CITY OF RALEIGH

INVASIVE SPECIES PROGRAM

PHASE I REPORT

Volunteers and staff remove bamboo from the Rose Garden.

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CONTENTS

Japanese privet (Ligustrum japonicum) is removed at Fallon Park.

Native wildflowers thrive at John Chavis Park after the removal of invasive trees.

EXECUTIVE SUMMARY

The City of Raleigh created the Invasive Species Program in September 2015 in response to citizens' concerns that invasive plants – English ivy, wisteria and the like – were overrunning neighborhood parks. With the launch of the program, the Parks, Recreation and Cultural Resources Department made the control of invasives and restoration of native ecosystems a clear priority.

City Council directed the program's focus initially on four neighborhood parks: Cooleemee, Fallon, Cowper and Marshall, known as the Big Four. It also asked that the program report on its progress after three years. This document is designed to fulfill that request.

Over the past three years, the Invasive Species Program has successfully promoted healthy habitat at the Big Four. Invasives have been pulled, chopped, mowed or sprayed. Native plants have been reintroduced. And the quality of habitat is being monitored.
But the program has not stopped there. We also have fought the march of invasives into other parks and nature preserves. In all, management efforts have taken place in 41 parks and preserves across the City.

The Invasive Species Program coordinator, the sole full-time staffer, is based in the Volunteer Services Division. But this is more than a one-person effort. The program engages staff in a number of City departments, organizes volunteers, conducts extensive outreach and forms partnerships throughout Raleigh and beyond.

The work is never ending. Invasive plants constantly migrate into our parks. Even after removal, their seeds lie dormant, awaiting the right conditions to germinate. Expansion of our park system will require ongoing attention to invasives. The City of Raleigh has long recognized the value of protecting and enhancing our natural areas (Appendix A). Control of invasive plants aligns with that value.

EXECUTIVE SUMMARY CONT.

N.C. State University volunteers cut vines at Walnut Creek Wetland Park.

BY THE NUMBERS

99.8% increase in volunteers engaged in invasive plant removal over past 3 years

18 partnerships throughout the City of Raleigh and Wake County

$162,770.29 value of volunteer invasive removal efforts in 3 years

7 parks Restoration plantings (reintroduction of native plants)

Over 1,400 acres of park property had invasive management efforts

INVASIVE SPECIES

Invasive species include plants and animals that have been introduced from other regions and spread quickly, free of the predators and diseases of their native territory. The Invasive Species Program focuses on invasive plants, rather than animals, as a result of policy and limits on resources.

Non-native plants are considered invasive if they harm the native ecosystem of our parks and nature preserves. They prevent the growth of native species, including our beloved oaks. A variety of invasive plants – vines, grasses, shrubs and trees – threaten native plants. Many grow faster and spread more rapidly than natives. They may leaf out early or be evergreen, shading out the seedlings of native deciduous trees.

Most of the plants that the City seeks to eradicate or control migrated from residential yards and gardens. Homeowners in urban areas often acquire invasive plants from nurseries and landscapers, inadvertently contributing to their spread.

Sometimes invasive plants not listed by agencies such as the N.C. Forest Service and U.S. Department of Agriculture turn up in our parks. This is because urban spaces like ours create micro-climates, or mini-habitats, for exotic plants that escape from plant collectors' home landscapes. Melia azedarach (chinaberry), Ulmus parvifolia (Chinese elm) and Firmiana simplex (Chinese parasol tree) are just a few of the invasive plants found in our parks, although they may be overlooked on regional lists of invasive plants.

The AmeriCorps team poses at Fallon Park.

INVASIVE SPECIES CONT.

INVASIVE SPECIES IN RALEIGH PARKS

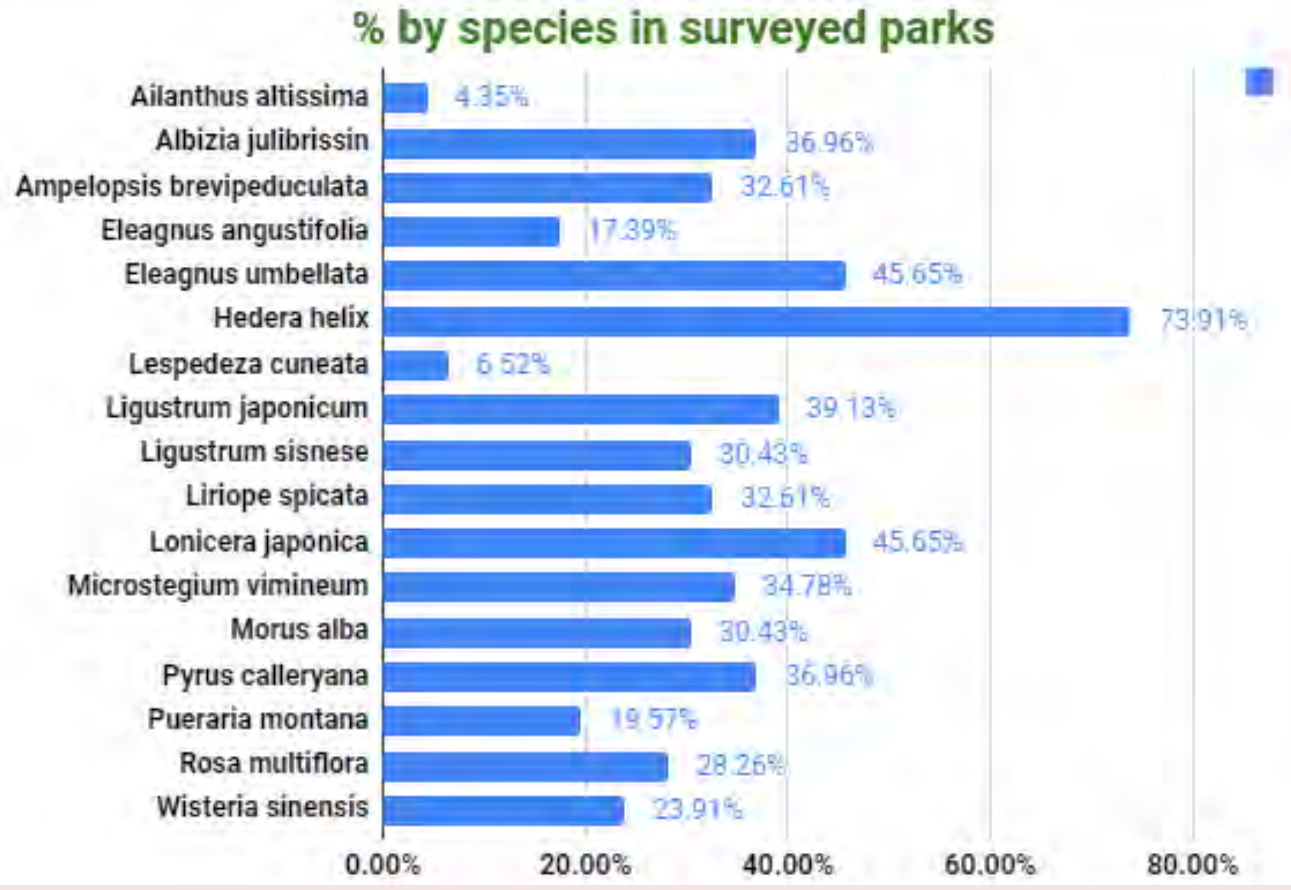
The Invasive Species Program has surveyed invasive plants in 41 parks and preserves. The chart shows the most common invasive plants at these sites. Percentages are the percentages of surveyed parks and preserves in which each of these plants was found.

