore | Christian/Little Bay/ Murray |
| *Polygonum hydropiperoides* | Swap Smartweed | Butler/Christian/ Lost / Murray/ Turtle Creek / Whiteman |
| *Polygonum persicara* | Lady's Thumb | Christian |

| Scientific Name | Common Name | Drainage Reach Occurrence |
|---|---|---|
| *Populus deltoides* | Cottonwood | Moore / Murray/Turtle Creek |
| *Potamageton spp.* | Pondweed | Butler |
| *Prunus serotina* | Wild Cherry | Murray |
| *Prunus spp.* | Plum | Moore |
| *Pueraria montana* | Kudzu | Christian/Higgin Bottom/ Little Bay/ Lost / Murray |
| *Pyrus calleryana* | Callery Pear/Bradford Pear | Christian/Higgin Bottom |
| *Quercus nigra* | Water Oak | Turtle Creek |
| *Quercus phellos* | Willow Oak | Murray |
| *Quercus stellata* | Post Oak | Whiteman |
| *Quercus velutina* | Black Oak | Murray/ Turtle Creek |
| *Rhus copallinum* | Sumac | Lost/Moore / Murray/ Turtle Creek/ Whiteman |
| *Rhus glabra* | Smooth Sumac | Butler/Little Bay/Higgin Bottom |
| *Rhynchspora innundata* | Beak Rush | Moore |
| *Robinia spp.* | Locust | Murray |
| *Rosa multiflora* | Wildrose | Lost/Moore/Murray / Whiteman |
| *Rubus allegheniensis* | Common Blackberry | Higgin Bottom/ Lost / Moore/ Murray / Whiteman |
| *Sagittaria lancifolia* | Bulltongue Arrowhead | Whiteman |
| *Salix nigra* | Black Willow | Butler/Christian/Higgin Bottom/ Little Bay/ Lost / Murray/ Turtle Creek/ Whiteman |
| *Sambucus nigra spp. canadensis* | American Black Elderberry | Higgin Bottom/ Little Bay/ Murray / Whiteman |
| *Sassafras albidum* | Sassafras | Christian/ Murray / Whiteman |
| *Sesbania herbacea* | Sesbania | Lost |
| *Setaria spp.* | Foxtail | Christian/ Moore |
| *Smilax glauca* | Smilax | Murray |
| *Solidago spp.* | Goldenrod | Higgin Bottom/ Little Bay/ Lost / Moore/ Turtle Creek |
| *Sorghum halepense* | Johnson Grass | Butler/Christian/Higgin Bottom/ Little Bay / Lost / Moore / Murray / Turtle Creek / Whiteman |
| *Symphoricarpus orbiculatus* | Coralberry | Murray |
| *Toxicodendron pubsecens* | Poison Oak | Murray |
| *Toxicodendron radicans* | Poison Ivy | Murray / Whiteman |
| *Tradescantia zebrine* | Wandering Jew | Moore |
| *Typha angustifolia* | Narrow Leaf Cattail | Moore/ Turtle Creek |
| *Ulmus americana* | American Elm | Butler/Christian/Moore/ Murray / Turtle Creek / Whiteman |
| *Vinca minor* | Periwinkle | Murray |
| *Vitis rotundifolia* | Muscadine | Christian/Moore/ Turtle Creek / Whiteman |
| *Xanthium strumarium* | Cockleburr | Higgin Bottom/ Turtle Creek |

A total of 94 species were recorded. These species were recorded on two transects running perpendicular to the river channel on opposite banks. Species percentage cover was evaluated as the percentage aerial cover occupied by the three most dominant species on each of the transects. Canopy cover was estimated as the percent of river channel that was closed by canopy from the bank vegetation. Canopy cover is a good metric for the presence of large woody debris much greater than 5m in height. There were only four species which occurred in seven or more drainage systems: *A.trifida* (Giant Ragweed), *S.halepense* (Johnson Grass), *S.nigra* (Black Willow) and *C.radicans* (Trumpet Creeper). With the data collection each site was evaluated for dominant species as well as percentage cover associated with four discrete categories: % trees greater than 5 m, % brush less than 5 m, % herbs or forbs, % grass and % bare ground. These metrics are valuable as irrespective of the species it provides a quick idea of the baseline vegetation composition of each drainage system. It is also interesting to note that out of the 94 species sampled in the drainage basins, nine were considered obligate wetland species (i.e. species that were growing in the channel under saturated conditions).

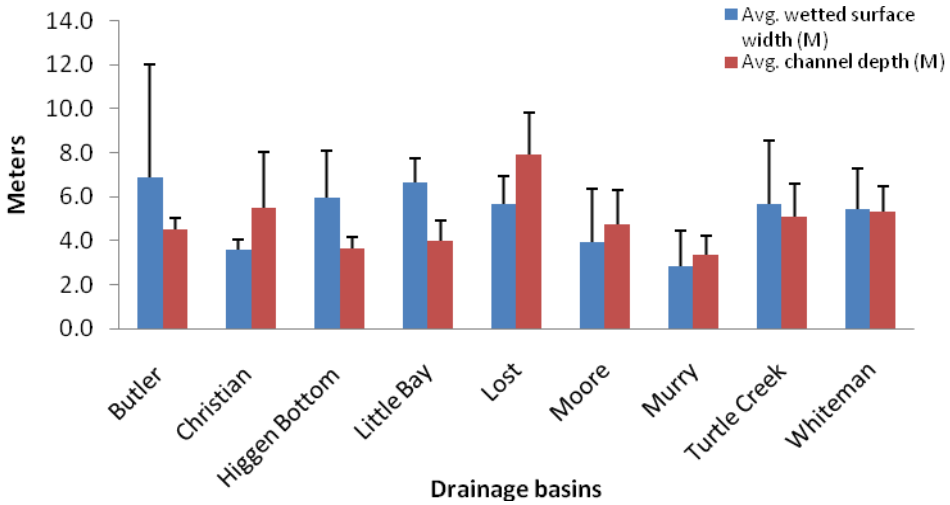


Figure 1. Average surface width and channel depth (±S.D.) in Jonesboro AR, drainage basins.

There were no significant differences in average channel depth and average surface width between the drainage basins (Figure 1). Lost was the deepest site, with incised channels, while Butler had the largest wetted surface width. The wetted surface width was the wetted channel breadth and is climate driven. Based on this data, six of the sites (Butler, Little Bay, Higgin

Bottom, Lost, Turtle Creek and Whiteman) hold a large amount of water within the stream channel.

