

# **Vegetation Management on LFUCG Greenways**

## **Non-Native Species Removal and Native Species Restoration**

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## **EXECUTIVE SUMMARY**

During the 1980's, Lexington Fayette Urban County Government (LFUCG) increased its commitment to protecting environmental resources by developing an innovative greenway plan. This network of open space provides trails that link communities to natural areas and provides environmental benefits and educational and recreational opportunities. While greenway corridors provide habitat for native plant communities, they may also serve as dispersal routes for non-native species. Currently, non-native shrubs, vines, and grasses dominate while native species are scarce on Lexington's network of projected greenways.

To address these concerns, LFUCG contracted Natural Resources Conservation and Management students at UK to develop a vegetation management strategy for the city's greenways. NRC 471, the senior capstone course, addresses a complex natural resource issue each year. Students identify the scope of the problem, assess stakeholder input, research options for addressing the problem, and make recommendations to address the overall issue. This year the students focused on invasive plant management in the LFUCG Greenway system.

We assessed the magnitude of the non-native species problem, considered options for control, and identified public concerns. We quantified and prioritized the removal of the most common non-native invasive species, recommended non-native species control methods and suggested native shrubs, trees, and forbs as replacement species. The class installed a demonstration area as a tangible example of non-native species removal and native species replacement. The legal side of vegetation management was researched, as options for managing greenspaces need to take into account both private and public land and the regulations that govern both.

As part of the research process we identified and surveyed 16 key stakeholder groups and sent out 600 residential surveys. As a whole, Lexington's residential stakeholders see value in open space and have an overall awareness of non-natives but don't see them as a real threat to native plants. Based on our stakeholder assessment we targeted a specific subset of the 16 stakeholder groups for additional outreach. We created educational materials directed at gardeners, tourists, elementary school children, and community volunteer groups.

Our technical and legal recommendations for non-native removal and native alternatives will guide LFUCG's goal of having a greenway ordinance with enforceable management guidelines by 2003. The educational materials we prepared will help LFUCG distribute information on the benefits of the proposed greenway system and increase awareness of non-native threats and native species options within Lexington's greenways.

## ACKNOWLEDGEMENTS

Over the course of this project there were many times that assistance was required from people in various areas of expertise. The quality of our final product would never have reached the level we were able to attain without their assistance. We greatly appreciate all of these people taking time out of their busy schedules to assist us with this project. The following list acknowledges those who went out of their way to help us in any way that they could. Again, thank you for all of your help; we could not have done it without you.

Dr. Tom Barnes

Keith Lovan

Carey Bateman

Rob Paratley

Joyce Bender

Tim Queary

Cindy Deitz

Dr. Charles Rhoades

David Gabbard

Jill Taylor

Kate Krebs

Third Rock Consultants

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## **PROJECT TERMINOLOGY**

### **What are Greenways?**

Lexington-Fayette Urban County Government (LFUCG) Greenway Plan was first conceived in the 1980's with a proposed "ribbon park" in Lexington. The idea behind the Greenway Plan was preservation, protection, and enhancement of Fayette County's green infrastructure (K. Lovan, LFUCG Div. of Planning, pers. com.).

Greenways are connected strips of land that usually contain trails and serve as a way to link a community together in a natural setting. The LFUCG's Greenways Plan has 21 main trails and a system of secondary trails and bike routes. These trail-ways are located in natural areas, such as stream corridors, or take advantage of human created landscape features, such as abandoned railroad beds. The trails along the railroad beds will be a part of the Rails-to-Trails system, which are envisioned as a nationwide network of public trails from former rail lines (Rails to Trails Conservancy, 2002).

More specifically, greenways serve as vegetative buffers, which protect natural habitats, improve water quality, and reduce the impacts of flooding in floodplain areas. Most greenways contain trails, which enhance existing recreational opportunities, provide routes for alternative transportation, and are thought to improve the overall quality of life in the area (LFUCG website).

### **What are Native and Non-native plants?**

According to the Tennessee Natural Areas Program, "Natives are plants that evolved over geologic time and are distributed across the landscape largely in response to climatic episodes and adaptation to site conditions related to land formation." European settlement of North America resulted in the introduction of a variety of non-native plant species. Non-native plants (also known as exotic and alien) can be defined as plants that are "directly or indirectly, deliberately or accidentally introduced by human action"(Tennessee brochure). Non-native plants are not necessarily introduced from a different continent; they are considered exotic if they are not a natural element of a regional landscape (Tennessee brochure). For example, plants native to eastern North America, but non-native to western North America may become problematic if grown there.

Although many non-native plant species are harmless, some can pose a significant threat to native flora and fauna and to ecosystem functions. These plants invade native plant communities, become established and disperse, then out-compete and displace natives; these are termed "invasive". The introduction of non-natives can "cause economic or environmental harm or harm to human health" (National Agricultural Library of the U.S. Department of Agriculture, 2002). More specifically, "aggressive non-native species have displaced native plants, reduced habitat suitability for native animals, spoiled pastures for livestock, blocked forest re-growth, and clogged rivers" (Colton et al, 1998).

### **Invasive Species Management: A Federal Mandate**

Invasive species cost the United States 138 billion dollars annually, in the form of control costs and agricultural losses. Of that, 35 billion dollars are lost in battling invasive plant species (Piementel, 1999). To address the invasive species problem, former President Bill Clinton

created the U.S. Invasive Species Management Council in 1999 under the Executive Order (EO) 13112. The order addresses the need to prevent the introduction of invasive species, provide for their control, and minimize their economic, ecological, and human health impacts. The order requires that Federal agencies use relevant programs and authorities to:

- (i) prevent the introduction of invasive species;
- (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
- (iii) monitor invasive species populations accurately and reliably;
- (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
- (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species;
- (vi) promote public education on invasive species and the means to address them; and not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

The order calls for establishment of an Invasive Species Council that will provide national leadership regarding invasives and will coordinate development of a national Invasive Species Management Plan. ***The Invasive Species Management Plan will encourage planning and action at local, tribal, state, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan, in cooperation with stakeholders and existing organizations addressing invasive species*** (National Agricultural Library of the U.S. Department of Agriculture, 2002). This gives LFUCG the basis for incorporating a vegetation management plan with goals identified in the Executive Order to be implemented in the Lexington area. Such a plan will aid LFUCG in meeting several primary goals of the projected greenways, such as environmental stewardship and habitat restoration, as well as address concerns regarding the spread of invasive plant species into natural areas via greenways. The greenway system will link natural areas, where protection of native plant diversity, and subsequently ecosystem diversity, is a primary concern, with areas dominated by non-native species (i.e. urban areas). The threat of invasion of these natural areas via greenway corridors is a genuine concern to natural area land managers such as Joyce Bender of the Kentucky State Nature Preserves Commission. The combined approach of non-native species removal and native species promotion is needed to address these concerns.

## **PROJECT OBJECTIVES**

LFUCG Division of Planning has contracted the University of Kentucky Natural Resource Conservation and Management seniors to develop a vegetation management strategy for projected greenways. This multifaceted project is intended to assist LFUCG realizing the environmental goals of its greenways project. The specific goals of the project were to:

- establish standards for the assessment of non-native, invasive species along the greenways;
- prevention and control of non-native, invasive species;
- identify native replacements of invasive plants and develop recommendations as to how this can be done;
- assess community interests and recommendations for working with the public;
- develop outreach.

This project will link LFUCG's activities with the federal mandate on invasive plants (EO 13112) and will provide a local pilot study to guide future vegetation management.

## NON-NATIVE, INVASIVE PLANT SPECIES MANAGEMENT PLAN

The Vegetation Management Plan for the LFUCG Greenways establishes guidelines for non-native species assessment, control, and prevention. The goals of this plan include defining standards and producing a technical manual for removal, maintenance, and restoration of native species for LFUCG while utilizing stakeholder input. This technical manual consists of five main sections: introduction to non-native, invasive species, priority species list, selection of control methods, management timeline, and maintenance and costs of removal.

### Non-Native, Invasive Species in LFUCG Greenways

Land managers of natural areas in Fayette County define non-native, invasive plant species as those that are not native to their current habitat and cause a decline in native species by out-competing them for light and space in addition to stopping regeneration of natives in natural areas. Invasive species can cause several different changes in ecosystems:

- if they out-compete native species, the invasive species can cause local extirpation of native species, thus reducing biodiversity;
- they can cause diseases in native organisms;
- they can degrade habitats and reduce biodiversity through erosion or other means;
- they can interrupt natural processes in ecosystems, such as influencing natural fire and flood regimes.

The greenways are located in natural areas, primarily in riparian zones; however, they are currently overrun with non-native plants such as bush honeysuckle (*Lonicera maackii*, *L. morrow*, *L. tartarica*), tall fescue (*Festuca arundinacea*), and winter creeper (*Euonymus fortunei*). A vegetation survey produced for the LFUCG Greenways finds bush honeysuckle to be the dominant species found within forested areas in all surveyed greenways (Appendix A). Native seedlings or saplings that dominate the midstory of the greenways were found only at Masterson Station, where natives were planted by a community effort (Reforest the Bluegrass) (Appendix B). Fescue was found in every sample (averaging slightly less than 50% cover) and was most prevalent in both the forested areas and the areas strictly covered by grasses (Appendix B). Winter creeper made up 20% of the groundcover (Appendix B). Other non-native, invasive groundcover species of concern include garlic mustard, wild carrot, wild garlic, field garlic, musk thistle, dandelion, English plantain, and red and white clover, but these made up less than 5% of total groundcover (Appendix B).

The LFUCG Greenways will best meet their educational and environmental intentions if they support diverse native Bluegrass floral and faunal communities. Currently, they are choked with escaped non-natives, agricultural, and ornamental shrubs, vines, and grasses. There are many reasons, both environmental and economic, to invest in removal the non-native vegetation and restoration of plant species that naturally occur in the greater Bluegrass Region.