The top three invasive species surveyed in Raleigh's Parks are listed below.

1) Hedera helix (English ivy) 73.91%

2) Eleagnus umbellata (Autumn olive) 45.65%

3) Lonicera japonica (Japanese honeysuckle) 45.65%



HARMFUL EFFECTS

The City is a leader in sustainability, and our citizens and visitors enjoy abundant parks and open spaces. Approximately 9 percent of the City's 144 square miles remain in parkland. Our stewardship of these resources has helped us earn recognition as a Bee City, Tree City and Playful City. Invasive plants imperil our natural environment, our economy and our safety. Resources added to this issue now will reduce losses, costs and hazards in the future.

ENVIRONMENTAL IMPACT

Invasive species escape cultivation and push their way into unmanaged areas. As they cover the ground, they block sunlight from native plants and suppress the germination of native seeds. Native trees are unable to compete and regenerate. Some invasives can alter soil chemistry by changing nutrient cycling in ways that our native plants, which evolved in very specific habitats, cannot tolerate. By changing the ecosystem, invasives can increase the likelihood of wildfires and even poison wildlife.1

Because of invasive plants' capacity to colonize rapidly, they can quickly overwhelm natural areas. The spread of invasive plants in southern forests is conservatively estimated at 145,000 acres each year, accelerated by a warming climate and disturbances related to human activities.2

Much research has been devoted to the ways trees contribute to human health. Trees sequester carbon, reduce harmful stormwater effects, decrease crime rates, cool urban areas and help preserve built infrastructure, among other benefits.3 As the mature tree canopy fails due to disease, pests, lightning or storm damage, invasive plants quickly dominate. This creates a low wall of impenetrable vegetation.

Based on U.S. Forest Service projections, the only trees remaining in Raleigh in 40 years might be the ones lining the streets unless we maintain and care for our native habitats.4

Common invasives include Japanese stiltgrass (Microstegium vimineum).

HARMFUL EFFECTS CONT.

ECONOMIC IMPACT

Raleigh's reputation as a "park with a city in it" entices businesses and workers. Our tree canopy and green spaces contribute to this reputation, making their protection a vital economic issue for our citizens.

Based on three separate valuation tools (iTree, USDAFS & COR UF tree replacement), the monetary value of Raleigh's forests ranges from approximately $164,000,000 to greater than $3 billion.5

Our city is not alone in facing an economic danger from invasive plants. Invasive plants and animals undermine, engulf or endanger U.S. agriculture and infrastructure to the tune of an estimated $137 billion a year.6

Croplands nationwide are being invaded, leading to rising food costs. Clearing lakes, rivers and waterways of invasive plants raises the costs of energy and drinking water. And managing invasive plants along highway and street rights-of-way requires tax dollars.

Raleigh is not alone in addressing the problem. Wake County and the City of Greensboro, along with localities across the country, have had to hire specialized contractors to manage invasive plants in stormwater corridors and parks.

IMPACT ON SAFETY

Invasives put safety at risk in a number of ways. Their evergreen nature creates unwelcoming spaces that limit use and may hide illicit activities in parks and greenways. Their speedy growth creates visual obstruction for drivers and bikers along streets and greenways. Invasive vines, such as wisteria, can kill or uproot large trees with their weight or by light suffocation, making them prone to fall on streets, powerlines, sidewalks and private property. Invasive plants also block vital infrastructure, such as streetlights, stop signs, sidewalks and fire hydrants.

GROWTH OF THE PROGRAM

Volunteers take part in invasive removal at the Rose Garden.

The Parks, Recreation and Cultural Resources Department was addressing the problem of invasive plants prior to the launch of the Invasive Species Program in September 2015. The program gave greater organization and focus to this effort. The position of program coordinator was created and assigned to the department's Volunteer Services Division.

At City Council's direction, the program gave priority to the Big Four properties: Cooleemee, Fallon, Cowper Drive and Marshall parks. The four neighborhood open space parks range in size from one to nine acres, with similar habitats and levels of infestations. All four help mitigate stormwater flow and serve as passive recreation areas, promoting public well-being, habitat for wildlife and environmental preservation.7

Most of our initial efforts at managing invasives occurred at these four properties. Working with department staff and enthusiastic volunteers, we have removed invasive plants at all four parks. And we have replaced the invasives with native plants at Colleemee, Fallon and Cowper. Native plant restoration is scheduled to start in December at Marshall.

Our work, however, extends beyond the Big Four. In the past three years, we have conducted invasive management in 41 parks and nature preserves. The program has prioritized its work in other parks and preserves based on the quality of habit, the threat ranking of species and the availability of resources.8

An AmeriCorps volunteer removes invasives at Fallon Park.

GROWTH OF THE PROGRAM CONT.

NATURE PRESERVES

Extending the program to the City's nature preserves only made sense, given the preserves' sensitive environmental habitats. The program has made significant progress in controlling invasive plants at several of our preserves.

The program coordinator has worked with the department's Maintenance and Nature Preserve staffs to set site- and species-specific thresholds, or acceptable levels, for invasive plants at the preserves. These thresholds are based on factors such as quality of habitat, aggressiveness of invasives, topography and site features and accessibility. Acceptable thresholds help determine achievable, measurable goals and maintenance frequencies.

Setting thresholds requires mapping of all infestations at a site, a difficult task under current staffing levels. The addition of a part-time staffer to the program in FY19 will increase our capacity to map and control. Nonetheless, if invasives have significantly degraded a site, no action may be taken.

KEY PERFORMANCE MEASURES

	FY2016	FY2017	FY2018
TOTAL NUMBER OF VOLUNTEER INVASIVE PROJECTS	41	67*	64
			Growth: 56%
TOTAL NUMBER OF INVASIVE VOLUNTEERS	516	972*	1,031
			Growth: 99.8%
TOTAL HOURS OF INVASIVE VOLUNTEERS	1,237.75	2,993.5*	2,640.25
			Growth: 113%
TOTAL VALUE OF INVASIVE VOLUNTEER SERVICE	$28,554.91	$70,526.14*	$63, 689.24
			Growth: 123%

*The cost of two contracted removal experts is $1,400 per eight-hour day. Based on a rate of $87.50 per hour, our volunteers provided a cost savings of $231,022 in FY18.