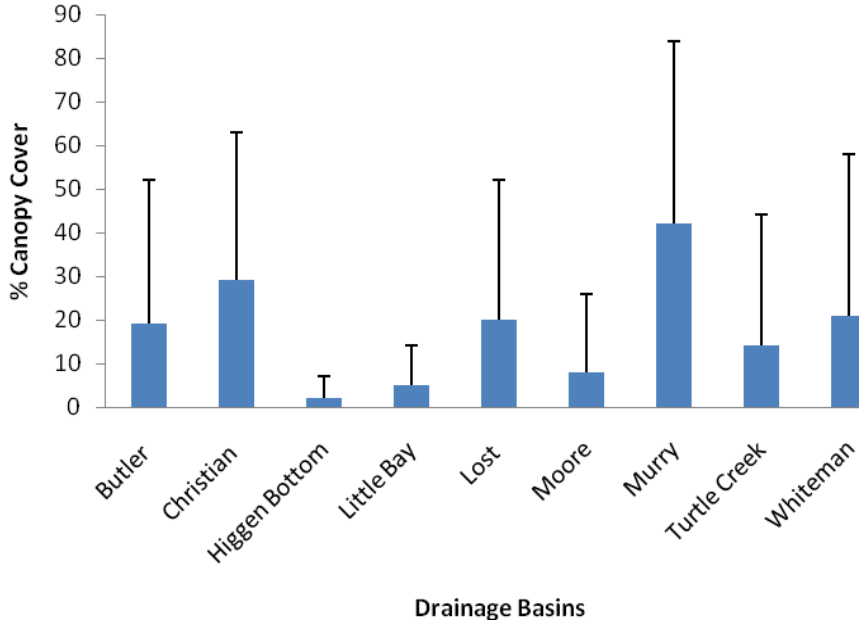


Figure 2. Average percent canopy cover (±S.D.) over each stream in selected drainage basins in Jonesboro, AR.

Average percent canopy cover was a measurement of the percent cover over each stream channel in the respective drainage basins. Canopy cover was used as an indirect metric for the presence of large woody species (>5m) that are leaning over the channel bed and potentially could fall in and create large woody debris. Large woody debris in channels can cause blockages on bridge crossings, bridge pilings and culverts resulting in storm water abatement and potential flooding. The percent canopy cover was highly variable between sites (standard deviation over 100% in some sites) (Figure 2). Higgin Bottom, Little Bay and Moore had very small amounts of canopy cover which was highly correlated to the vegetation assessment of less than 10% trees >5 m in their vegetation assemblages (Figure 6, 7, and 9).

Details of the vegetation community assemblage of each drainage basin are detailed below.

*Butler Drainage*

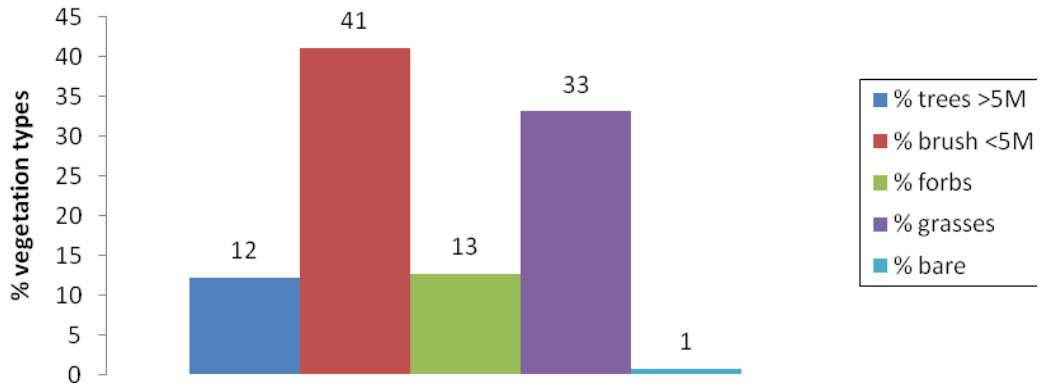


Figure 3. Vegetation type percentage for four sites within the Butler Drainage. Note a large proportion of brush less than 5 m in height, and high proportion of grasses.

Butler drainage has a 12% proportion of large trees within its drainage (Figure 3), but has a substantial cohort of brush that is less than 5 m in height (41%). This cohort could potentially in the next 5 years become large woody structures that could pose drainage problems if they fall into the drainage canal. This brush consisted of Black Willow, Red Mulberry, and Sumac. Of these species Black Willow is the species of concern to track into the >5 m category. This tree species can potentially grow large, and at senescence due to bank destabilization or natural causes will result in significant contributions of large woody debris to the channel.

*Christian Drainage*

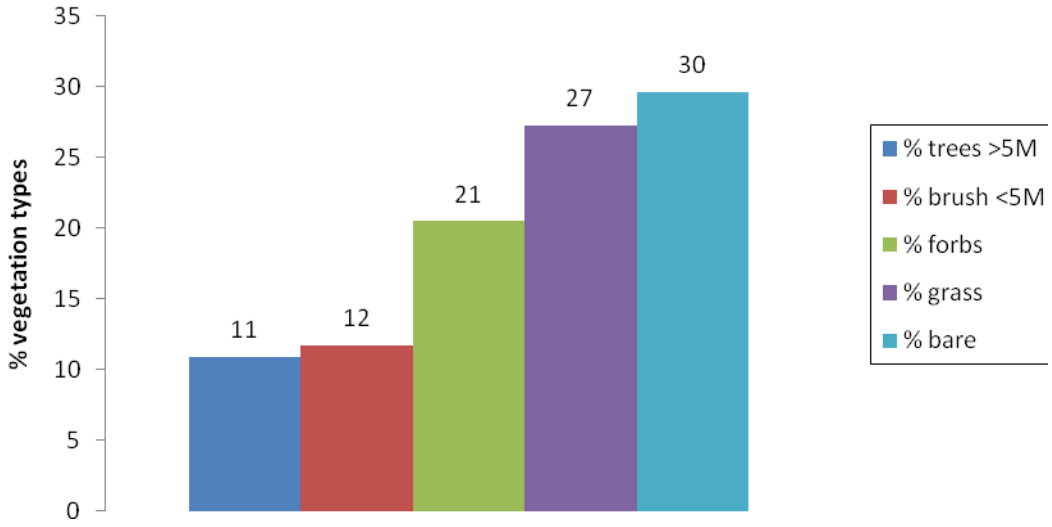


Figure 4. Vegetation type percentage for Christian drainage. Note small percentages of trees and brush as compared to grass, forbs and bare ground.

Christian has very low percentages of trees >5 m and brush < 5 m (Figure 4). Species that potentially could play roles in drainage problems are Sweetgum, Black Willow, and Red Maple. The large proportion of bare ground is reflected in the high percentage of rip-rap that is dominant within the Christian drainage. Rip-rap is 50% more prevalent in Christian than in any other drainage (Figure 5).