### Priority Species Identification

The non-native, invasive priority species list was created for the purpose of illustrating and prioritizing the most aggressive and abundant invasive species that inhabit Kentucky (Appendix C). Local land managers that were interviewed referenced thirteen species that they list as a high priority for removal (Appendix D). Those thirteen species that the local land managers listed are: Autumn Olive (*Elaeagnus Umbellate*), Bush Honeysuckle (*Lonicera maackii*, *L. morrow*, *L. tartarica*), Crown Vetch (*Coronilla varia*), Garlic Mustard (*Alliaria petiolata*), Japanese

Honeysuckle (*Lonicera japonica*), Japanese Stilt Grass (*Microstegium vimineum*), Multiflora Rose (*Rosa Multiflora*), Privet (*Ligustrum sinense*, *L. vulgare*), Sericea Lespedeza (*Lespedeza cuneata*), Sweet Clover (*Melilotus alba*), Tall Fescue (*Festuca arundinacea*), Tree-of-Heaven (*Ailanthus altissima*), and Winter Creeper (*Euonymus fortunei*)(Appendix D). All thirteen species referenced were categorized as being a severe threat on the Kentucky Exotic Plant Pest Council (KEPPC) list that identifies all the known non-native, invasive species in Kentucky (Appendix C). The list of Kentucky's invasive species is divided into three categories: severe threat, significant threat, and lesser threat (KEEP list). The three categories for the non-native, invasive species represent the particular species aggressive and dominating behavior. Invasive species listed as being a severe threat are notorious for dominating their inhabited landscape. Usually, the severely threatening species proliferate and grow at an alarming rate causing the displacement of native species.

During the performed vegetation field survey there were three species that were most commonly found and identified. The three species are bush honeysuckle, winter creeper, and tall fescue. The area density measurements from the field survey conclude that these three species occupy more area than any other invasive species surveyed (Appendix B).

Winter creeper  
*Euonymus fortunei*



<http://www.orst.edu/dept/ldplants/eufo4.htm>

**Tall Fescue**  
*Festuca arundinacea*

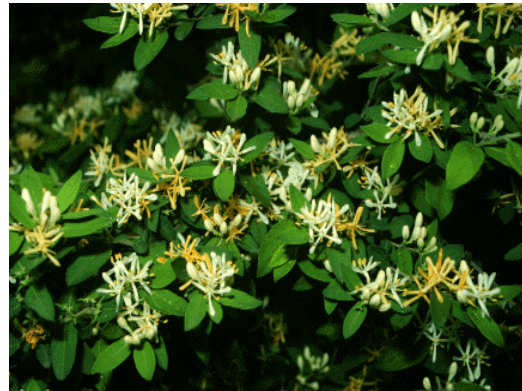


<http://www.amerigreenonline.com/tall%20fescue.htm>

**Bush Honeysuckle**  
*Lonicera maackii*, *L. morrowi*, *L. tartarica*



<http://www.nps.gov/plants/alien/fact/loni1.htm>



<http://www.inhs.uiuc.edu/chf/outreach/VMG/bhnysockl.html>

**Selection of Control Methods**

Each of the three species of concern have slightly different methods for eradication (Table 1 and 3). It is our recommendation that honeysuckle be removed using the cut stump treatment in conjunction with the herbicide, Garlon 4. Removal of euonymus is dependant upon the extent of infestation. Euonymus that is found as a ground cover is best removed using foliar spraying in conjunction with the herbicide Rodeo. Euonymus, found in the form of a vine, is best removed using cut stump treatment in conjunction with the herbicide Garlon 4. Tall fescue is removed using foliar spraying in conjunction with the herbicide, Rodeo.

**Table 1: Commonly Used Herbicides and Their Applications**

<b>Brand Name</b>	<b>Primary Application</b>	<b>Target Plants</b>	<b>Current Price*</b>
Garlon 3a	Low volume foliar, cut stump, basal spray	Woody plants, broadleaf weeds	\$65.59/ga.
Garlon 4	Low volume foliar, cut stump, injection	Woody plants, broadleaf weeds	\$83.92/ga.
Rodeo Roundup Pro	Low volume foliar, injection, and cut stump	Annual and perennial grasses, broadleaf weeds	\$45/ga. \$35/ga.
Escort	Low volume foliar	Grassy weeds, brush and broadleaf weeds	\$17.85/oz.
Transline	Low volume foliar	Broadleaf weeds	\$298.79/ga.
Plateau	Soil, low volume foliar	Noxious weeds	\$262.40/ga.

\*Prices quoted, UAP Timberland Co., April 2002 (Appendix E)

Most applications of herbicide come from the use of small hand sprayers or backpack sprayers. This forces workers to come in close contact with potentially harmful chemicals, creating environmental and personal concerns (Table 2). Proper personal protection equipment should be used where necessary (Appendix F). In most cases the label will provide the most up to date information on safe handling techniques.

**Table 2: Various Environmental and Personal Protection Concerns When Using Herbicides**

<b>Environmental Concerns</b>	<b>Personal Protection Concerns</b>
Drift can cause damage to non-target plants	Possible inhalation Possible eye irritant Possible skin absorption Possible ingestion
Leachability in soil	
Non-selective and can kill non target species	
Contamination of wetlands	
Volatilization	

**Table 3: Non-Native Control Methods**

<b>Method</b>	<b>Application</b>	<b>Tips</b>	<b>Pros</b>	<b>Cons</b>
Low and high volume foliar spray	(Low) 10-60 gal of solution/acre (High) 60-400 gal of solution/acre. Used to treat large areas of herbaceous plants or grasses.	Use of a backpack sprayer and a fan tip delivering 30 oz./minute at 10 psi is recommended.	Can treat a large area at one time.	Has the highest potential for harming non-target species.
Cut stump Treatment	Used to kill large diameter trees.	This method is only recommended on stumps that are less than one hour old.	Minimizes chemical use and potential for contamination.	Very labor intensive.
Manual/hand pulling	Used to control sprouts and seedlings.	Best method for maintenance of weed free natural areas.	Does not use chemicals.	Very time consuming.
Biological Controls	Introducing natural predators of invasive species.	Cost effective, Very risky to introduce other species. Technology not available for all species.	Can be very effective for removing invasives.	Hard to determine possible side effects of introducing another non-native species.

### **Non-Native Species Removal Timeline**

Non-native species removal efforts can be partitioned into the initial stage of intensive removal and then annual maintenance activities. Labor and equipment costs will differ among these phases. Regardless of target species, removal costs will be greatest during the initial removal effort. It is during this time that the majority of the biomass will be removed. This usually involves the use of chainsaws for multi-stem or tree species and/or large amounts of chemical herbicide for herbaceous species (Appendices E and G). The biomass can be hauled out or chipped and left on-site. Herbaceous species will be sprayed with a foliar herbicide. Vine species can be sprayed with a foliar herbicide, but often times the vine itself is so thick that it must be treated as a stump and cut, followed by basal herbicide application.

The removal process is very labor-intensive during this first season. Two to three person crews average between 0.5 to 20 acres per day removing bush honeysuckle in its first treatment. The large range in labor investment relates to varying density of the invasive shrub. This results in a large percentage of costs being incurred during the initial eradication.

Native plants should be planted as soon as possible after this initial removal is complete. Specific planting recommendations can be found in the following sections on native plant

species. These native plants provide competition for the non-natives, aiding in keeping them from returning to the greenways. Time of year should be considered, as plantings are ideal in the springtime.

After the initial eradication is complete, the non-native removal process enters its maintenance stage. Because there are no longer any large non-native plants remaining in the natural area, the use of chainsaws and/or large amounts of chemical herbicide is no longer necessary. However, to insure that native species thrive in the greenways, competition from non-native species must be controlled. For most non-native species, stump re-sprouts or new seedlings can be controlled by hand pulling, which is sufficient and efficient enough to adequately control the growth of the plants. Hand pulling is easiest in late spring before the plants go to seed but before the vegetation becomes so dense that it is too difficult with which to work.

The seeds from different species of plant remain viable in the soil for different lengths of time. This length of time, or seed bank, will determine the number of years for which management is necessary. For instance, the seeds of bush honeysuckle remain viable in the soil for up to ten years, so maintenance will be necessary on that plant species for at least that long. Most non-native plants are also capable of traveling to the greenways from neighboring lands. This presents a problem, because non-natives will continue to persist on adjacent lands even after LFUCG has removed them from the greenways. This generates the need for a management plan that will encompass private lands adjacent to the greenways.

### **Costs Associated With Non-Native Plant Eradication**

Several excellent sources of information are available regarding the costs of removing non-native plants from natural areas. Numerous consulting firms specialize in non-native plant removal, and there are a good number of them located in the Southeastern U.S. who frequently work in the Lexington area, some of which have stated interest working with LFUCG on the Greenways project. Noxious Vegetation Control Inc. (2820 Winding Creek Lane, Evansville, IN 47715, 812-471-3015) provides custom application, backpack, high-volume foliar, bare ground weed control, tractor mounted radi-arc, mowing, aerial application (helicopter) and herbicide products, surfactants and application equipment. Invasive Plant Control, Inc. (PO Box 40987 Nashville, TN 37204 1-800-449-6339) also provides similar services as well as in-depth surveying and analysis preceding their removal work.

If LFUCG determines it to be cost efficient to perform the maintenance themselves, there are several herbicide dealers in the Southeastern U.S. whose prices are all comparable. The costs incurred during the initial stages of removal will be considerable, however ongoing maintenance of the greenways in a “weed free” manner will cost relatively little.

### **Results of Greenways Vegetation Survey**

In order to fully understand the severity with which non-native vegetation has invaded current and future LFUCG Greenway areas, an initial study was conducted on five selected properties in the proposed greenways system. The information collected in this study can be used as baseline information for managing non-native vegetation throughout the greenways system. The data provides information as to the degree with which non-natives are out-competing native species and will analyze the costs and time of removing them. The survey included portions of the Wolf Run, Town Branch North, and Masterson Station greenways. One representative parcel was

surveyed in each area to produce an estimate of the dominance of non-native species in Fayette County greenways.