KEY PERFORMANCE MEASURES CONT.

	FY2016	FY2017	FY2018
TOTAL NUMBER OF LOCATIONS OF INVASIVE PROJECTS**	21 (1,113 acres)	24 (1,272 acres)	27 (1,431 acres)
PERCENT OF PARKS WITH INVASIVE EFFORTS***	11.2%	12.8%	14.4%
AVERAGE NUMBER OF PROJECTS PER WEEK	0.79	1.28	1.23

PARK	NUMBER OF VOLUNTEERS	VALUE OF VOLUNTEER SERVICE
Fallon/Cooleemee****	1026 volunteers	$24,135.01
Cowper	243	$5.729.73
Marshall/Poplar	246	$5,752.09

Successful restoration (reintroduction of native plants) has occurred at all Big 4 sites

* FY17 numbers reflect the use of AmeriCorps NCCC volunteers.
** All parks that have been treated will continue to require management.
*** Based on 187 parks, excluding parks without natural areas (i.e. Roberts, Clark and Merriman) and greenways.
**** Adjacent properties are combined as they receive equal care.

PROGRAM RESOURCES

The overarching aim of the Invasive Species Program is to prevent, control or eradicate invasive plants in our parks and preserves. The program also strives to educate the public about the problem of invasives and how they can help. We rely on department staff, volunteers, outreach and technology to carry out our responsibilities.

DEPARTMENT STAFF

The program has one full-time employee, the program coordinator. In FY19, it will add a part-time employee to work 15 hours a week. Other divisions of the department provide equipment and assistance as available. The program coordinator creates policy and develops educational programming on invasive plants for the department.

Members of the Parks Maintenance and Nature Preserve staff formed a committee to work with the coordinator on a departmental policy guiding invasive plant management. The staff consulted regional experts and mined research by local universities for best management practices. The department adopted the policy in early spring 2016. Management guides for identifying, mapping and controlling invasives and for volunteer roles were also created. All Maintenance staff members have access to these guides. Using a system of plant codes, Horticultural staff can develop an overview of infestations in our parks.

The program also has created maps using ArcGIS to track natural resource information, including invasive and native flora and fauna.

VOLUNTEERS

The Parks, Recreation and Cultural Resources Department has a robust volunteer program, and volunteer participation is key to the work of invasive control. Volunteers perform most of the labor required to remove invasive plants. In FY18, citizen volunteers carried out 67 projects outside regular working hours. This represents a 14 percent increase over three years.

Citizens learn of volunteer opportunities through the City of Raleigh website and other online sites. Some volunteers come to the program through partnerships. For example, under a partnership with Exploris Middle School, students are mapping invasives at Edna Metz Wells and Forest parks, both within walking distance of the school.

One of the Invasive Species Program's greatest successes was in securing a team of 12 volunteers from AmeriCorps NCCC. AmeriCorps members, ages 18-24, came to Raleigh from across the country in fall 2016. They provided 984.5 hours, valued at $23,195. The program is applying for another AmeriCorps team to work for 10 weeks in spring 2019.

PROGRAM RESOURCES CONT.

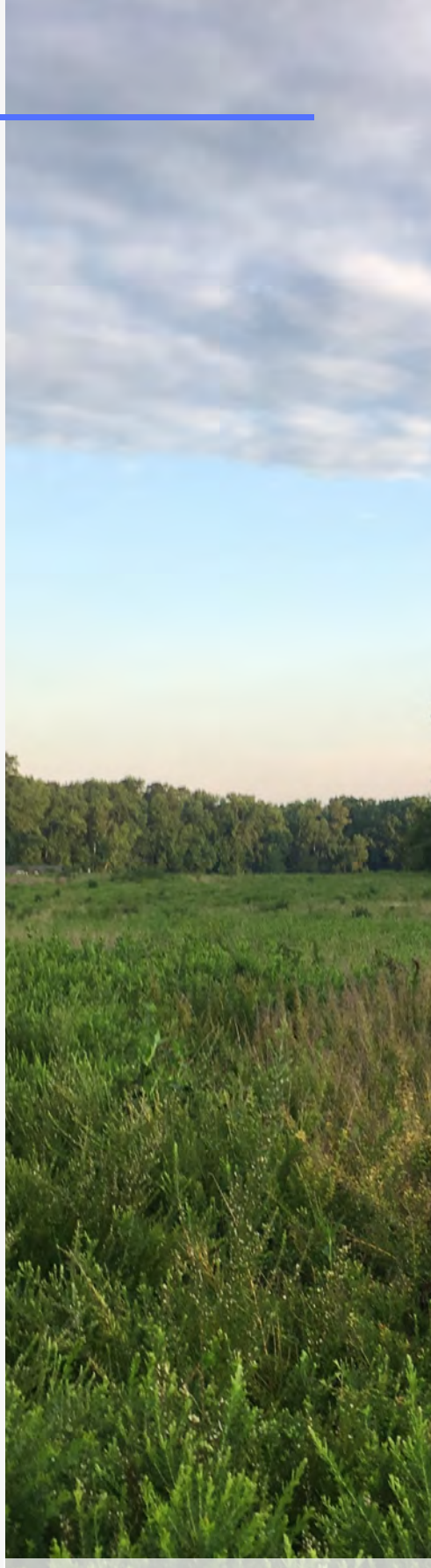
OUTREACH

The coordinator engages with civic groups, schools and other organizations to inform citizens about invasive plants and develop support for the City's efforts. She has made presentations to classes at N.C. State University, Wake Technical Community College and numerous high schools, middle schools and elementary schools. She has spoken to garden clubs, landowners/partners and Citizens Advisory Councils. This outreach has led to partnerships in land stewardship across the community.

The coordinator also conducts outreach through other City departments. She is currently working with the Police Department so officers can teach the public about the safety hazards of invasive species. This project is being conducted with two police districts at Dorothea Dix Park in cooperation with Parks Maintenance. The coordinator is undergoing training to become certified in Crime Prevention Through Environmental Design. The Fire, Public Utilities and Transportation departments have partnered with the program to assist in control of invasives along greenways and rights-of-way.

Other partnerships include Adopt-A-Park groups, Boy Scouts, WakeNature, Wild West, Fallon Park Garden Club, NCSU College of Natural Resources, Bugg Elementary School, Athens Drive High School, Audubon North Carolina, N.C. Invasive Plant Council, Friends of Lake Johnson, N.C. Wildlife Federation and the Neuse River Hawks.