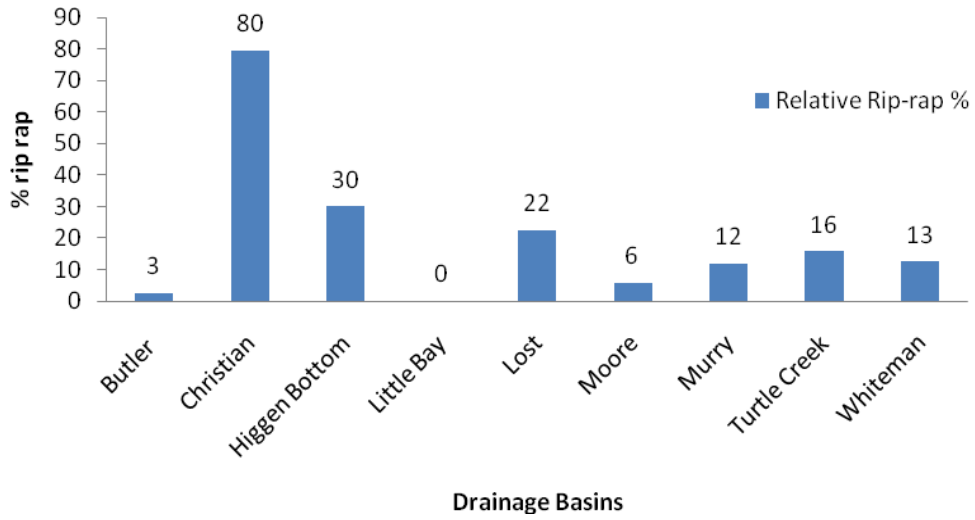


Figure 5. Relative percentage rip-rap in each drainage basin surveyed within Jonesboro. Note the high percentage of rip-rap in Christian in comparison to all other sites.

*Higgin Bottom Drainage*

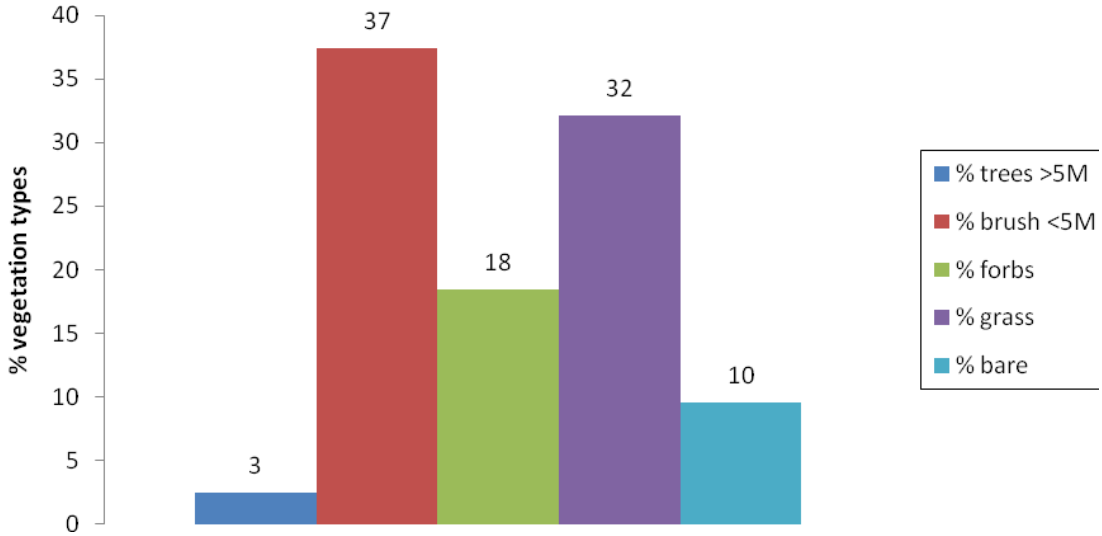


Figure 6. Vegetation type percentage for Higgin Bottom. Note large percentage of brush <5m within the drainage and very low percentage of trees>5m.

Higgin Bottom has a very low proportion of trees >5m, and a large proportion of brush <5 m (Figure 6). This suggests similar to Butler Drainage, Higgin Bottom Drainage has a number of species that have the potential to move into the >5 m tree size class. Specifically *S* Black Willow (*S.nigra*) is fairly prevalent (3/5 sites) at high percentages within each site. Other

species of concern in this drainage include Sumac and River Birch both of which occurred at 4/5 sites sampled. The large proportion of bare ground was a result of large sections of rip-rap (see Figure 6).

*Little Bay Drainage*

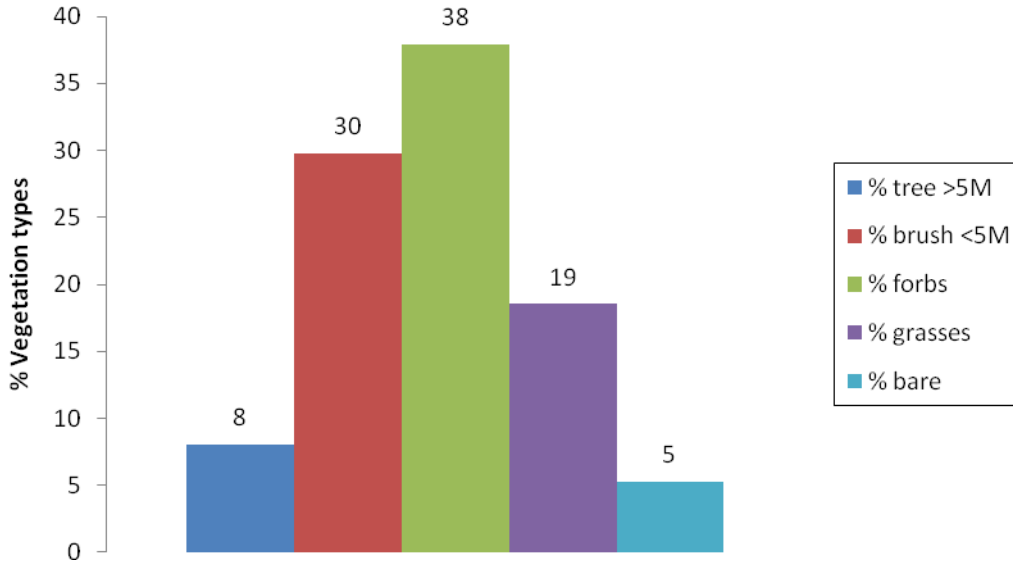


Figure 7. Vegetation type percentage for the Little Bay Drainage in the Industrial Park

Little Bay drainage had an even distribution of brush <5 m, % forbs and % grasses within its drainage canals (Figure 7). The 30% proportion of <5 m brush consisted Black Willow (*S.nigra*) four of the five sites sampled. Other trees that were classified brush included Box Elder, American Sycamore, and Red Maple. Without required maintenance and supervision Little Bay Drainage will contain very large woody plants, and which have the potential to become large woody debris structures in the canal.