The survey data shows bush honeysuckle to be the dominant species found within the forested areas in all greenways surveyed. Very few native seedlings or saplings were present in the greenways. This can be seen in the absence of native hardwoods in the midstory. This is most likely caused by excessive competition with the honeysuckle, which is impeding the growth of the next generation of hardwoods. The forest canopy seems very healthy as native hardwoods dominate. This can be attributed to the inability of honeysuckle to attain canopy-level heights. If bush honeysuckle is allowed to grow unrestricted in Reforest The Bluegrass planting areas, honeysuckle will likely out-compete the natives for resources, resulting in widespread mortality. This process has been documented on several occasions in natural systems. Groundcover found in both the forested areas (when present) and further from the stream or riparian zone was also dominated by non-native species. Fescue, a non-native, was found in every sample and was the most prevalent in the forested areas and grassy areas. Forested areas refer to those lands where a diverse community of plant species, ranging from shrub and mid-story to over-story, are located together. This usually occurs in the greenways along stream corridors or buffers.

Honeysuckle ranges from a minimum of 250 plants/acre to a maximum of 1900 plants/acre (mean 785 plants/acre.) in greenways where forested areas were present. These numbers can be compared to those of the native hardwood species found within the forested areas. Hardwoods ranged from 0 to 1425 plants/acre (mean 420 plants/acre.) in greenways where forested areas were present. Fescue averaged slightly less than 50% ground coverage for all greenways surveyed. Winter creeper made up nearly 20% of total ground cover. Several other non-native groundcover species were found, though they occurred on less than 5% of the total greenway acreage.

### **Initial Removal**

The initial stages of removal involve the majority of labor, time, chemicals, and equipment needed to remove non-native vegetation. Several consulting firms offer flat fees that include all of the aforementioned inputs, and many of them guarantee their work.

**Bush Honeysuckle:** Invasive Plant Control charges \$800 to \$1000 per day to remove bush honeysuckle; this includes labor, machinery (chainsaws, gasoline, pruning shears, backpack herbicide sprayers, etc) chemical herbicides, and transportation to and from the site. The amount of treated acreage depends on the density of the target species. High densities, which average several thousand stems/acre according to Invasive Plant Control, would be ½ acre per day (\$1600 to \$2000/acre). On average densities, the two person teams can clear 10 acres (\$80 to \$100/acre); however, if the density is relatively low, 100 stems/acre or less according to Invasive Plant Control, 20 acres can be cleared in a day (\$40 to \$50/acre). The bush honeysuckle found at Floracliff Nature Sanctuary occurs at rates of one thousand to two thousand stems/acre, with a mean density of 1650 stems/acre. Land managers at this Fayette County preserve have estimated costs of removal, including labor, herbicide, gasoline, and other equipment costs, at \$375 per acre for initial removal, clearing one acre in an average of eleven hours.

**Herbaceous species:** Herbaceous species such as garlic mustard, fescue, and red and white clover, are relatively cheaper to control even during the initial stages of removal. Invasive Plant Control charges \$65 to \$80 per acre to remove herbaceous species. This is accomplished through foliar herbicide spraying and is far less time consuming. The majority of this cost is to

cover the cost of herbicide. Floracliff Nature Sanctuary is not currently eradicating herbaceous or grassy species. At Floracliff, bush honeysuckle is the priority, while herbaceous species, though invasive and destructive to the native flora, present less of a severe threat to the Preserve as a whole and therefore their removal is given a lower priority.

If LFUCG decides to use in house labor and machinery, herbicides can be purchased directly from dealers. Prices do not vary considerably from one dealer to the next, but they can fluctuate throughout the growing season. (Appendices E and G).

### **Maintenance Stage**

The maintenance stage usually begins in the second season of removal. At this point the use of chemicals and/or machinery is no longer necessary. If the initial work was performed thoroughly, hand pulling will be sufficient in keeping the non-native plants from re-infesting the greenways. Consulting firms such as Invasive Plant Control also perform hand pulling of non-natives. They charge on average \$100 per hour per person working. This covers transportation to and from the site. These prices include highly skilled labor and result in higher “per hour” costs than if LFUCG was to employ its own staff or volunteer groups to perform the hand pulling.

### **Costs to LFUCG**

According to current LFUCG computer records, the greenway system is currently made up of eighty individual greenways, totaling 2,208 acres. Of these acres, roughly 25% are forested, while the other 75% is made up only of grasses and other herbaceous species.

Bush honeysuckle, the most costly and time-consuming species to eradicate, will only be found on the 552 acres that are forested. Using the densities for bush honeysuckle observed during the greenways vegetation survey (Appendix B) and the costs of eradication obtained through current removal efforts by Invasive Plant Control and at Floracliff Nature Sanctuary as well as figures from the Furlong greenway removal effort, a high, low, and average cost estimate can be generated for removing bush honeysuckle on all of LFUCG’s current greenways. A high, low, and average cost estimate can also be obtained for removing non-native grasses and other herbaceous species on the 1,656 acres of non-forested greenways using the same methods.

The estimated cost of initial removal of bush honeysuckle and other multi-stem or tree species on all of LFUCG’s Greenways is \$55,200 (\$100/acre). This cost uses the average density of bush honeysuckle found during the greenways survey. Depending on actual density on each individual greenway, costs could be as low as \$22,080 (\$40/acre) or as high as \$207,000 (\$375/acre). The costs of initial removal of grassy species as well as other herbaceous vegetation on all of LFUCG’s Greenways ranges from \$107,640 (\$65/acre) to \$132,480 (\$80/acre). The higher amounts account for a higher density of non-native plants, as well as a higher labor and materials cost. These higher costs could possibly be due to higher paid or contracted labor, increased cost of herbicides, and/or upkeep of machinery associated with removal. The lower amounts relate to a lower estimate of non-native plant density and lower paid labor supplemented with occasional volunteer work.

Total costs for initial removal, including all inputs used in eradicating non-native trees, multi-stem trees and shrubs, and herbaceous species ranges from \$129,720 to \$339,480. A realistic estimate of aggregate costs is from \$162,840 to \$187,680. It should be noted that these cost

estimates apply to the greenways in their present state. Currently there is a wide range of non-native plant densities found on the greenways. If allowed to persist, these plant species are known to completely infest an area, producing much higher densities of non-natives, and, therefore, higher costs of removal and maintenance. Bush honeysuckle in particular, is capable of reaching densities of several thousand stems per acre in five to ten years. If initial removal efforts are delayed until this time, costs could run as high as \$1,015,680 to \$1,269,600. These costs include \$1600 to \$2000 per acre for bush honeysuckle and other tree and multi-stem species and \$80 to \$100 per acre for herbaceous and grassy species.

This initial eradication will likely take place over the course of several years, with a select set of greenways managed each year. To present these costs in a more realistic setting, costs were estimated for the Masterson Station greenways system. According to LFUCG records, there are roughly 169 acres making up this system. Using the same system of determining expenses, the cost is between \$12,464 and \$14,365 to completely eradicate non-native, invasive plants from the Masterson Station greenways.

## NATIVE SPECIES RESTORATION

Non-native management does not end with removal of the non-native plant species. Vegetation management on LFUCG Greenways must confront the combined challenge of controlling large acreages of invasive species and the overwhelming threat of reinvasion.

A traditional weed management approach that simply removes non-natives from the site may actually perpetuate site occupancy by the invading species. For example, removal efforts may stimulate non-native seed within soil seed banks and actually cause a net increase in the density of unwanted plants (Luken, 1997). More ecologically based approaches consider how natives and non-natives respond to various resource levels (i.e. light, water) or community conditions (i.e. plant density). Integrating this knowledge into management prescriptions is experimental, but may have great potential for turning the tide on non-native, invasives. If the non-natives are reproducing, then the seed bank has been filled with non-native viable seed, which will germinate when given the proper conditions.

Effective initial removal of invasive plants should combine chemical and mechanical removal methods of invasive plants, and be followed up with frequent repeat maintenance. For Lexington residents living within close proximity to greenways and stream corridors, herbicide use will probably be a point of contention (Woodall et al, 2000). In surveying neighbors at the UK Arboretum, it was found that homeowners surrounding natural areas were concerned with herbicide use, and the Arboretum has adopted an experimental approach as a result (Rhoades, 2002). In an attempt to minimize conflict, an ecological approach that both stops reinvasion and minimizes herbicide use may be advised. This approach will not completely eliminate the use of herbicides but aims to reduce it dramatically (Woodall et al, 2000). Native plants would re-establish themselves and fill the niche, which would create unfavorable conditions for invasive plants. For example, if a mid-story shrub layer was established, this would shade out honeysuckle seedlings and keep them from reestablishing.

To advance both long-term non-natives eradication efforts and restoration aims of LFUCG Greenways, we recommend establishment of dense native shrubs, trees, forbs, and grass vegetation immediately after initial non-native species removal. This approach is intended to both replace lost native species and halt reinvasion of non-natives. At sufficient densities, native species should exploit site resources to an extent that non-natives are unable to re-colonize. In Kentucky, the challenge of finding native species that can out-compete fast growing species that are both rapidly dispersed and have long-term seed banks is daunting; it may be impractical under certain conditions. One selection option might include the use of species, such as spicebush (*Lindera benzoin*), pawpaw (*Asimina triloba*), viburnum (*Viburnum spp.*), and native cane (*Arundinaria gigantea*) to replace shrub honeysuckle (*Lonicera mackii*). In order to develop self-sustaining alternatives to long-term chemical management, it will require experimental manipulation of various native and non-native species combinations.

The process of establishing native species requires a lot of specific care if it is to be done successfully. To help ensure that the proper procedures are followed, we developed a native plant technical manual (Appendix H). This manual contains instructions for assessing site conditions, species lists, site preparation detail, planting directions, and a maintenance schedule.