In one particularly innovative partnership, the program is helping the Town of Wake Forest devise a plan for invasive control at an 80-acre parcel it recently acquired. In return, Wake Forest will assist in an invasive removal project in Raleigh.



Sericea lespedeza advances in a meadow at Annie Louise Wilkerson, MD Nature Preserve.

Common Mycena growing in Raleigh's greenery.

PROGRAM RESOURCES CONT.

TECHNOLOGY

The public can find information about invasive species, links to useful sites, volunteer opportunities and program updates at a webpage on the City's website, raleighnc.gov, by searching "invasive species." The page draws from many resources to inform the public about ways they can be involved independently in mapping/tracking/monitoring. It also provides contact information for the Invasive Species Program.

For information about specific species, the webpage directs the public to the websites of the N.C. Native Plant Society and Southeast Exotic Pest Council. We also encourage residents and visitors to take advantage of the SEEDN (Southeast Early Detection Network) or iNaturalist apps. These tracking apps, both free for Android and iPhone, use GIS and provide plant identification assistance.

MANAGEMENT OF INVASIVE PLANTS

Chinese privet (Ligustrum sinensis) is removed at Mt Hope Cemetery.

The Invasive Species Program has devoted many hours to identifying and mapping valuable habitat for preservation. Knowing the location of rare or threatened species is necessary to prioritize and protect habitat before it is destroyed. Many native species occur in highly specific ecosystems that are difficult, if not impossible, to replicate. Conserving these natural resources ensures quality parks and open spaces for the next generation.

Unfortunately, returning a property to 100 percent native plants may be unachievable at properties that have been overrun by invasives introduced by many years of wind, water, animal and human interference. Neighborhood parks in particular are often surrounded by landscapes dominated by exotic plants that migrate into park property. The goals for each site differ depending on level of infestation, value of habitat and our ability to maintain the site after reclamation.

MANAGEMENT PHASES

The park system includes 187 parks containing natural areas. The program moves through a series of management phases in deciding where within this vast system to address invasives and how to do so:

Prioritize:

Properties that can and should be redeemed are identified. We give priority to sites where volunteer efforts would be effective, nature preserves and valuable undeveloped properties.

Map:

Using a visual survey or GIS, we categorize plants within a park as native, exotic (non-invasive) or invasive. The species, size of infestation, maturity and specific location are recorded. Previous infestations are shown on negative (not occurring) surveys.

Prescribe:

A specific treatment is chosen for each invasive species. Treatments may include hand pulling, mowing, burning, applying herbicide and solarization. The program identifies tasks that are suitable for volunteers and those that require only trained staff.

Remove:

The application or deliberate action suggested by the prescription takes place on site.

Restore:

Sites qualify for restoration when they have been sufficiently cleared of invasive plants that the introduction of native plants would not be a wasted effort. The selection of species for restoration is important. Plants used in restoration must withstand competition in the early years as invasive seeds in the soil continue to germinate and invasives migrate onto the site.

Monitor:

A property moves to the monitoring phase if it has few invasive plants and a rich, diverse plant community. Properties that have been cleared of most invasive plants and can host restoration plantings are also moved to the monitoring phase.

MANAGEMENT PHASES CONT.

1. PRIORITIZE

- Biltmore Hills
- Lake Wheeler
- Cedar Hills
- Millbrook
- Shelley Lake
- Wooten Meadows
- Glen Eden
- West Lake
- Berkshire Downs

2. MAP

- Kaplan Dr. Park
- Powell Drive
- Sunnybrook Property
- Brookhaven Park
- Edna Metz Wells
- Forest
- Laurel Hills
- Windemere Beaver Dam
- Green Road
- Dorothea Dix
- Rocky Branch

3. PRESCRIBE

- Lake Johnson Pool
- Worthdale

4. REMOVE

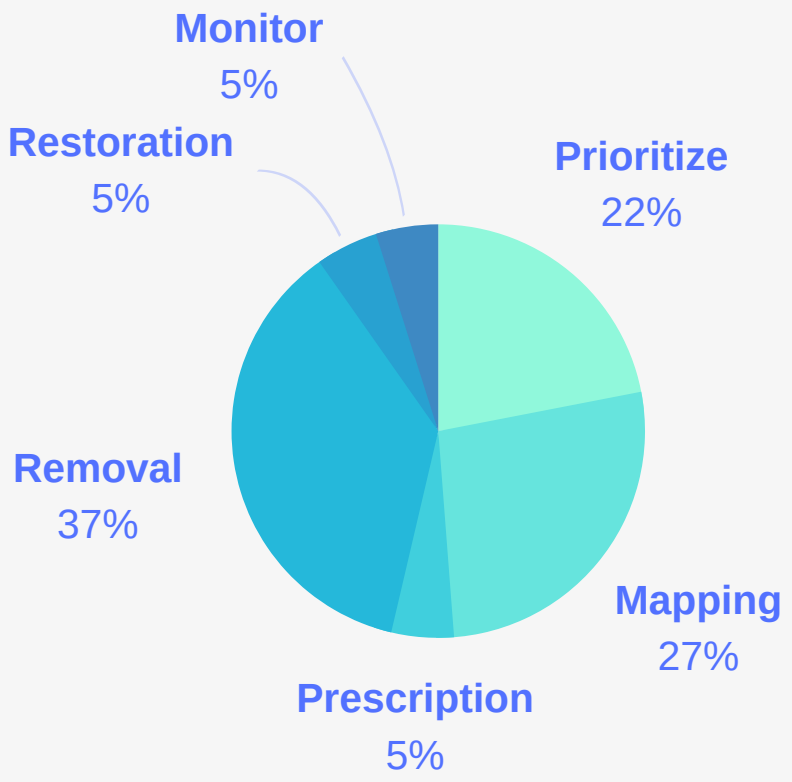
- Linville Drive
- Anderson Point
- Dr. Martin Luther King Jr. Memorial Garden
- Lions
- Walnut Creek Wetlands
- Annie Louse Wilkerson
- Hymettus Woods
- Isabella Cannon
- Jaycee
- Chavis
- Marshall Street
- Durant Nature Preserve
- Horseshoe Farm
- Mount Hope
- Rose Garden

5. RESTORE

- Cowper Drive
- Fallon

6. MONITOR

- Magnolia Cottage
- Poplar Street



*Percentages based on 41 labeled parks

**A list of parks and comments can be found as an appendix

RECLAIMING A PARK

COWPER DRIVE

This timeline illustrates a case study at one of the Big Four parks, from identification and prioritization to restoration and maintenance.

Prioritize
2007 - 2009

1. July 2007: Staff effort to control invasive plants began on limited basis.
2. March 2009: Site identified by neighbors as needing more attention.