*Lost Creek Drainage*

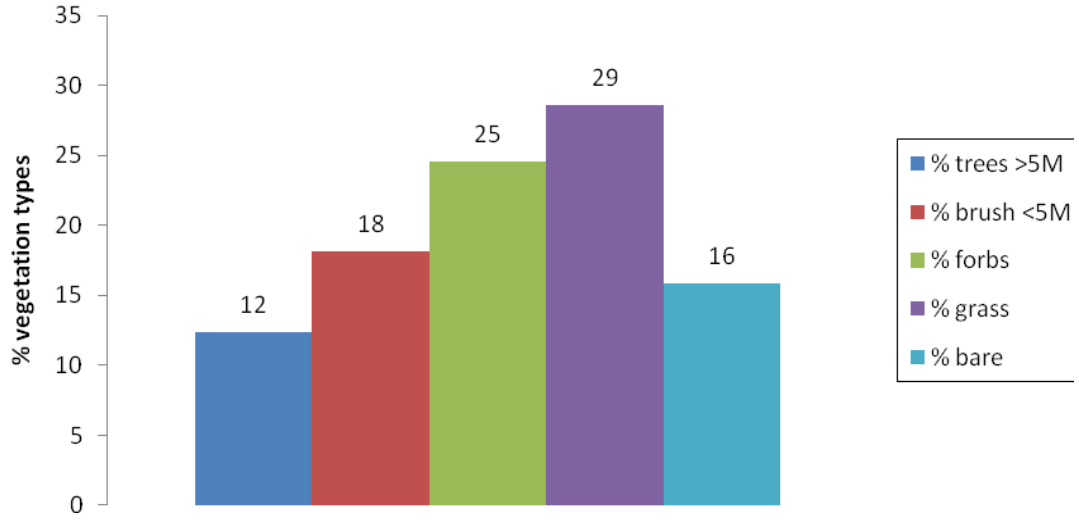


Figure 8. Vegetation type percentage for the Lost Creek Drainage.

Lost Creek drainage was dominated by grass and forb species (25 and 28% respectively) (Figure 8). Common brush species less than 5 m included Black Willow, and Red Maple. The 12% tree cover and canopy cover over the stream bed is from large Black Willow and River Birch. The large proportion of bare ground included rip-rap sections (see Figure 5).

*Moore Drainage*

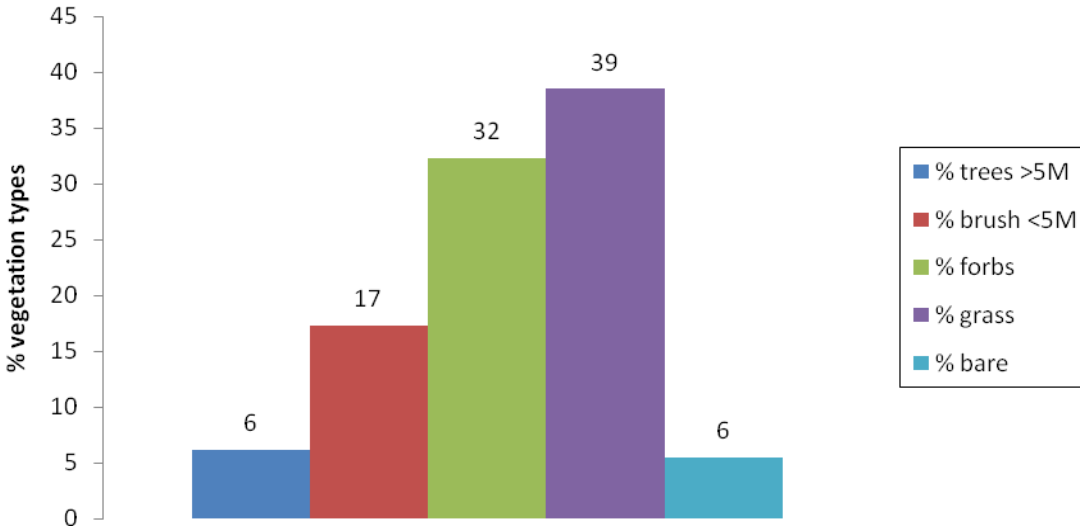


Figure 9. Vegetation type percentage for the Moore Drainage in the Industrial Park.

Moore Drainage, like Little Bay, and Butler are fairly new drainage canals which have had maintenance occur to them in the last two years. This difference is clear as grass and forbs

were the dominant percentages in vegetation within the drainage system (Figure 9). Canopy cover for the six sites averaged less than 5% (Figure 2) suggesting a lack of tree cover and large woody species. This is corroborated by the lack of large woody species within each transect.

*Murray Drainage*

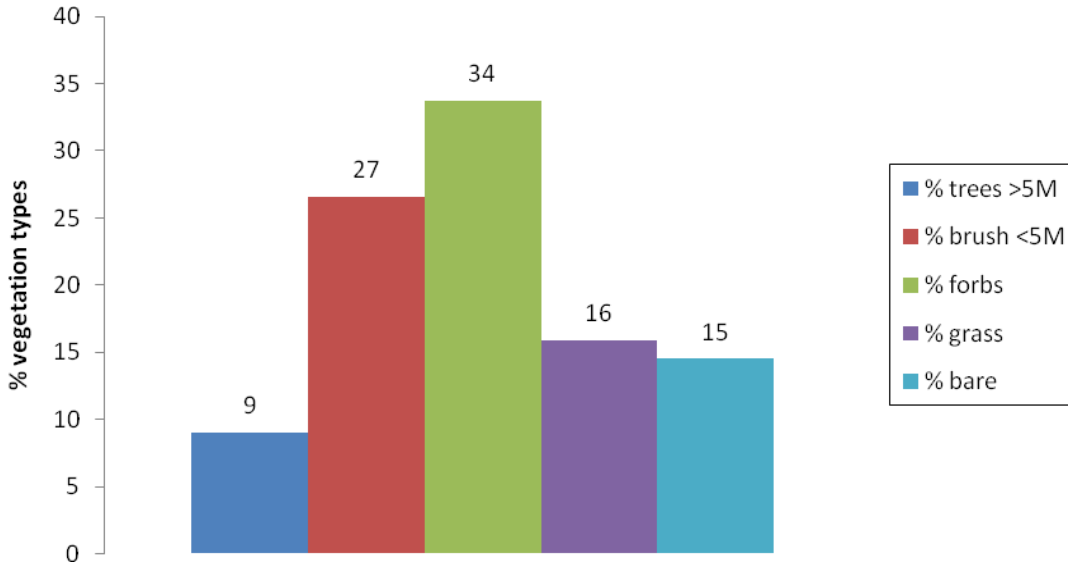


Figure 10. Vegetation type percentage for Murray Drainage, an un-evaluated drainage system in Jonesboro, AR.