The best way to prevent invasion of non-native species is to not plant them in the first place. Bernheim Forest has a program that creates educational material about a 'least-wanted' plant

each year. In 2001 purple loosestrife (*Lythrum salicaria*), an invasive riparian plant, was on the least wanted list and Bernheim advocated planting native alternatives, such as great blue lobelia (*Lobelia siphilitica*), blazing star (*Liatris spicata*), and obedient plant (*Physostegia virginiana*). This idea of providing options for homeowners may have great potential for getting the idea of natives onto the larger landscape. Greenways with natives may also be able to provide a demo lot role for adjacent private lands.

### **Native Plant Restoration Issues in Lexington**

There are other issues to note in regards to the use of native plants by LFUCG. The current LFUCG planting manual contains many problematic plants and should be revised using the amended acceptable native plant species list for the removal of invasive species and the replacement with native species (Appendix I).

Another point to highlight is that there are some ways of increasing native plant availability and reducing costs. Particular greenways can be managed to produce cuttings and seed stock for further planting in the greenways. Some species are very easy to propagate using cuttings such as willow and dogwood, these mother plants can produce propagules that can be used for restoration on further greenways and they will save money.

Invasive species and native replanting should occur, however there may be limits to what can be done. We recommend that LFUCG devise a method for prioritizing restoration efforts with the available funds. This method should take into consideration factors such as locations to target, specific plant species that are more invasive than others, and types of removal methods that are more costly or labor-intensive. This information can be used to place a priority for restoration in the greenways system. This prioritization should also factor in the use of volunteers in programs similar to Reforest The Bluegrass that will increase the amount of work, and can expand the target areas and target plants.

### **Landscaping Considerations**

For an ecological approach to work, it is imperative that good planting stock be used. Larger plants, even though expensive, may be more desirable because they will have had more chance to prove their hardiness and health while giving a competitive edge to the native plant over any potential invasive plants. Bare root seedlings, plant plugs, and seeds planted at high densities may provide a lower-cost way to install plants. Using a variety of species and plant sizes also allows for greater diversity of species, greater diversity of canopy layers, and a greater likelihood of having a mix that is more resistant to plant pests.

### **Source of Plant Material**

A standard option of locating wholesale garden centers that specialize in native plants can be used to obtain plants for a native plant restoration (Appendix J) However, there are other options that LFUCG can look into. Local garden centers may be receptive to creating a special order of native plants for LFUCG. In order to do this, LFUCG will need to work with the garden center at least a year in advance so that yearly greenhouse plantings and/or stock orders can be planned according to LFUCG requests. Another possibility is to work with local land managers and set up an agreement to collect seed, dig native plants that are abundant and cut live stakes on their land. This would be most useful for specialty areas or garden plots with unique native plants, but is not practical on a large scale planting, both because it is very labor-intensive and because

there are sustainability concerns when harvesting wild plants. For the purpose of long-term implementation of natives, either on the greenways or in the entire Lexington public land system, stock plants can be cultivated to provide a future seed-base and cutting source for important native plants. LFUCG's Reforest the Bluegrass is currently developing plots of warm season grasses that will provide seeds for city greenspace projects.

**Cost**

Costs can range greatly depending on the size of the project, the amount of labor involved, the methods used, and the amount and kind of plants used. For example, planting rates can vary depending on weather, soil conditions, and if volunteers are used as opposed to trained personnel. In particular, some of the Lexington greenway sites are in areas that, during development, had topsoil removed, soil compacted, and fill material that contains rock and brick. These types of site conditions will slow planting time and decrease survival rate. In favorable conditions a trained crew of 3 people can plant 100 bare-root seedlings an hour and 150 plant plugs an hour, which includes digging holes, planting, back filling, and flagging the site (Buffer Toolkit). To give an estimate of costs, we developed two hypothetical one acre plots, one with perennials and trees and one without perennials and a denser tree spacing.

**Table 4: Tree & Perennial Planting: Estimated Installation Costs for 1 Acre of Riparian Area**

<b>Example Planting Site</b>		
<b>Trees*</b>		
Bare Root Tree Seedlings 8' x 8' spacing, 680 tree/acre		\$ 156.00
<b>Perennials*</b>		
Perennial plugs, 880 plants/acre (2' x 2' spacing in 10-25' x 25' plots)		\$ 2,838.00
<b>Labor</b>		
39 labor hours at \$8.50/hour		\$ 332.00
<b>Total</b>		<b>\$ 3,326.00</b>
*Plant Costs Based on:	Perennials	\$1.00-\$1.15 ea.
	Trees	\$0.15-\$0.30 ea.
Note: See Invasives Management Plan for Removal Costs		

**Table 5: Tree Planting: Estimated Installation Costs for 1 Acre of Riparian Area**

<b>Example Planting Site</b>		
<b>Trees*</b>		
Bare Root Tree Seedlings 6' x 6' spacing, 1210/acre		\$ 278.00
<b>Labor</b>		
36 labor hours at \$8.50/hour		\$ 306.00
<b>Total</b>		<b>\$ 584.00</b>
*Plant Costs Based on: Trees \$0.15-\$0.30 ea.		
Note: See Invasives Management Plan for Removal Costs		

**Plant Selection**

Selecting species to plant is an important step in the process of establishing vegetation. There are many factors that could be taken into consideration, one of which is the idea of what definition of 'native' to use. There are plants such as black willow (*Salix nigra*) and bald cypress (*Taxodium distichum*) that grow well in riparian areas and are native to Kentucky, but are not native to the Bluegrass Region. Native status can be defined according to whether a plant is native to a geographic region, a state, or a region within a state, such as the Bluegrass Region. The following lists contain various species of trees, shrubs, and perennials that are suitable for riparian areas and native to the local Bluegrass Region. The trees won't come in on their own or will do so slowly, unlike trees such as silver maple (*Acer saccharinum*), box elder (*Acer negundo*), and hackberry (*Celtis occidentalis*), which are self-seeders.

**Table 6: Selected Plants Suitable for Bluegrass Region Riparian Areas**

<b>Trees</b>	<b>Shrubs</b>	<b>Perennials</b>
American Sycamore	Eastern Redbud	Blazing Star
Bitternut Hickory	Hoptree	Blue Lobelia
Black Walnut	Indigo Bush	Blue Vervain
Bur Oak	Kentucky Viburnum	Cardinal Flower
Green Ash	Ninebark	Culver's Root
Shellbark Hickory	Pawpaw	Ironweed
Shumard Oak	Silky Dogwood	Monkey Flower
White Ash	Southern Arrowwood	Pink Turtlehead
White Oak	Spicebush	Swamp Milkweed
Yellowwood	Wild Hydrangea	Wild Geranium

The use of native plants in the greenways is important in order to restore lost species, ward off invasive plants, and establish a model for the community. As people seek to mimic greenway plantings, they will ask for them at their nearby garden centers and this will increase the demand for native plants. Planting natives will become more popular and will create a snowball effect

that makes using native plants more accessible to everyone and expands the reach of native plants beyond the greenway system. Furthermore, as more and more native plants are planted this will expand the range of native plants in Lexington and will also increase the spread of native plants by their own reproductive methods. When a variety of natives are planted and naturally dispersing this will not only increase the number but also the diversity of plants on the landscape.

## LEGAL RESOURCES AND RECOMMENDATIONS

By 2003, LFUCG intends to write and establish a public Greenway ordinance to provide enforceable guidelines for management of the urban open-space system. To assist with this process, we have summarized relevant local regulations pertaining to vegetation management, erosion and sediment control, and floodplain protection, as well as additional state and national standards. Portions of the following ordinances pertaining to private and public land management will provide Lexington with comprehensive guidelines to regulate greenways management:

### Primary Resources

- Planting Manual, November 30, 2000
- Storm Water Manual, November 19, 1999
- Code of Ordinances, April 19, 2001
- Zoning Ordinance, January 22, 2002

### Additional Resources

- Rails to Trails, March 2, 2002
- American Disabilities Act Accessibility Guidelines, January 1998
  - Regulatory Negotiation Committee, September 1999
  - Public Rights-of-Way Access Advisory Committee, January 2001
- Minnesota Noxious Weed Law Enforcement, January 2000
- Rural Service Area Land Management Plan, 1999

## Legal Resources

Greenways are dedicated to public use, conservation, and storm water management (ZO 23A-2 (g)). Several of the proposed LFUCG Greenways are located in floodplains; therefore, riparian vegetation for conservation and storm water management is an issue of importance. Local government legal materials were researched that addressed general vegetation management standards as well as floodplain regulations and with few modifications, these existing guidelines can be tailored specifically for greenways and included in the future greenways ordinance. Such standards refer to plant selection, maintenance and erosion control, and unacceptable plants and removal standards. Proper vegetation management with the incorporation of street trees and groundcover along greenway areas can have such benefits as a decrease in noise and air pollution, temperature reduction, erosion control, storm water management, wildlife habitat, recreational opportunities, and aesthetic enhancement (PM II A, I, J).