Map
2009 - 2010

3. March 2009: Staff conducts walk-through to identify native and invasive species in park.
4. August 2010: GIS mapping begins and continues to the present.

Prescribe
2009 - 2010

5. March 2009-August 2010: Neighbors and staff meet to recommend options based on the availability of staff and volunteers and the level and type of infestation.

Remove
2010 - Present

6. Winter 2010-present: Staff performs tasks not suitable for volunteers, such as using chainsaws.
7. October 2011-present: Individual volunteers and community groups from throughout Raleigh participate in removal of invasives.

Prioritize
2015 - 2017

8. September 2015: City launches Invasive Species Program
9. June 2015, October 2017: GIS mapping takes place.

Restore
2015 - Present

10. November 2015-present: Restoration begins.

Remove
2015 - Present

11. Volunteer efforts to control invasive plants continue on a smaller, finely-targeted basis.

PROGRAM GOALS

The following are ongoing goals of the Invasive Species Program:

DEPLETE THE SEEDBANK

Invasive plant seeds can lie dormant in the soil after a removal project. Depleting this seedbank prevents invasives from reappearing and allows a site to move into "monitor" status. At any site where we have removed invasive plants, we seek to deplete the seedbank. This involves removing occurrences of stands rapidly and repeatedly after germination. This is most effective on annual and perennial forbs. Removing large, mature woody plants prevents the formation of seeds for the following year. This allows us to focus on smaller plants that are not mature enough to reproduce and require fewer resources to manage.

A volunteer removes bamboo (Phyllostachus aurea) at Horseshoe Farm Nature Preserve.

CREATE OPPORTUNITIES TO RECRUIT, TRAIN AND WORK WITH VOLUNTEERS

Citizen volunteers play an important role in clearing neighborhood parks on a repeated basis. Volunteers who are able to properly identify plants – not a common skill – are especially valuable. Experienced volunteers can hone their skills at identification and removal and see the satisfying results of their efforts over time.

To further this goal, the program coordinator is piloting a site-specific program recurring throughout fall 2018 and spring 2019 at Green Road Park, home to valuable forest. The Police Department has received citizen complaints about illegal dumping and plant overgrowth screening possible criminal activity. The pilot program directly involves the surrounding community in six invasive removal projects, furthering education efforts and neighborhood participation in the park. This model has been successful for other communities, and our partners are sharing lessons from their experiences.

PROGRAM GOALS CONT.

Volunteers remove porcelainberry (Ampelopsis brevipedunculata) at Dorothea Dix Park.

COLLECT MORE COMPLETE, SYSTEMWIDE DATA FOR MAPPING/TRACKING

Keeping live data will allow us to more fully understand the scope of the infestations in Raleigh. We will be able to track the spread of invasives and monitor our control efforts. Having this data will also help us allocate resources appropriately.

CHALLENGES

LIMITED RESOURCES

With limited staffing and equipment of its own, the Invasive Species Program relies on the support of Parks Maintenance and Natural Resources for aerial lifts and other equipment, ATVs and trailers when they are not otherwise in use. The program coordinator has a pickup and backpack/handheld sprayers with which to manage small areas.
Other department staff serve as spotters for herbicide applications, per department policy.
Personnel from a parks district crew are assigned to work with the coordinator as needed, removing them from normal duty. The coordinator also depends on Parks Maintenance and Natural Resources to provide staff for weekend and after-hours volunteer projects.
Current staffing levels limit the number of volunteer projects the program is able to conduct.

Workers remove white mulberry (Morus alba) at the Falls canoe launch.

SAFETY

Some sites are difficult to access. Many parks contain steep slopes, and slippery footing makes them hazardous for volunteers. Safety is a priority for the program. We use ropes, winches and other tools to overcome accessibility issues. We are also piloting the use of contracted support for areas deemed unsafe for staff and volunteers.

The evergreen habit and cloaking nature of invasive plants provides a screen for illicit activities, potentially putting staff and volunteers in harm's way. When hazards are identified, the Police Department ensures safety for staff and volunteers engaged in removal or treatment.

WORK SCHEDULES

Scheduling must remain flexible. Our ability to work depends on the weather. Adverse conditions can delay or cancel volunteer projects. Cleanup after major storms takes precedence over invasive management tasks.
Volunteer projects take place from September to May for safety reasons. Insects, poison ivy, and heat exhaustion are the biggest concerns for our volunteers and peak during summer. Holidays and staffing limitations restrict the number of Saturday projects we can hold. In FY18, we held Saturday morning and afternoon projects on four occasions to accommodate demand. We expect the need for Saturday projects to rise in the future.

CHALLENGES CONT.

N.C. State University volunteers remove Chinese privet (Ligustrum sinensis) at Walnut Creek Wetland Park.

MAINTENANCE

Control of invasives does not end when a site is cleared. Plants migrate as wind, water, animals and humans disperse propagules. If an area has had an infestation for many years, it will require many years to reduce the extent of invasives to an acceptable threshold. Logistics and implementation of management plans require staff with special training. This is a different skill set from the Horticultural staff's general knowledge of landscape and maintenance. Once a threshold has been reached, a site requires inspection and appropriate maintenance by competent staff in perpetuity.

NEIGHBORING PROPERTIES

Because plants do not recognize property boundaries, they easily move from neighboring areas via seed, cutting or illegal dumping. Native seedbanks in neighborhood parks suffer from suffocation by leaves, trash and debris. This material often carries invasive plant propagules from neighboring yards or properties. This is a continuing issue for the program.

A New Mind employee removes English ivy (Hedera helix) at Jaycee Park.

FUTURE PRACTICES

The Invasive Species Program is developing practices to aid in defending our parks from invasive plants in the future. Some of these practices may include:

- Funding the removal and management of invasive species upon acquisition of parks and greenways. This would occur prior to or in conjunction with the master plan process.

- Developing management guidelines to ensure continuing and consistent practices systemwide.

- Requiring contractors to provide landscape management plans that address invasive species and are suitable for current staffing resources.

- Developing a business plan that identifies priorities, goals, action items and key performance measures for Phase 2 of the Invasive Species Program.

COST OF DOING NOTHING

The City relies on its reputation as a "park with a City in it." to entice businesses and workers, This is a vital issue for all our citizens. There is a public demand for, and much international research about, the value of urban forests and trees. Much of the research has been devoted to the human health value of these critical infrastructure components. Trees sequester carbon, reduce harmful storm water effects, decrease crime rates, cool urban areas and help preserve built infrastructure, among other benefits.7 Our forests are also habitats for urban wildlife and other native, beneficial plant species. Using three separate valuation tools (iTree, USDAFS & COR UF tree replacement), the monetary value of Raleigh's forests ranges from ~$164,000,000 to greater than $3 billion.8 As our mature tree canopy fails due to disease, pests, lightning, or storm damage the invasive plants will quickly dominate. This will create a low wall of impenetrable vegetation that will quickly become the landscape of the City of Oaks.Without maintenance and care for our wild spaces, our forests will be gone in one generation.