Even though not a designated FEMA evaluated flood/storm water canal, the Murray Drainage yielded some interesting results. Species richness was highest in Murray through various ornamentals and mowing practices. Murray had high percentages of brush < 5 m (27%) and forbs (34%) (Figure 10). Brush included species such as Black Willow, Red Maple, Cherry, Black Walnut, Buttonbush and Elms. Other ornamentals included Hickory, Cottonwood and Bamboo.

*Turtle Creek Drainage*

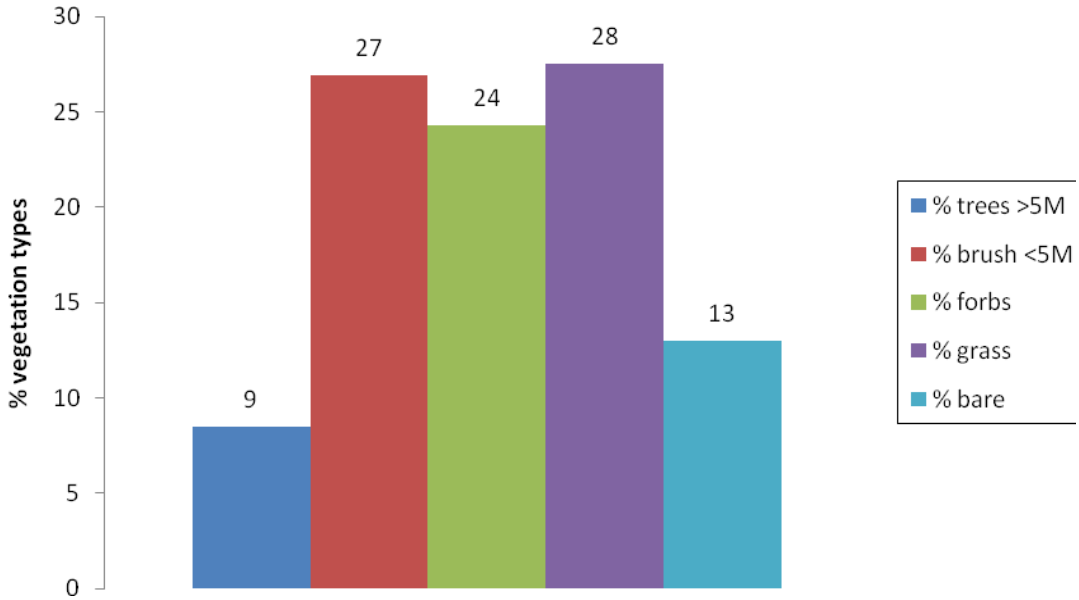


Figure 11. Percentage vegetation types for Turtle Creek Drainage.

Turtle Creek drainage is in urban Jonesboro and is dominated at various points by brush and forbs and grasses. The dominant grass and forb component comes from regular maintenance in and around the mall area. There is an equal distribution of vegetation covers for Turtle Creek between <5 m brush, forb and grasses (Figure 11). Canopy cover of less than 5% throughout the drainage suggests a lack of large woody trees within the channel banks. Brush species included Black Willow, Red Bud, Privet, Cottonwood, and Red Maple. Within a small section of Turtle Creek (Aggie and Stadium) a number of mature trees (Sweetgum, Maple, Water Oak and Black Oak) were within the banks of the channel.

*Whiteman Drainage*

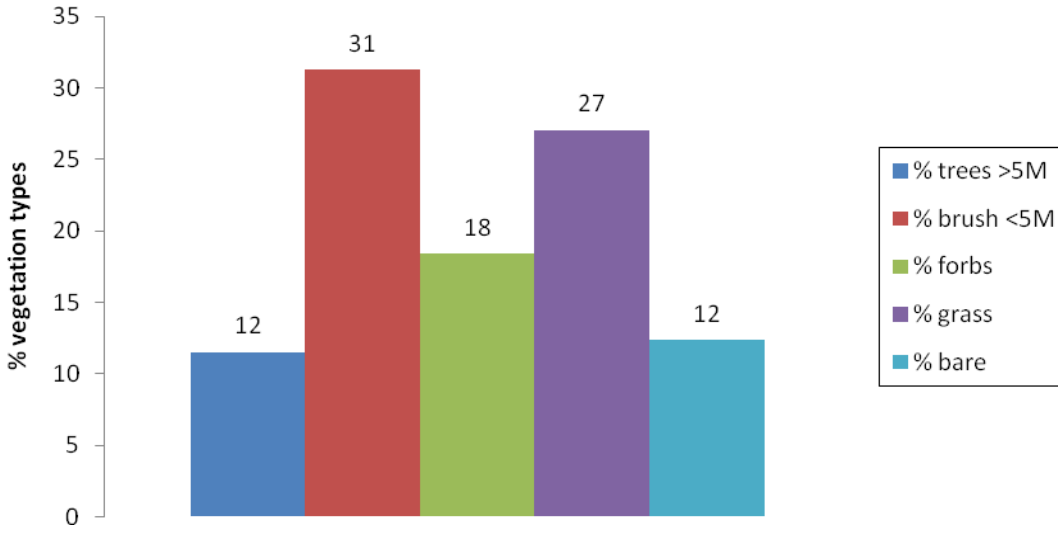


Figure 12. Vegetation type percentage for Whiteman Drainage.

Whiteman Creek Drainage is very similar to Turtle Creek drainage as it is in the heart of urban Jonesboro and has a number of ornamental species from neighboring gardens within the drainage canal. Brush species had a high percentage of the total vegetative cover (31%) (Figure 12). Dominant brush species included Privet, Bamboo, Sumac, and Sweetgum. Large trees within the channel banks included Honey Locust, Mimosa, Sassafras, Pecan and Post Oak. Bare ground was a result of rip-rap entries on box culverts, and active placement of rip-rap and washes within the channel.