### Existing Local Standards

#### 1. Plant selection

1. Selection of native vegetation requirements in riparian areas: soil type and chemistry, land use, flooding periods, and stream velocity (SWM 9.2.2)
2. Only native vegetation permissible in environmentally sensitive areas (i.e. riparian and floodplain areas) (PM II, J)
3. Plant selection for erosion control: herbaceous ground cover and/or woody shrubs and trees (SWM 9.2.3)

4. Native plant species suitable: (SWM Table 9-1)
  5. Introduction to riparian buffer zones concepts and definitions (SWM 9.3.1)
  6. Riparian buffer zone plant selection by zone (SWM 9.3.2)
  7. Wildflower species selection and site selection considerations (PM VI)
2. Installation Methods and Maintenance
1. Installation methods: direct seeding, bare root seedlings, hardwood cuttings, containerized plants (SWM 9.2.3); seeding and sodding (PM IV, H)
  2. General maintenance: plant selection, quality, size methods, topsoil, staking and wrapping, mulching, pruning, natives, fertilization (PM IV)
  3. Stream bank regular maintenance (SWM 9.2.5)
  4. Riparian buffers: periodic inspections, protection, restoration (SWM 9.3.3)
  5. Stream bank stabilization:
    1. Erosion control matting or turf reinforcement used along with vegetative measures (SWM 9.2.2)
    2. Rectifying stream bank deterioration: restoration to prevent further degradation using vegetative methods and/or bioengineering techniques (SWM 9.2.1)
  5. Maintain buffer function by controlling erosion and sedimentation (SWM 9.2.3)
3. Removal and Unacceptable Plant Standards
1. Tree removal in an existing or planned greenway must be accompanied by approval from the LFUCG Urban Forester (ZO 26-6 (b))
  2. Additional Tree removal guidelines and permitting procedures (CO 17B-3, 17B-6)
  3. Damage or abuse of street trees (CO 17B-4)
  4. Kentucky 31 or tall fescue not permitted to stabilize stream banks (SWM 9.2.3)
  5. Unacceptable plant materials and growth inhibitor notes (PM VIII)

### **Additional Resources**

This section summarizes additional resources to assist in developing zoning regulations pertaining to trail design and greenway planning. The proposed LFUCG Greenways are referenced in the Lexington-Fayette County Greenway Master Plan Draft, the Rural Service Area Land Management Plan, and the Expansion Area Master Plan, and will be categorized as a *conservation* designation for future zoning purposes (E.A.P. 6.1.4).

The National Rails-To-Trails organization has standard recommendations for development of trail systems as transportation corridors. This organization's guidelines aim to manage stormwater, preserve history, protect the environment, establish wildlife habitat, and enhance community aesthetics. Their recommendations include minimum trail widths, pathway setbacks from streets and surface waters, and consideration of American Disabilities Act Accessibility Guidelines (ADAAG) (Kentucky Rails-To-Trails Conference, 2002).

Currently, there are no ADAAG specifications pertaining to trails or shared used paths; however, the U.S. Access Board, the organization charged with ADAAG implementation, appointed two committees to create trail design standards. The Regulatory Negotiation Committee drafted

recommendations for outdoor developed areas, and the Public Rights-of-Way Access Advisory Committee developed accessibility standards for sidewalks and paved trails.

### **Legal Recommendations for Greenway Vegetation Management**

This section provides recommendations for the proposed LFUCG Greenways scheduled for adoption by 2003. These recommendations pertain to the public and private land managers and the Lexington citizens involved with greenway vegetation management.

The network of LFUCG Greenways has the potential to act as a dispersal corridor for non-native species. Extant federal regulations direct eradication of non-native, pest plant species and reestablishment of native plant communities on public lands. The following ordinances provide the legal framework for enforcing non-native species management on LFUCG Greenways:

- Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990;
- Federal Noxious Weed Act of 1974;
- Endangered Species Act of 1973;
- Executive Order 13112 (1999).

Successful vegetation management, especially control of non-native, invasive plants and the establishment of native ecosystems in the greenways depends on both public and private land managers. It is important to note that the objective of these recommendations is to establish a framework that will insure both private and public sector responsibility for greenway management.

#### Public Accountability

In addition to the federal laws above, several local standards currently exist that should be utilized by the Division of Parks and Recreation and the Division of Engineering when administering greenway vegetation management species selection, planting design, and vegetation removal.

Guidelines pertaining to species selection are outlined in the LFUCG Planting Manual and Stormwater Manual. We recommend that land managers refer to the Amended Acceptable Native Plant Species list (Appendix I).

Floodplain and riparian area planting design criteria are discussed in the LFUCG Zoning Ordinance and Stormwater Manual. These recommendations insure proper revegetation to promote stream bank stabilization and flood control.

Plant removal in the greenways should follow current standards and best management practices and will require a removal plan approval by Lexington's Urban Forester. Such methods can be referenced in the local Street Tree Ordinances, Tree Protection Standards, Planting Manual, and Stormwater Manual.

### Community Oversight Program

To secure public accountability, we recommend the formation of a Community Oversight Program. This program is a response to citizens' concerns regarding public facilities and vegetation management and will provide a link between the public and LFUCG Greenways managers. The program involves a community oversight committee, modeled after the already established Greenspace Commission, but this new committee will have authority to approve plans for vegetation management on LFUCG Greenways.

The oversight program follows erosion control permitting guidelines for private development explained in the LFUCG Zoning Ordinance (Article 20). This article details the erosion control plan approval process, permitting approval process, and bond requirements for private developers typically approved by the Division of Engineering, the Planning Commission, or the Division of Building Inspection. Each plan is designed to minimize erosion and sediment pollution of surface waters and insures project completion in a timely fashion. Bond penalties are assessed to delinquent developers for permit delays and violations.

A community oversight committee must approve any plan that involves both removal and restoration of vegetation. These guidelines are necessary to ensure a minimum amount of environmental damage and community distress. Community distress can include deterioration of aesthetics, deterioration of private property due to improperly managed public land within some proximity, and deterioration of private property values as a result of improperly managed adjacent public land.

Plan extensions may be submitted and approved by the commissioned community group. If the approved plans are not completed properly according to specified guidelines within the designated time period, penalties will be assessed by the Department of Public Works (for Division of Engineering violations) or the Department of General Services (for Division of Parks and Recreation violations) with recommendations from the community oversight committee.

### Private Accountability

Private accountability will pertain to private land adjacent to the public greenways. On these properties, planting species from the thirteen high priority plants for removal list should be prohibited (Appendix D). A way to enforce private sector accountability would involve the establishment of an Invasive Species Control Program. Such a program would modify noxious weed regulations developed for agricultural land (i.e. the Minnesota Department of Agriculture's Standard Operating Procedures for Noxious Weed Law Enforcement) to suit urban landscapes.

Warnings should be issued to adjacent landowners who permit non-native plants from their property to invade the greenways. With initial warnings, LFUCG should provide landowners with technical guidance for pest plant removal. If the landowner does not eliminate invasive plants on his/her property within the specified time period, a citation will be issued. Funds generated from these citations will be utilized for invasive species removal efforts on public Greenways.

To insure that LFUCG provides adequate leadership and technical support, we suggest that this program rely on partnerships with the Fayette County Cooperative Extension Service, Conservation District, and Natural Resources Conservation Service field office.

In addition, to provide an incentive for private landowners who own land adjacent to the public greenways to landscape with native plant species, a government cost-share program, formed with cooperative partnerships with local nurseries, should be implemented to provide assistance for the purchase of native plants (Appendix I). This program will be available to adjacent landowners only.

The complete implementation of the recommendations and programs will aid the city of Lexington and the surrounding rural communities in establishing a strong framework of public and private accountability.

## STAKEHOLDER ANALYSIS

Due to the level of community involvement in this project, a stakeholder analysis was necessary to address community concerns. This gave us the opportunity to consider all individuals, communities, social groups, and organizations that may be impacted by this project or have the potential to affect the continuation of the project. The information gained from stakeholder analysis was used to make recommendations to LFUCG on how to best approach the community sector concerning vegetation management within Lexington’s greenways.

A stakeholder is any person, group, or institution that will affect or be affected by a proposed activity or decision (Rhoades). Different stakeholders have different powers and potential roles in a project. These roles must be assessed in order to ensure the success of a project.

Stakeholder analysis entails determining what benefits the stakeholder will gain from the project, the required changes the stakeholder might need to make, and the aspects of the project that could cause loss or conflict for the stakeholder. The process might also identify conflict that cannot be prevented, but must be confronted or at least acknowledged. This stakeholder analysis had three main components: stakeholder identification, categorization, and prioritization.

### Stakeholder Identification

A crucial component of stakeholder analysis is stakeholder identification. Dialogue and stakeholder participation at the early stages of project development can help reduce conflict, opposition, and increase the potential for project success. A series of questions were asked for the purpose of identifying potential stakeholders (Table 7).

**Table 7: Questions utilized in stakeholder identification.**

Identification of Stakeholders:
1. Who would benefit from the LFUCG Greenways?
2. Who is likely to benefit from the non-native, invasive species management plan?
3. Who has the potential to be adversely affected?
4. Who is likely to be voiceless?
5. Who currently has existing rights?
6. Who is likely to resist the project?
7. Of those in resistance, who is likely to mobilize against the project?
8. Who has information vital to the project?

Based on these questions, we identified the following sixteen stakeholder groups:

- LFUCG:
  - Division of Planning
  - Division of Engineering
  - Police Department
- Homeowners and landowners adjacent to the proposed greenways
- Homeowners and landowners not adjacent to the proposed greenways
- Neighborhood Associations
- Recreation businesses
- Recreation groups
- Nurseries
- Landscapers
- Academia:
  - UK Department of Forestry
  - UK Department of Horticulture
  - UK Department of Weed Science
- Primary and secondary schools
- Land managers:
  - natural areas
  - parks
- Developers/home builders
- Community groups
- Environmental groups
- Local and state tourism industry
- Pet owners