Simply put, if we do nothing, we stand to lose everything.

Lack of light to the forest floor will eliminate native tree seed germination and our native tree species will be unable to compete with this invasion. Our forests do not have the ability to regenerate naturally if in contest with invasive plants. Raleigh will lose its forests. This problem requires immediate attention. The more resources added to this issue now will reduce losses, costs and hazards in the future. Based on current US Forest Service projections, the only trees remaining in Raleigh will be lining the streets.

Removing invasive plants helps preserve habitat for wildlife like this marbled salamander at Walnut Creek Wetland Park

FOOTNOTES

FOOTNOTE 1 Causes and Consequences of Invasive Plants in Wetlands: Opportunities, Opportunists, and Outcomes
Joy B. Zedler &Suzanne Kercher 2010

FOOTNOTE 2 The Invasion of Southern Forests by Nonnative Plants: Current and Future Occupation, with Impacts, Management Strategies, and Mitigation Approaches
James H. Miller, Dawn Lemke, and John Coulston

FOOTNOTE 3 Value, Benefits, and Costs of Urban Trees
Brian Kane, Assistant Professor, University of Massachusetts, Amherst
Jeff Kirwan, Extension Forestry Specialist, Virginia Tech

FOOTNOTE 4 Invasive Plants Found in North Carolina's Forests, 2010 Forest Inventory & Analysis Factsheet Christopher M. Oswalt and Sonja N. Oswalt
https://www.srs.fs.usda.gov/pubs/su/su_srs100.pdf

FOOTNOTE 5 Ecological, social and infrastructure benefits calculated at $185,552,837.71 iTree
Timber value by acre ($1800/acre) calculated at $164,505,600.00 USDAFS
Tree replacement cost ($700.00/tree) calculated at $3,427,200,200 COR UF

• Estimates (excepting iTree which utilizes satellite sampling) assuming 40-60 trees/acre; based on 50 trees/acre based on USDA FS averages for NC native piedmont forest

FOOTNOTE 6 The Cost of Invasive Species
US Fish and Wildlife Service 2005

FOOTNOTE 7 https://definitions.uslegal.com/p/passive-recreation-area/

FOOTNOTE 8 NC Native Plant Society Invasive Exotic Species List
https://ncwildflower.org/plant_galleries/invasives_list

APPENDIX A

Phase		
Prioritize		
mapping		
prescription		
removal		
restoration		
monitor		

District 1	Park	Invasives found	Notes
39.02	Biltmore Hills	1,2,3,4,6,9,10,18,19,46,53	could be salvaged
0.3	Bragg St. Mini Park	N/A	
0.55	Caraleigh Mini Park	N/A	
	Carolina Pines Dog Park	N/A	
38.71	Carolina Pines Park		
6.24	Eliza Pool	N/A	
0.32	Hertford Village	N/A	
5.19	Kaplan Dr. Park	3,6,8,9,10,18,42,45,46,47,49	some mapping done with ADHS
14.63	Kentwood Park	3,9,38,39,40,41,42,43,45,46	
4.18	Kingwood Forest		
33.98	Lake Johnson Pool	10,19,34	efforts to control invasives beginning
471.97	Lake Johnson Waterfront		
866.28	Lake Wheeler Park	1,3,5,23	could be considered
0.3	Lee St. Mini Park	N/A	
4.85	Linville Dr.	3,4,9,19,43,45,46,47	active AAP group
13.75	Magnolia Cottage	1,18,45,	valuable native habitat
8.32	Method Rd. Park	N/A	
0.88	Method Road Warehouse	8,23	
6.96	Peach Road		
8.64	Powell Drive	3,5,9,10,23,42,47,53	some mapping done by intern
25.39	Sanderford Road		
2.45	Sierra Dr. Park	2.52	
8.84	Southgate		
0.37	Spring Park		
District 2	**Park**		
89.57	Anderson Point	1,6,7,18,19,23,28	efforts ongoing 2014
4.26	Apollo Heights	N/A	
54.47	Barwell Rd		
	Birch Ridge/Middle Branch		
0.17	Boundary		
	Dacien Rd		
	Donald Ross	N/A	
2.38	Dr. Martin Luther King Jr Memorial Garden	8	kudzu; anticipate 3 additional years
	Fisher St Mini	N/A	
	Green Park		
	King Charles at New Bern		
41.41	Lions	1,2,3,4,5,7,10,11,12,18,23	efforts begun fall 2015

APPENDIX A

	Lockwood Mini		
6.91	Longview Pool		
	MLK Blvd.		
12.72	Oakwood	3,19	
0.09	Pender/Carver	N/A	
6.1	Poole Rd Property		
2.94	Shannon St		
	Sherrybrook		
19.98	Sunnybrook Property		almost pristine undeveloped property
58	Walnut Creek Wetland Center	1,2,3,4,5,6,7,8,9,10,12,14,16,18,19,20,22,23,24,48,50	efforts ongoing 2011
36.14	Worthdale	1,2,3,5,18,23	efforts begun fall 2018
District 3	**Park**		
157.6	Annie Louse Wilkerson	1,5,11,20,29,42,45	efforts ongoing 2015
50.16	Baileywick	5,8,18	
9.98	Brier Creek Park	N/A	
25.92	Brookhaven Park	3,23	reasonable to expect monitor status in 2 years
38.49	Cedar Hills		very good native habitat
25.27	Eastgate		
29.99	Honeycutt Park	8	
51.99	Lake Lynn		
57.63	Leesville Rd Park		
69.53	Millbrook		very good native habitat
48.66	Mt. Herman		
31.92	North Hills		
30.72	Optimist		
144.8	Shelley-Sertoma	1,3,5,23	could be salvaged
36.1	Strickland Rd Park		
8.71	Williams		
0.05	Wingate Circle	N/A	
20.5	Wooten Meadows	3,6,7,12,18,20,23,26,35,45,48,53	new development will bring issues
District 4	**Park**		
	Alexander		
	Ann St		
1.17	Barmettler	1,2,3,6,7,12,14,18	
0.71	Beckana/Dade		
1.44	Chamberlain	N/A	
1.02	Charlotte Hilton Green		
	Chester & Oberlin		