**Objective 2 – Results**

Objective 2 was initiated to identify a suite, and generate a list of facultative wetland vegetation that fits a set of rigorous ecological criteria that can be introduced in the drainage canals of Jonesboro. Any proposed vegetation needs to be facultative wetland plants; that being plants able to withstand upland conditions but can, if necessary, survive flooding and soil saturation and soil anoxia for limited periods of time. It was also suggested that the species be native and non-invasive, can consistently reproduce vegetatively, illustrate some environmental benefits, be region specific (i.e. can withstand environmental conditions within northeast Arkansas) and are robust enough to survive active management (i.e. mowing). It was quite clear that a re-vegetation program for the drainage canals of Jonesboro was 1) cost prohibitive with a good chance of seedling mortality, and 2) time in-effective. This time issue was brought forward as the City has problems maintaining the drainage canals right now without the extra burden of planting and

caring of seedlings. It is envisioned that with proper maintenance certain plant species that already occur within the drainage canals can be maintained and encouraged to grow. A number of species both woody and non-woody were in high abundance within most of the drainage canals. These species can be subdivided into two categories: woody brush and non-woody herbaceous species. Woody brush species are those plants that will remain less than 5 m in height, have a broad basal and aerial coverage and can vegetatively reproduce with rhizomes. These plant species are ideal for drainage canals as they offer erosion protection of the banks, are aesthetically pleasing to the eye and provide multiple ecological functions such as wildlife habitat, pollination sources, and do not result in large woody debris falling into the main channels. Often these types of plants handle mowing exceptionally well, with coppicing occurring within a couple of months of mowing. Table 2 highlights the woody brush species recorded, on which drainage and site they occurred, and are species that should be maintained. *Ligustrum sinense* or Chinese Privet is a great low growing woody brush species that creates effective erosion control, excellent basal cover and does not produce large woody debris. Chinese privet creates aesthetically pleasing vegetative cover and is native to the Southeast (see Figure 13). *Ilex deciduas* or Possumhaw is another low growing species that has great basal and aerial coverage, good erosion control, is native to the Southeast (see Figure 14) and is aesthetically pleasing. Possumhaw is a classified tree/shrub by USDA plants database and is a perennial species

**Table 2.** Woody brush species that occurred within the respective drainage canals and sites (B: Butler; C: Christian; HG: Higgin Bottom; L: Lost; MO: Moore; M: Murray; TC: Turtle Creek; W: Whiteman)

| Species | Drainage | Sites |
|---|---|---|
| *Rhus glabra* (Smooth Sumac) | Butler/Higgin Bottom/ Little Bay/ Lost / Moore | CW Post (B); Harrisburg Rd (HG); Planters and Stadium (HG); South Caraway Rd (HG); CW Post (LB); Hwy 63 (LB); CW Post (MO); |
| *Vitis rotundifolia* (Vine – Muscadine) | Christian/ Turtle Creek / Whiteman | West Nettleton (C); Woodsprings (C); Aggie (TC); Woolum (W); |
| *Ligustrum sinense* (Chinese Privet) | Christian / Higgin Bottom / Moore/ Turtle Creek/ Whiteman | West Nettleton (C); Greensboro (HG); CW Post (MO); Stadium (TC); Aggie (TC); Richardson Drive (W); |
| *Rosa multiflora* (Wild Rose) | Lost / Moore / Murray/ Whiteman | Culberhouse (L); East Highland (MO); Kathleen (MO); Pacific (MO); Paragould (M); Stadium (W); |
| *Ilex deciduas* (Possumhaw) | Moore | Commerce (MO); |


Figure 13. Conterminous US native distribution of Chinese Privet (*Ligustrum sinense)* (courtesy and with reference to USDA-Plants Database; plants.usda.gov)


Figure 14. Conterminous US native distribution of Possumhaw (*Ilex decidua)* (courtesy and with reference to USDA Plants Database; plants.usda.gov)

Typically, non-woody herbaceous plants are forbs and grasses. These plants dominate areas where there is limited canopy cover and usually occur in drainage canals that have recently been maintained. These plants provide a good aerial and basal cover, as well as multiple ecological benefits of wildlife habitat, pollination sources and will result in no large woody debris falling into the drainage canal. Furthermore, herbaceous species tend to provide a better ground cover against erosion and bank failure. Herbaceous plant species can be encouraged by

minimizing the canopy cover of large woody plants, resulting in competition for light and resources. Herbaceous plant species cover can also be encouraged through frequent disturbances such as mowing and fire. Though fire is not a management tool recommended for urban drainage canals, it is a management tool viable for large drainage canals in less urban settings such as the industrial park. Fire as a management tool is inexpensive (i.e. no diesel, time labor for mowing), requires certain amount of supervision, and can be fairly well controlled if conditions were selected that favored a slow burn (i.e. early mornings, no wind or favorable downslope, down ditch wind). Mowing is a management tool that will disturb the herbaceous layer, but will result in a greater biomass once growth occurs. Greater biomass results in better erosion coverage and less opportunity of large woody species to encroach. Table 3 highlights the non-woody herbaceous species that are dominant in the various drainage canals in Jonesboro and are species that should be managed for. Kudzu (*Pueraria montana*) is a successful species in canals occurring in Christian, Higgin Bottom, Little Bay, Lost and Murray drainages. Though an excellent erosion control agent, this report would advise against the establishment and placement of Kudzu. Mechanical or chemical control could reduce the distribution and abundance of the species as well as allow native species occurring within the same drainage to establish and provide the necessary ground cover.

**Table 3.** Non-woody herbaceous species that occurred within the respective drainage canals that should be maintained

| Species | Drainage | Common Name |
|---|---|---|
| *Sorghum halepense* | Butler/Christian/ Higgin Bottom/ Little Bay / Lost/ Moore/ Turtle Creek/ Whiteman | Johnson Grass |
| *Campsis radicans* | Butler / Higgin Bottom/ Little Bay/ Lost/ Whiteman | Trumpet Creeper |
| *Lespedeza virginica* | Butler/Higgin Bottom / Lost/ Moore/ Turtle Creek | Slender Lespedeza |
| *Ambrosia trifida* | Butler / Christian/ Little Bay/ Lost / Moore / Murray/ Turtle Creek/ Whiteman | Giant Ragweed |
| *Lonicera albiflora* | Butler/Higgin Bottom/ Turtle Creek | Western Honeysuckle |
| **Species** | **Drainage** | **Common Name** |
| *Setaria sp.* | Christian / Moore | Foxtail |

| | | |
|---|---|---|
| *Leersia hexandra/oryzoides* | Christian / Lost / Moore / Murray/ Whiteman | Cutgrass |
| *Phytolacca americana* | Christian / Lost / Moore/ Murray | Am.Pokeweed/Poke Salad |
| *Iva annua* | Moore / Turtle Creek / Whiteman | Sumpweed |
| *Coreopsis basalis* | Whiteman | Goldenmane tickseed |
| *Echinochloa crus-galli* | Whiteman | Barnyard grass |