### **Stakeholder Categorization**

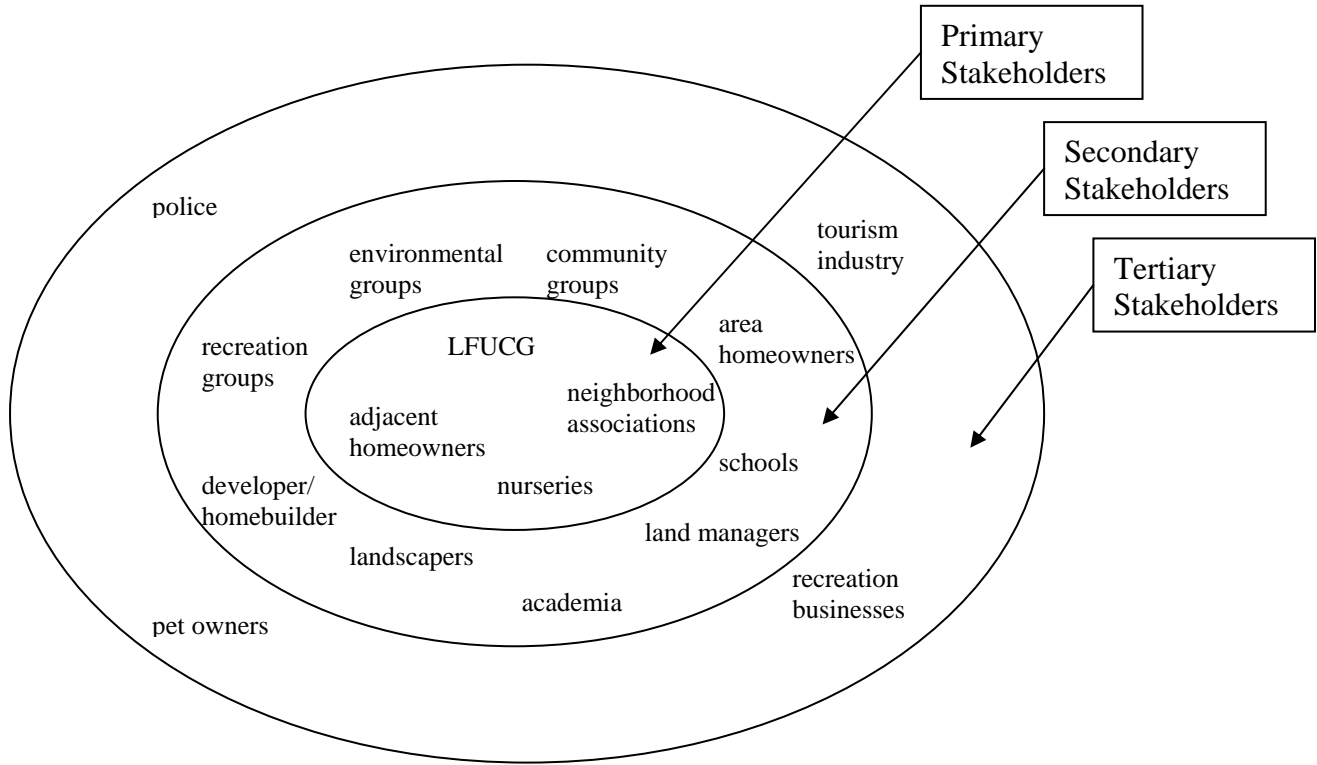
The listed stakeholders were classified into one of four categories based on their connection with greenways vegetation management: potential greenway users, businesses, political/government employees, and native species and natural areas advocates. Users include people who utilize the greenways for recreational purposes. The economic stakeholder category includes groups that have a vested financial interest in vegetation on the greenways such as nurseries and recreation oriented businesses. The advocate category consists of groups whose mission coincides with the objectives of the project such as environmental groups, as well as groups who may oppose this project, such as businesses (i.e. nurseries and landscapers) due to concerns that their business will suffer. The political/government stakeholder category includes groups that served as a resource for technical and legal information.

### **Stakeholder Prioritization**

Due to the time constraints and scope of this project, it was necessary to prioritize the identified stakeholders. In prioritizing the stakeholders, several factors were considered: the degree of stakeholder relevance to the project, stakeholder proximity to the proposed greenways, their interests regarding the success of the project, and their ability to affect the progress/outcome of

the project. Based on these criteria, the stakeholders were stratified into primary, secondary, and tertiary levels of importance (Fig. 1). Our goal was to ensure that, at a minimum, the primary and secondary stakeholders received proper representation.

**Figure 1:** Stakeholder prioritization based on the degree of importance in the implementation of native plants on LFUCG’s proposed greenways.



## NONRESIDENTIAL STAKEHOLDER RESULTS AND ANALYSIS

### Stakeholder Groups

Eleven nonresidential stakeholder groups were identified and surveyed (Table 8, Appendix K).

**Table 8: Stakeholder Groups and Number of Respondents**

<b>Stakeholder Group (number of Respondents)</b>
Garden Center/Nurseries (6)
Developers/Homebuilders (4)
Landscapers (4)
Recreation Groups (12)
Neighborhood Associations (8)
Community Groups (3)
LFUCG (1)
Environmental Organizations (4)
Formal and Non-formal Educators (11)
Tourism (2)
Land Managers (4)

### Nurseries

Six nurseries throughout the central Bluegrass Region were randomly selected from the telephone book and interviewed using surveys specifically developed for these stakeholders. Surveys were distributed personally, by phone, and by fax (Appendices K and L). Information regarding their knowledge on native, non-native, and invasive plants was requested from the nursery managers. Other information requested from nursery managers included recommendations for replacements of invasive plants and what types of plants they sell, especially any invasive plants included on Kentucky Exotic Plant Pest Council's list of most severe threats. The survey yielded information on the volume and relative percent of non-native plant sales, the number of high-risk invasive species stocked, and the overall most popular plant species. The nursery survey also included questions to provide us with information useful for educational and technical recommendations. The educational questions were included to gain a better understanding of the existing knowledge of the invasive plant issue. Each manager was asked to provide definitions of native, non-native, and invasive plants. They were also asked if the average customer understood the difference between these terms.

Few stakeholders were familiar with native replacements for non-natives. Managers indicated that if they were to carry native species they wouldn't know where to find a supplier. Garden centers generally conduct business with the same suppliers year after year and aren't aware of other options that might include a focus on native plants. In addition, managers base some of their ordering decisions on industry publications and organizations that push certain plants and gardening trends influence people to buy the newest plant varieties. For example, customers are

currently buying day lilies (*Hemerocallis* spp.), burning bush (*Euonymus alata*), and monkey grass (*Liriope spicata*). Cost is also a factor in homeowner demand, and native plants tend to be more expensive than non-native species on average. Managers also seemed to have misconceptions of the variety and hardiness of native plant options. Some of the managers interviewed felt that native species weren't as healthy as non-natives and that natives tend to be more difficult to grow and don't look as pretty as non-natives. The majority of the nursery managers surveyed could list ecological impacts invasive plants have on the environment but few believed non-natives are a problem in Kentucky.

The answers obtained from the technical questions gave an idea of what kind of plant stock the nurseries around Lexington are selling. All the nurseries sell native plants but the answers were variable (10 percent – 90 percent) for the proportion of non-native plant stock. Eight plants included in Kentucky's list of severely threatening plants can be found in many of the nurseries surveyed. This might pose a problem for control of these species if homeowners use these severely invasive plants in their gardens next to greenways.

Specialty Garden Centers were found to carry more natives than other garden centers, possibly due to a higher demand from customers who plan on spending more money on their plant purchases. Specialty garden centers also responded that they would be willing to provide native plants for LFUCG for the Greenways Master Plan if approached.

In conclusion, garden centers need to be advised about invasive species problems and given information relating to native plant alternatives and benefits. Misconceptions should be clarified and information regarding invasive plant problems could potentially influence nursery managers to stop carrying invasive plant species.

#### Developers/Homebuilders

Developer/homebuilder groups were randomly selected from the yellow pages of the Fayette County phone book. The survey for developer/homebuilder groups was distributed via fax and phone to a total of nineteen developers and homebuilders (Appendices K and L).

Of the nineteen stakeholders, 21% (4) completed the survey. The general impression of the survey results is that most homebuilders/developers are not particularly informed about the invasive plants issue. Three out of four of the stakeholders did not know what invasive species were. Those who did not know what invasive species were, thought invasive species were not a problem in Kentucky (67%). Also, three out of four respondents do not use native plants for landscaping. A comment was received that plant selection is not of particular importance in the developer/homebuilder business, therefore the overall lack of knowledge about the invasive plant issue and reluctance to receiving educational materials is to be expected.

## Landscapers

Surveys were randomly given to ten landscapers found in the phone book, as well as an interview with a personal contact. Of the ten, six of them replied (Appendices K and L).

The general impression was that local landscapers were informed about invasive plant issues in Kentucky. All of the respondents were aware about the invasive nature of non-native plants that were listed on the survey. All of the respondents voiced a genuine concern for the environment, as well as interest in promoting native species here in the Bluegrass. This gives hope that local landscapers may be convinced to gradually replace non-native plants with plants native to Kentucky. Their interest in receiving educational materials is unclear.

## Recreation Groups

Several groups were chosen from the community to represent different recreation groups. Bicycle sales and repair shops were targeted to represent bikers; gyms for those who run, walk and bike for health reasons; professional dog sitters and walkers for pet owners who would be walking their dogs; and run/walk shops for recreational runners and walkers. Each person surveyed was advised that they were chosen to represent a specific recreation group and to keep the group in mind when answering questions regarding the specific interest group (Appendices K and L).

In summary, the recreation groups were not concerned with invasive species in greenways but concerned about the appearance of the species present in the greenways, the management of the plant species once planted (i.e. trimmed bushes, manicured flower beds, etc.) and overall appearance of the greenway (litter-free). Only the several hobby-gardeners within this group expressed knowledge about plants in general and were able to distinguish between native and invasive species.

Approximately half of those surveyed were not familiar with the greenways plan. To help them understand what the greenways are to aid in answering the remaining questions, they were given an explanation and the Rails-to-Trails program was used as an example. It was discovered that most people were familiar with that program and helped to give an idea of the function of the greenways.

Most people surveyed were very receptive to the survey and willing to respond unless several customers were in the shop at the time. The majority of surveyed individuals expressed interest in receiving more information on both Lexington's greenways and invasive plants in the form of a brochure.

## Neighborhood Associations

A neighborhood association includes residents of a certain neighborhood who oversee issues and events taking place in their neighborhood. Individual residents are chosen to lead the association, and make decisions for the neighborhood. For this survey, LFUCG gave us a list of all neighborhood associations and their contacts. Associations were randomly chosen from this list, and members were surveyed (Appendices K and L). Proximity to greenways was not a

factor in the selection of those surveyed because opinions of all neighborhoods were needed, not just those of individuals living close to greenways.