APPENDIX A

11.52	Claremont		PU project
0.71	6 Oaks Park	N/A	
0.46	Compiegne	N/A	
3.86	Cowper Drive Park	2,3,4,5,6,7,9,12,14,15,16,18,19,20,22,23,25,26,32,33,35,45,48,53	BIG 4
	Drewry Hills		
	Drewry Hills #2		
	East & West Gardner Street		
2.94	Edna Metz Wells	2,3,4,5,6,7,8,9,10,12,14,18,19,23,25,26,33,35,45,46,48,53	mapping with Exploris
	Faircloth & Hillsborough		
10.33	Fallon	2,3,4,5,6,7,9,10,12,14,18,19,23,25,26,33,35,45,46,48,53	BIG 4
1.85	Forest	2,3,4,5,6,7,9,10,12,14,18,19,23,25,26,33,35,45,46,48,53	mapping with Exploris
21.36	Fred Fletcher		
0.65	Furches		
20.41	Glen Eden	1,2,3,6,7,8,9,10,19,23	could be salvaged
	Glenwood & Wake		
	Harvey & Carr		
	Harvey & Jarvis		
4.49	Hymettus Woods		efforts ongoing 2008
3.53	Isabella Cannon	1,3,10,12,23	
24.85	Jaycee	1,3,6,8,14,18,23,25,33,34,35	
1.34	Kimbrough	N/A	
29.5	Kiwanis		
1.97	Latta Property	N/A	
48.18	Laurel Hills		could be salvaged
	Lt. Col. George F. Marshall Memorial Park	8,	
	Mayview	N/A	
	Nobel St		
	Oxford		
	Pasquotank & Granville		
0.66	Pollock		
6.78	Ridge Road	1,3,7,8,23	
1.62	Roanoke	N/A	
6.74	Rothgeb		
2.12	Smallwood	8,	
	Varnell		
	West & Peace (SAM)		
	West Lake		
	West Park	N/A	
	Williamson & Iredell		

APPENDIX A

4.41	Windemere Beaver Dam	2,3,4,6,8,9,10,12,14,15,16,18,19,23,25,26,27,33,36,45,46,48	AAP individual mapping
CBD	Park		
	A, B, D Parking Lot	N/A	
	CBD Fence lot	N/A	
	CBD trees	N/A	
28.87	Chavis Park	3,5,6,7,9,12,14,16,18,19,23,37	efforts ongoing 2013
	Chavis Way	N/A	
	City Plaza	N/A	
	Davie St Mini Park	N/A	
	DECPA	N/A	
	Dillon Building	N/A	
	Exchange Plaza	N/A	
	Fayetteville St	N/A	
4.7	Halifax	New landscape	
	John Winters		
	Lane St Mini Park	N/A	
0.21	Lenoir St Mini Park	N/A	
	Market Plaza	N/A	
1.1	Marshall St (SAM)	1,2,3,5,6,7,9,10,12,14,16,18,19,23,25,26,30,33,35,36,45,46	BIG 4
	Mcdowell and South corner beds	N/A	
	Mcdowell/Dawson North		
	Moore Square	N/A	
	Mordecai Historic Park	N/A	
	Mordecai Mini Park	N/A	
	Mordecai Springs Park		
	Municipal Building	37,53	
	Nash Square	N/A	
	Oakwood Commons	N/A	
	Pope House	N/A	
0.97	Poplar St (SAM)	1,2,3,5,6,7,9,10,12,14,16,18,19,23,25,26,30,33,35,36,45,46	adjacent to Marshall
	Quarry St Mini Park	3,6	
	Raleigh Convention Center	N/A	
	RCC Parking Deck	N/A	
	Red Hat Amphitheatre	N/A	
7.2	Roberts	14,35	
	Salisbury St gravel lot	N/A	
	St. Monicas	N/A	
	Tarboro Road	N/A	

APPENDIX A

	Top Green	N/A	
	Tucker House	N/A	
	Vallie Henderson Park	N/A	
District 6	Park		
100.36	Alvis Farm		
7.8	Berkshire Downs		could be salvaged
19.2	Brentwood		
	Buffalo Rd Aquatic Center		
	Buffalo Rd Athletic Park		
237	Durant Nature Preserve	1,5,8,14,18,24	efforts ongoing
587	Forest Ridge/Fall of Neuse	1,3,5,21,50	
	Forestville Property		
29	Green Road	1,3,4,6,7,18,19	efforts begun spring 2018
16.9	Hill Street Park		
146	Horseshoe Farm	13,23,50	efforts ongoing 2015
27.25	Kyle Drive		
	Leonard Property		
	Marsh Creek Maintenance Facility		
	Marsh Creek Park		
	Milburnie East		
63.73	Milburnie West		
21.8	Spring Forest Road Park		
	Thornton Rd		
38.22	Watkins Property		
Cemeteries	Cemetery		
28.58	Mount Hope		efforts ongoing 2016
	City	N/A	
	O'Rorke	N/A	
	Dorothea Dix		
	Other small sites		
Pullen	Park		
75.6	Pullen South	N/A	
	Pullen North	8	
6.6	Rose Garden	1,3,4,6,7,13	efforts ongoing 2016
~300	Dorothea Dix		very bad

APPENDIX A

Ballfield	**Park**		
	BRAP	N/A	
	WCSBC	N/A	
	All other athletic fields	N/A	
Greenways			
	Corridors		
	Abbott's Creek - Falls River Ave. Conn.		
	Abbott's Creek		
	Baileywick		
	Barmettler		
	Beaver Dam		
	Birch Ridge Conn.		
	Crabtree Creek - Oak Park Seg.		
	Crabtree Creek - Crabtree Valley Seg.		
	Crabtree Creek - Alleghany Seg.		
	Crabtree Creek - North Hills Conn.		
	Crabtree Creek - Fallon Creek Seg.		
	Crabtree Creek - Kiwanis Park Conn.		
	Crabtree Creek - Middle Crabtree Creek Seg.		
	Crabtree Creek - Buckeye Seg.		
	East Fork Mine Creek - Bent Creek Seg.		
	Edwards Mill		
	Gardner Street		
	Hare Snipe Creek		
	Honeycutt Creek		
	House Creek		
	House Creek - Wade Ave. Conn.		
	Lake Johnson		

APPENDIX A

	Lake Johnson - Lake Dam Parking		
	Lake Lynn	8, 13, 16, 18	
	Lassiter Mill Park		
	Little Rock		
	Longstreet Dr.		
	Marsh Creek - Brentwood Seg.		
	Mine Creek - Inman Connector		
	Mine Creek - Ironwood Seg.		
	Mine Creek - North Hills Dr. Conn.		
	Mine Creek - Lake Park Connector		
	Mine Creek - Sawmill Segment		
	Neuse River		
	Neuse River - Falls Canoe Launch		
	Neuse River - Falls River Conn.		
	Neuse River - Bedfordtown Conn.		
	Neuse River - Thornton Rd. Conn.		
	Neuse River - Wake Forest Conn.		
	Conn.		
	Neuse River - Horsesoe Farm Conn.		
	Neuse River - Trailhead Conn.		
	Neuse River - Buffaloe Canoe Launch		
	Neuse River - BRAP Conn.		
	Neuse River - Abington Ln. Conn.		
	Neuse River - Milburnie Park Conn.		
	Neuse River - Milburnie Canoe Launch		
	Conn.		
	Neuse River - Poole Rd. Conn.		