There were also a number of sites that had obligate wetland vegetation within the drainage channel. These plants are typically plants that can only occur in wetland conditions (i.e. saturated or flooded conditions, and anaerobic soils). The species encountered were all herbaceous sedge like species that had a small growth structure (<0.8 m in height) and were not robust. This lack of robustness results in plants bending and being flexible for high flow events, not impeding flow. The plants actually play vital ecological roles for increasing water quality by assimilating various non-point and point source pollutants such as nitrogen, phosphorus, certain pesticides and heavy metals. In low flow conditions these plants decrease the velocity of the water column and which increases sedimentation. Sedimentation improves water clarity and downstream water quality. Table 4 highlights the obligate wetland species recorded within the drainage canals of Jonesboro, and the drainage and site where they were encountered. Bamboo was recorded in the Whiteman drainage. Though not native, Bamboo could be used for water quality improvement, erosion control and aesthetics of the drainage canal. Due to its robust stature, however, its large growth form it might add to blockages on culverts and thus should be discouraged and mechanically removed.

**Table 4.** Obligate wetland plants species encountered within the drainage channels within the respective drainage canals and sites (B: Butler; C: Christian; HG: Higgin Bottom; L: Lost; MO: Moore; M: Murray; TC: Turtle Creek; W: Whiteman)

| Species | Drainage | Sites |
|---|---|---|
| *Ludwigia peploides* (Floating primrose) | Butler/Christian/ Higgin Bottom / Lost / Moore / Turtle Creek/ Whiteman | Grisham (B); West Matthews (C); Greensboro (HG); North Floyd (L); Commerce (MO); East Highland (MO); Moore Rd (MO); Race (TC); Limestone (TC); Industrial (TC); East Highland (TC); Woolum (W); Racefair Park Blvd (W); Richardson Drive (W); |
| *Potamageton sp.* (Pondweed) | Butler | Grisham (B); |
| *Carex sp.* | Butler / Moore | Nestle (B); Opportunity (MO); |
| *Polygonum hydropiperoides* (Swamp Smartweed) | Butler / Lost / Moore / Murray/ Turtle Creek | CW Post (B); North Patrick (L); Peachtree (L); Opportunity (MO); East Highland (MO); Moore Rd (MO); CW Post (MO); Peachtree 1 (M); Limestone (TC); Stadium (TC); Industrial (TC); East Highland (TC); Woolum (W); |
| *Equisetum fluviatile* (Water Horsetail) | Little Bay | Hwy 18 (LB); CW Post (LB); |
| *Typha angustifolia* (Cattail) | Moore | Opportunity (MO); Moore Rd (MO); |
| *Rhynochspora innundata* (Beak Rush) | Moore | Opportunity (MO); |
| *Sagittaria lancifolia* (Burhead) | Moore | East Highland (MO); |
| *Alternanthera phylloxeroides* (Alligator Weed) | Turtle Creek | Race (TC); |
| *Arundinaria gigantea* (River Cane) | Turtle Creek | Race (TC); |

## Objective 3 – Results

*Management Conclusions*

1. *Butler*

Butler sites can be visually assessed in Appendix A. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Butler Creek. It is important to note that large woody debris falling into the drainage canal will accumulate on the front end of culverts resulting in storm water backups and flooding. The Dorton Road crossing

highly influenced the amount of large woody debris present. Butler Creek often had deep water flows (>3ft) and thus was ideal habitat for beavers to create dams.

*Management Suggestions:*

- Physical maintenance of mowing and removal of large woody trees above and below Dorton Road crossings
- Physical maintenance and removal of individual large woody trees and willows on CW Post
- Herbicide application in 1 – 2 years time to control the growth of brush seedlings (i.e. willows, sweetgums)
- Physical removal of beaver dams and careful observations for subsequent builds. If problem persists call in USDA-Wildlife Services or Arkansas Game and Fish Commission to help with the problem

Overall Butler Creek seems to be recently maintained or created, with large stretches or sections that are devoid of woody vegetation and have a very well established herbaceous species community. Certain areas around bridge crossing that have the capability to have large woody trees and large woody debris within 3 – 5 years need to be observed and monitored for changes.

2. *Christian*

Christian drainage sites can be visually assessed in Appendix B. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Christian Creek. Christian drainage tended to be deep, with steep banks. Often banks were so steep that bank washouts were frequently occurring (West Nettleton). Large trees with exposed tree roots tend to maximize the likelihood that certain sites on Christian will significantly contribute to the addition of large woody debris into the drainage canal. This was evidenced by large woody debris around bridge pilings (West Nettleton). Gee Road crossing was the only maintained site. Upstream of that crossing were rip-raped banks with herbaceous cover; downstream however, large trees covered both banks, close to 100 % dominant cover.

*Management Suggestions:*

- Physical removal and clean out of Gee Road crossing downstream to Lost Creek
- Physical clean out of Woodsprings Road crossing upstream (downstream site, rip-rapped and maintained till Gee)
- Physical removal of certain large trees in upper reaches of Christian; rip-rap or Gambian sides of drainage banks
- Observe and monitor bridge crossings for large woody debris accumulation (Woodsprings, Gee and West Nettleton)

3. *Higgin Bottom*

Higgin Bottom drainage sites can be visually assessed in Appendix C. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Higgin Bottom. Large proportion of small > 5m willow saplings that need to be removed, mowed or have herbicide applied before they reach size that will impede flow and result in large woody debris accumulating (not Caraway Crossing). Urban portions of Higgin Bottom (Greenbriar) are well maintained, with rip-rap channel beds, a lack of large trees, and a small proportion of <5 m shrubs. Further downstream sites (i.e. Parker – near Home Depot) will need to be monitored for large woody debris buildup on the box culverts, as there are a high proportion of trees and shrubs upstream of Parker Road crossing.

*Management Suggestions:*

- Maintain the urban sections with small proportions of large trees and shrubs
- Monitor culvert at Parker Road crossing for accumulation of large woody debris which will avoid flooding the main intersections

4. *Little Bay*

Little Bay drainage sites can be visually assessed in Appendix D. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Little Bay. Little Bay drainage occurs in the industraial district and is well maintained or is newly developed. Low

percentages of shrubs and trees along with a dominant herbaceous and grass cover provide clear wide flowing drainage channel.