One goal of this survey was to discover if the association members lived near a greenway. Another goal was to determine the level of support for greenways, and whether they would take advantage of the greenways if they were available. Other questions dealt with whether members would be concerned with specific types of vegetation, and whether they would be receptive to planting recommendations from LFUCG in their private lawns. These questions established the level of support and concerns held by the surveyed neighborhood associations.

In spite of specific concerns, there was overall support for LFUCG Greenways by neighborhood associations. Most of the data collected was positive for the project. Seventy-seven percent believed that greenways would increase their individual property values. Eighty-five percent of the associations surveyed said they would use a greenway located close to them. There was some concern property values may be degraded if crime rates rose from the presence of greenways as well as concern for increased litter in the neighborhood from users of the trail. Ninety-three percent expressed they would be conducive to suggestions by LFUCG regarding vegetation recommendations for their areas. Safety issues were a dominant concern of the neighborhood associations. Seventy-nine percent were concerned with vegetation height, expressing that low or short plants (except for trees) are recommended to be planted. Another fear was raised taxes in order to financially support the greenways.

### Community Groups

The category of community groups included the Boy Scouts, Girl Scouts, and 4-H. These organizations were chosen based on their outdoor recreational activities and volunteer potential. The survey was conducted with the idea that these specific groups would be likely to utilize the greenways (Appendix K and L).

The goals of this survey were to find if members of these community groups would be interested in volunteering for greenway maintenance projects and to reveal their level of greenway utilization.

The response of the Boy Scout representative was in favor of greenways and possibly participating in future projects. The Girl Scout representative responded that program tours and day hikes would be a favorable greenway use. Also the 4-H agent said that greenways could benefit environmental education. Based on the low response, creating a conclusion was difficult. Further analysis should be completed for community groups in order to get a more complete picture.

### LFUCG

A representative from LFUCG was surveyed for their views on greenways and vegetation management (Appendix K). They expressed that the native versus non-native issue was important but not a priority to the government. Biodiversity remains important, but more urbanized greenways did not need to be exclusively native. Non-native, ornamental plants might be suitable for these urban greenways but avoiding invasive species was crucial. They stipulated

that conservation easement greenways probably needed to be entirely composed of native species, and buffer strips were imperative along stream banks.

The representative said that the LFUCG would probably view the greenway vegetation management issue on a site-by-site basis depending on the independent variables of each area. Species recommendations including those that would work well and those that should not be planted in any situation was asked about and requested.

### Environmental Organizations

Tools used in the identification of the environmental groups included the List of Greenway Master Plan Participants provided by LFUCG, University of Kentucky's Earth Day contact list, the yellow pages and Internet search engines (Appendix K and L).

Three out of four of the environmental groups surveyed were familiar with the term non-native, invasive species and were aware that they are a problem in Lexington. The majority were also aware of LFUCG's proposed greenways and believe the greenways will play a positive role in the community. These environmental groups stressed a need to make native plants a priority in natural areas such as the greenways. In addition, they could potentially assist in educating the general public on non-native, invasive species because the majority of them participate in environmental community events. This would allow the groups to continue their efforts with their present environmental organizations, while increasing awareness of greenways. .

### Educators

Tools used in the identification of the Educators included the List of Greenway Master Plan Participants provided by LFUCG, University of Kentucky's Earth Day contact list, the yellow pages, and Internet search engines (Appendices K and L).

Twelve out of 42 surveys (29%) were returned. Of the twelve, 33% were categorized as non-formal educators (i.e. McConnell Springs, Floracliff Nature Sanctuary, and Bluegrass PRIDE) and 67% were formal educators (science teachers for grades K-6). McConnell Springs and Raven Run are areas that promote the natural diversity of Fayette County and public environmental education. Both areas include trails and nature centers. Floracliff is a private nature preserve and is not open to the public. Bluegrass PRIDE (Personal Responsibility in a Desirable Environment) is dedicated to raising awareness of environmental issues that affect the Bluegrass area including septic system grants, clean-ups, and other community environmental activities.

All educators were familiar with the terms native, non-native, and invasive species. All non-formal educators and 75% of the formal educators were familiar with LFUCG's proposed greenway plan. From the survey, 100% of non-formal educators participated in environmental community events, while only 13% of formal educators participated in such activities. Of the eight schools represented by formal educators, only one had any type of environmental club.

The educators that were surveyed all had a science background with at least a bachelor's degree or masters in an education or science field. It is apparent the terms native, non-native, and

invasive were understood. However, familiarity with non-native species and issues concerning these species vary among educators in Kentucky. The introduction of native species into the elementary education curriculum could establish a link between LFUCG's educational efforts and the goals of Fayette County Public Schools. This is pending on the adoption of the materials into the KERA curriculum and into Fayette County's CORE content requirements. This procedure would have to be explored through the Fayette County School System and the Kentucky Department of Education's requirements.

The activity book designed should incorporate greenways as a community resource for teachers to use for educational purposes. The survey addressed the greenways as possible sites for outdoor classrooms. This question resulted in mixed reviews, based on the interpretation of the greenways. Most of the educators were in support of the idea of the greenways as sites for outdoor classrooms. However, with limited knowledge of the greenways program, some did not approve of the idea.

### Tourism

Both stakeholders surveyed (the Kentucky Department of Travel and the Lexington Convention and Visitors Bureau) were familiar with the terms native, non-native, and invasive species and were aware of LFUCG's proposed greenway system (Appendices K and L). However, neither stakeholder knew if non-native, invasive species were a problem in the Lexington-Fayette County area. They both agreed that replacing non-native plants with native plants on the greenways could possibly increase local tourism. The stakeholders were uncertain whether broad promotion of native plant greenways would increase tourist visits. When asked what is the most effective way to market native species on the greenways, the Kentucky Department of Travel suggested campaigning in magazines aimed at the consumers most interested in gardening and natural habitats. The Lexington Convention and Visitors Bureau had a similar suggestion of proactive editorial marketing in specialty magazines.

It is apparent that the stakeholders understand the definitions of native, non-native, and invasive species, but are not aware that non-native, invasive species are a problem in the Lexington-Fayette County area. If out-of-state tourists are targeted through specialty publications, it is possible that we could lure them to our area by marketing the LFUCG proposed greenways as consisting of vegetation native to the central Bluegrass.

### Land Managers

All four of the land managers surveyed struggle with non-native, invasive plants in their natural areas (Appendix K and L). At Bernheim, the biggest threat to natural areas is Japanese stilt grass (*Microstegium vimineum*). Other exotics include: autumn olive, bush honeysuckle, and Japanese honeysuckle heavily invading edge areas, and tall fescue, lespedeza, crown vetch, and sweet clover invading old fields. At Floracliff, problem species are bush honeysuckle, winter creeper, Japanese honeysuckle, English ivy, privet, Japanese stilt grass, and multiflora rose. At the UK Arboretum, the problem species are bush honeysuckle (*Lonicera mackii*) and winter creeper (*Euonymus fortunei*).

The land managers had several insights into what was the best solution when managing non-native, invasives. Optimally, they would want to remove the invasive species and plant natives in their place. They want to prevent further introductions by removing existing populations of non-natives.

All four of the land managers said that, in regard to LFUCG's Greenways Plan, the removal of invasives and a vegetation management plan on a corridor trail system is VERY IMPORTANT. Carey Bateman, director of Floracliff said, "If it is going to be called a greenway, it should serve as an example of how native plants can be used as buffers, attractors of wildlife and for landscaping to generate public awareness and appreciation."

## **General Conclusions**

Several concerns were expressed repeatedly by the various stakeholder groups. These needs fall into three broad categories of greenway maintenance, technical advice, and environmental awareness.

There was a lot of concern expressed about the maintenance of the greenways for safety and appearance. Groups expressed concern about shrub height and safety. They were curious if plants not classified as trees were going to be maintained below a certain height. Groups also expressed interest in the overall appearance of the greenways including maintaining plants that were there as well as litter collection.

When surveying those who were more educated on the subject, they expressed interest in a list of recommended native plant options for central Kentucky. This request was made by several different types of groups showing that this type of information could be very useful.

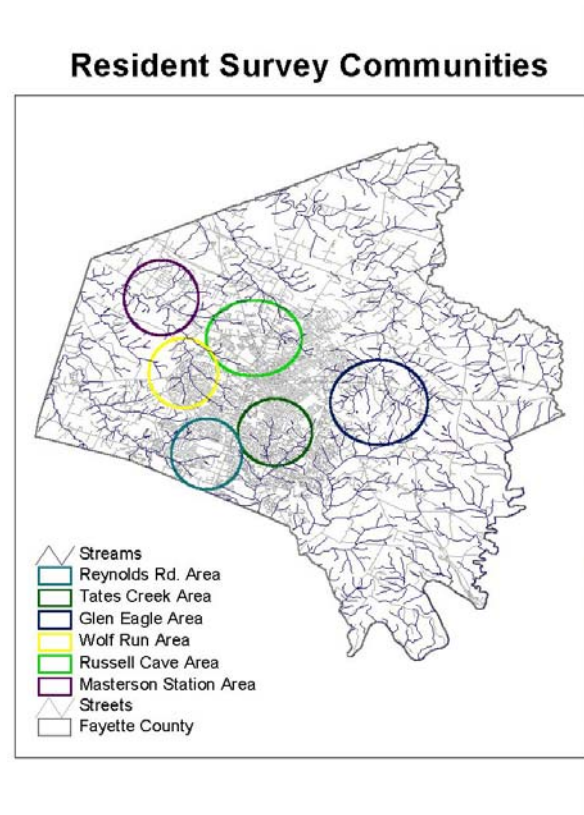
Lack of awareness of the greenways project and of the non-native vs. native plants issue seem to be an overwhelming theme in the survey results. First, education is needed to inform the public about the greenways project in Lexington. Many stakeholders weren't aware of the LFUCG Greenways project and were interested once they were told about it. Public education is needed to introduce invasive species, what they are and the problem that exists here in central Kentucky. The public needs to know what they can do about the problem once they know about it and know about native alternatives to plant. This again is where an invasive/native replacement list would be ideal.