APPENDIX A

	Neuse River - Auburn-Knightdale Rd. Conn.		
	Neuse River - Mial Pantation Rd. Conn.		
	Reedy Creek		
	Richland Creek - Loblolly Seg.		
	Conn.		
	Rocky Branch		efforts ongoing 2013
	Shelley Lake		
	Simm's Branch - Durant Seg.		
	Snelling Branch		
	Wakefield		
	Walnut Creek		
SAM			
	Medowbrook (Norris Street)		
	Rose Lane GWY		
	Parnell St.		
	Riverview Rd. off Poole Rd GWY		
	Idolbrook GWY		
	Pollock Place D-4		
	Furches St. & Faircloth		
	Hymettus Woods D-4		
	Varnell D-4		
	Bacanna Open Space (Dade D 4)		
	Yadkin Dr (addedback 10/17/2017)		
	Culpepper Cirlce		
	2017)		
	1213 N King Charles		
	1000 Glasscock St		
	New Bern Place		
	Six Oaks Park(Pollock and Taylor)		
	Mayview		
	Chester and Oberlin		

APPENDIX A

	Glenwwod and Crabtree View (Waynes Corner)		
	Marshall St		
	Poplar St		
	Longstreet		
	Winthrop and Sleepy Hollow		
	Crabtree Blvd GWY		
	Beaver Dam Rd.		
	Barmettler St.		
	Westborough Dr GWY		
	Coronado Dr GWY		
	Perry Creek Rd GWY		
Revision	2/11/05, 3/23/2005, 6/27/14, 6/10/15, 11/12/15, 6/13/17, 9/10/18		

Stopping invasive plants at Worthdale Park.

APPENDIX B

PRCR SYSTEM PLAN (2014) SECTION 4.3.3. (NATURAL ENVIRONMENTS)

Goal 1: The City of Raleigh will continue to expand residents' awareness of the environmental, economic and social benefits of natural areas.

Objective A: Foster a culture of thinking and acting within a broad regional ecological framework.

-Action Item 1: Promote and deliver youth and adult education on the values of natural environments.

Objective B: Identify and cultivate planning partnerships among the spectrum of agencies and organizations with similar goals and ecological jurisdictions.

Objective C: Promote education and awareness of ecological benefits of natural areas, floodplains, watershed preservation, and ecological conservation.

Goal 2: The City of Raleigh will continue to protect, enhance, and expand natural environment areas.

Objective A: Continue to provide stewardship of natural environments, ecological systems and local watersheds through best management practices.

-Action Item 1: Develop site specific management plans that include inventory of natural assets and guidelines for park or natural area use.

-Action Item 2: Recruit and coordinate research of evidence-based conservation best practices.

-Action Item 3: Research, establish and operationalize best management practice standards relative to

s Updated (2017 Draft) 2030 Comprehensive Plan for the City of Raleigh

Section 5.2 Design with Nature

As the capital city of North Carolina, Raleigh should aspire to conserve, preserve, and restore the natural resources that define the City's "sense of place." The design of the City should reflect Raleigh's commitment to protect and enhance its natural resources and environment. Designing with nature is a commitment to understanding the ecological significance of place and to grow the community in a manner that both respects and leverages the benefits of natural resources.

Section 5.2: Policy EP 2.1 Natural Resource Protection

Ensure protection of Raleigh's unique and significant natural resources – its natural areas, landscapes, and ecological systems – through best practices management, stewardship, conservation, restoration, and land use regulations.

Section 5.2: Policy EP 2.4 Scenic Vistas and Views

Protecting and create scenic vistas and views of natural landscapes and features that are important in establishing, enhancing, and protecting the visual character of the City, mindful of other goals such as preserving and enhancing the City's tree canopy.

APPENDIX B

Section 5.2: Policy EP 2.5 Protection of Natural Water Features

Protect, restore, and preserve rivers, streams, floodplains, and wetlands. These water bodies provide valuable stormwater and surface water management and ecological, visual, and recreational benefits.

Section 5.6 Wildlife and Habitat Protection and Preservation

Rapidly urbanizing communities such as Raleigh are in danger of losing their areas of wildlife habitat. Protecting the diversity of plant and animal species is important. Raleigh still has the opportunity to protect and enhance its wildlife habitat and a wide range of "priority species," including songbirds that are indigenous to North Carolina. "Priority species" of fish and wildlife are identified in the North Carolina Wildlife Action Plan and provide a useful resource for Raleigh's wildlife conservation efforts.

Section 5.6: Policy EP 6.2 Seasonal Pools and Streams

Protect and restore seasonal pools and intermittent streams, and their buffers that are home range/breeding habitat for water dependent species.

Section 5.6: Policy EP 6.3 Special Status Species

Place a high priority on protecting rare, threatened, and endangered species habitats and migratory corridors, as defined by Federal and State agencies, from development and its impacts through methods such as land acquisition, park and greenway stewardship, improved development regulations, intergovernmental coordination, and mitigation.

Section 5.6: Policy EP 6.4 Biodiversity and City Park Lands

Strive to maintain and improve species diversity and populations in the parks inventory through enhanced plantings and habitat management.

Section 5.6: Action EP 6.3 Invasive Species Control

Develop a program to increase awareness of, contain, and possibly eradicate the problem of invasive plants and insects.

Section 5.9 Environmental Education, Awareness and Coordination

One of the most important efforts that the City of Raleigh should undertake to protect, conserve, and steward the environment is to offer residents access to comprehensive environmental education programs and activities.

Section 5.9: Policy EP 9.1 Environmental Education

Develop and promote permanent environmental education and interpretive facilities and programs to foster broad public awareness of environmental issues and consequences and to promote greater appreciation and stewardship of our natural resources both locally and globally.

APPENDIX B

Section 5.9: Action EP 9.1 Environmental Education Programs

Expand environmental education offerings, (including master gardener programs) at City parks including, but not limited to, Annie Louise Wilkerson Nature Preserve, Horseshoe Farm Park, Lake Johnson Park, Anderson Point Park, Durant Nature Park, and the future Raleigh and Walnut Creek parks. Promote these offerings through web sites and other correspondence with residents.

Section 5.9: Policy EP 9.3 Environmental Stewardship

Optimize the appreciation, use, and stewardship of Raleigh's natural resources including its wildlife and habitats, flora and fauna, and waterways and floodplains to foster broad public awareness of the connection between humans and nature. Enlist the support of local colleges and universities in targeted research and other projects to meet regional environmental goals.