*Management Suggestions:*

- Monitor bridge crossings for accumulation of large woody debris
- Monitor banks every year for growth of woody tree saplings or brush that will mature into large trees
- Remove growth with either mechanical or herbicide applications
- Herbicide applications will control small saplings well in advance of large trees once established

5. *Lost Creek*

Lost drainage sites can be visually assessed in Appendix E. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Lost Creek. Lost Creek has a number of sites that require physical removal of large trees and willow saplings. Willow saplings are dominant within the system (Dan, Culberhouse, Lacy, North Patrick and Pleasant Grove) and pose a major threat to accumulation of large woody debris in the drainage canals, culverts and bridges. The Lacy crossing has the potential for being a very accessible and visible demonstration site for mechanical and herbicidal treatments associated with large woody debris / tree removal. Lacy site is very close to the new site for physical maintenance for the city engineers. Both upstream and downstream sites for Lacy are heavily vegetated with large trees (Willows, Sycamores and Sweetgums).

*Management Suggestions:*

- Establishment of three mechanical and three herbicide treatment plots to understand how large trees (specific species noted within each plot) are affected by mechanical and/or herbicidal control. These plots should be monitored through time to determine grow back rates, and how often management needs to occur (i.e. how regularly to mow? How often does a herbicide application need to be made post the first application, etc?).

- Large trees need to be removed for most of Lost and bank washes above Dan need to be repaired with grading and or rip-rap.
- Monitor accumulation of large woody debris on bridge pilings at North Patrick, Dan and Lacy.

*6. Moore*

Moore drainage sites can be visually assessed in Appendix F. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Moore. Moore drainage had multiple sites where there were large trees within channel banks. Kathleen (below airport), for example, was heavily vegetated upstream, while downstream a wide channel bed was completely vegetated in giant ragweed. East Highland site was wide, with a heavily vegetated channel bed with Cutgrass (*Leersia hexandra/oryzoides*). This site would allow good storm water flows and during low flows provide excellent water quality benefits of nutrient management and sedimentation. However, there was a large debris accumulation on the culvert at East Highland crossing. Multiple sites of Moore are in the urban / industrial area (Pacific, Commerce, Moore Road) and have high proportions of brush / shrubs < 5m that will enter into the tree size class in a number of years.

*Management Suggestions:*

- Monitor and remove accumulated debris on East Highland
- Mechanical removal or small brush and shrubs on most of Moore's crossings
- Herbicidal treatment of ragweed in channel bed if desired

*7. Murray*

Murray drainage sites can be visually assessed in Appendix G. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Murray. Murray drainage / creek represented the only non-FEMA designated drainage creek system evaluated. Typically, Murray ran through new urban neighborhoods and was the narrowest channel recorded. Though narrow, the channel often displayed steep and undercut banks. This is highly

evident at the Minga site. Minga site of Murray seemed to traverse a fairly new subdivision (i.e. lots still for sale, houses being built). Large trees and all bank vegetation for stabilization seem to be cleared. There is evidence of massive gully erosion, heavy bank scouring, and deep wash outs and undercuts.

*Management Suggestions:*

- Bank stabilization and complete re-working of Murray at the Minga subdivision site. This includes re-vegetation of banks, shaping, and drop pipe installation
- Willow trees are predominant features of the drainage canals (Paragould, Disciple, Chastain, CR 900). Mechanical or chemical applications for removal is strongly encouraged within the next 2 years to avoid large woody debris falling into the narrow channels
- Monitor and remove large woody debris accumulation on bridge pilings at Disciple. Flooding occurs frequently and could be reduced by mechanical removal of large trees on channel banks and the discouragement of growth of Willows, Sycamores and Sweetgums

*8. Turtle Creek*

Turtle Creek drainage sites can be visually assessed in Appendix H. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Turtle Creek. Certain sites were heavily vegetated with large trees. For example, Aggie upstream had a large proportion of channel banks that were completely covered in large trees. Downstream of the site was a large box culvert, which needs to be monitored for large woody debris accumulation. Aggie crossing of Turtle creek receives input from two head tributaries and should be a high priority for bridge monitoring as a result of large inputs and a large University intersection. East Highland is devoid of woody vegetation (brush and trees), it is well maintained (behind Mall and post small detention pond, prior to large detention area currently under construction). Limestone site similarly had no woody vegetation; however, had a large proportion of bare ground which was indicative of some bank scouring on the eastern bank. Another site was slated for evaluation above the sewage works but effluent discharge on the day of sampling precluded sampling of the site.

*Management Suggestions:*

- Monitor bank scour at furthest downstream site of Turtle Creek. Bank shaping or rip-rap sides according to determination of worsening
- Monitoring and removing of debris accumulation at culvert and bridge pilings along Turtle Creek

*9. Whiteman*

Whiteman drainage sites can be visually assessed in Appendix I. These photographs represent a visual depiction of the vegetation present at various bridge / road crossings of Whiteman. Whiteman along with Turtle creek are urban drainage systems that are important to maintain and clear out as they potentially affect a large proportion of residential, transportation and commercial interests.

*Management Suggestions:*

- Maintain channel banks devoid of large tree and brush vegetation
- Mechanical or chemical removal of invasive species (Mimosa)
- Encourage growth of low growing herbaceous species community – less drag on large flood events
- Monitor and removal of large woody debris on culverts and bridge pilings (Woolum, Race, Stadium)

## Concluding Remarks

Jonesboro, AR has over 300 miles of drainage canals to maintain every year. Of these 300 miles, eight drainage basins have FEMA flood designations and need to be managed to avoid the occurrence of flooding. The primary cause of flooding and stormflow abatement is the presence of large woody debris in channels, blocking bridge crossings, pilings and culverts retaining water, and backing up drainage ways. The maintenance and management of this drainage basin needs to be altered based on the vegetation present, and the stage or assemblage occurring in each site. Certain drainage basins (i.e. Moore, Little Bay, Butler) are fairly new and have recent

maintenance, thus showing a very low percentage of tree aerial cover, and a low canopy cover of the channel. These sites through management recommendations of herbicide applications, and potentially fire can be kept in a herbaceous state without too much cost. Physical maintenance of mowing and brush cutting is a cost prohibitive way of maintaining these drainage basins. Other sites such as Turtle Creek, Lost, and Christian which are more urban will require physical maintenance at the outset but can be followed with regular chemical maintenance to prevent the occurrence, germination and growth of large woody species. By maintaining a low growing, low stature, herbaceous / grass community assemblage the city will be removing the potential of large woody debris occurring in the channels, will stabilize the ditch banks with a dense undergrowth of herbaceous vegetation (which is not possible with shading from large woody species) and improve aesthetics of the drainage basin to the general public. Rip-rap is also a viable physical maintenance tool on both the toe and banks of the ditches to prevent sloughing and bank erosion. A combination of physical maintenance (based on site attributes), chemical applications, and fire (where feasible and logistically possible) will yield significant improvements in drainage basin vegetation communities, as well as impact the occurrence and severity of flooding in the drainage basins.

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