Overall, the stakeholders responded positively and seemed receptive to information if it was available (concerning greenways and native plants). The majority of stakeholders surveyed were supportive of the idea of greenways and promotion of native species in these areas despite being unaware of what invasive species are. This positive response is encouragement to manage Lexington's greenways using native species. When invasive plants out compete natives and take over an area, a space is created for several dominant species. When natives are planted, more species can coexist and occupy their natural niche, increasing plant and wildlife biodiversity. Once this concept is conveyed to stakeholders and they see native plants in Lexington's greenways, awareness of the multiple benefits of native species will be inevitable and the negative effects of invasive species on the surrounding environment will be obvious.

## RESIDENTIAL SURVEY RESULTS AND ANALYSIS

Residential communities located in close proximity to the proposed LFUCG Greenways were identified as crucial stakeholder groups. We selected 6 communities containing greenways: the Masterson Station neighborhood (Mast), the Wolf Run area (Wolf), the Glen Eagle area (Glen), the Tates Creek/Alumni Dr. area (Tates), and the Reynolds Rd. area (Reynolds) (Fig. XX / Appendix M). In each of the 6 communities, 100 surveys were distributed that included a self-addressed, stamped envelope, an introductory letter and an informative handout describing the purpose of the survey and explanation of the proposed greenway plan (Appendices N, O, and P). The 13-question survey was designed to evaluate each resident's awareness and level of support for the greenways project, dominant concerns with greenways, opposition to LFUCG managing the greenways by replacing non-native plants with native species, and familiarity with the terms, "non-native" and "invasive," as they pertain to plant species.

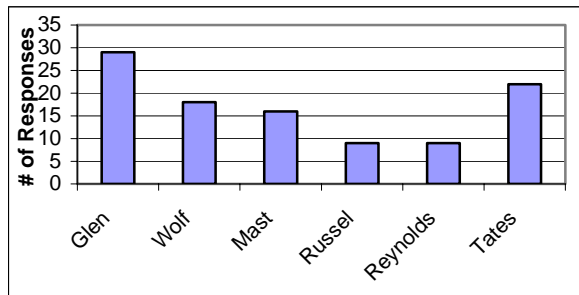
Figure XX / Appendix M.



## Residential Survey Results

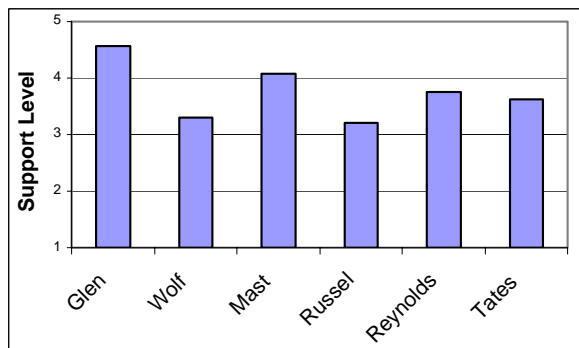
Community response varied from 9 to 29 returned surveys with an overall response rate of 16%. It is necessary to note that the distribution of completed surveys by each community was not equal, and, in some communities, the number of completed surveys more than tripled that of another community's responses (Figure 2).

**Figure 2. Survey Respondents by Community**



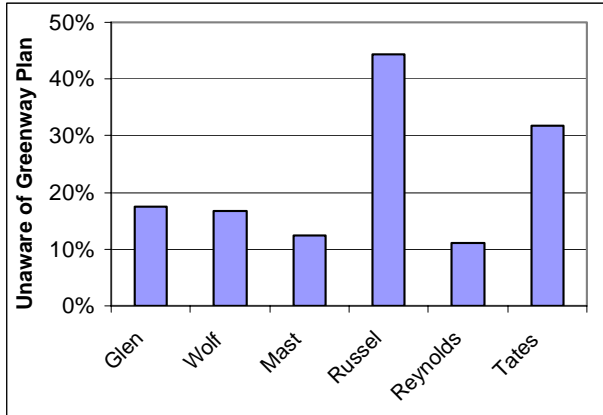
Each community was asked about their level of support for LFUCG's proposed greenways. Support was measured on a 5 point scale: 0 for unaware of the greenways plan and 5 for the highest level of support. A response of "unaware" is not a level of support and was placed into a separate category. The results show that the average levels of support from each community range from 3.2 (Russel) to 4.5 (Glen). Overall, the average level of support came to a total of 3.75 (Figure 3).

**Figure 3. Community Support for Greenways**



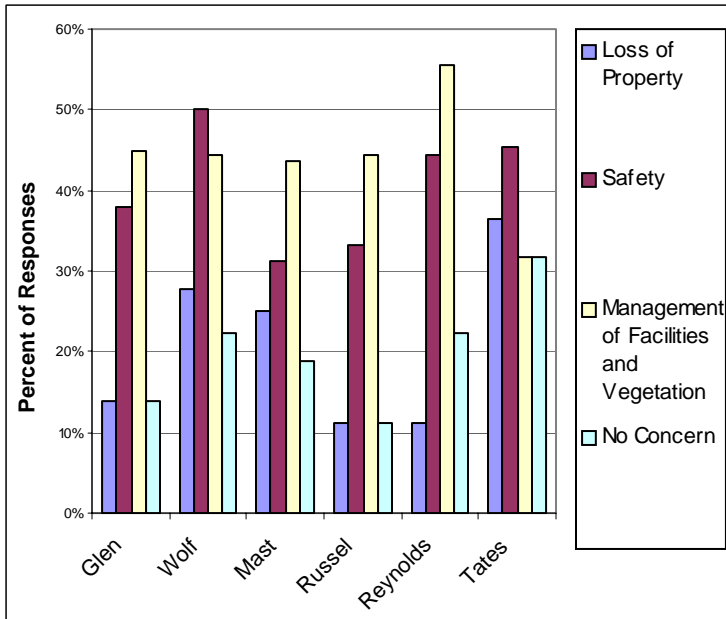
The Russel community had the highest percentage of unfamiliarity the greenways and had one of the lowest response rates (Figure 4). The average percentage of respondents in all communities that are unfamiliar with LFUCG's greenway was 22%.

**Figure 4. Degree of Unawareness of Greenways by Community**



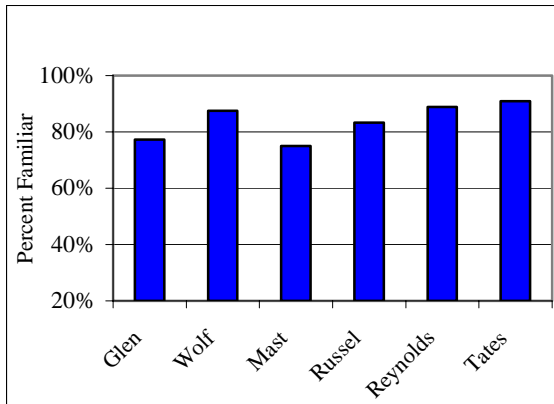
Respondents were asked what their dominant concerns were pertaining to greenways (Figure 5). This question was designed to allow respondents to select multiple concerns. The top concern listed in four of the six communities pertained to vegetation and facility management. The two remaining residential areas listed “safety” as their top concern. Comments made in the “other concerns” choice were categorized under the choices that were previously listed in the question. For example, if comments such as “...I did not know about this plan, and I don’t want the LFUCG taking my backyard from me,” were written, they were placed into the category, “loss of property.”

**Figure 5. Primary Concerns of Survey Respondents**

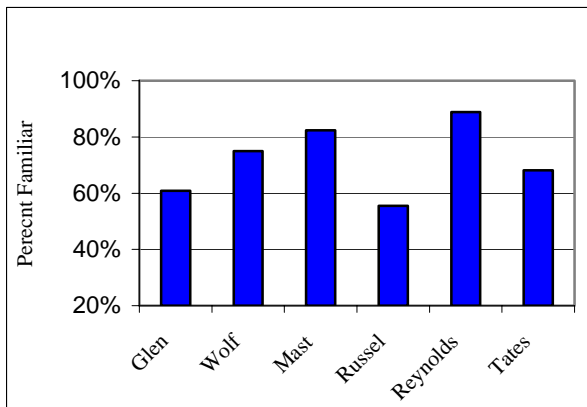


Individuals were asked if they were familiar with the terms, “non-native” and “invasive,” as they pertain to plant species. Familiarity with non-natives ranged from 75 to 91% among the communities surveyed whereas familiarity with invasive plants ranged from 56 to 89% (Figure 6 and 7). It is notable that respondents were more familiar with the more general term “non-native” than with the term “invasive” that describes the threat caused by introduced plants.

**Figure 6. Familiarity with the Term, “Non-native”**

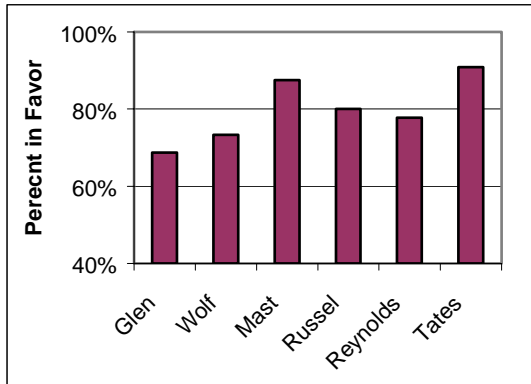


**Figure 7. Familiarity with the Term, “Invasive”**



Community residents were asked about their degree of support for LFUCG management of greenways by replacing non-natives with native plants (Figure 8). Respondents were largely in favor of non-native removal.

**Figure 8. Community Support for Non-native Removal and Native Replacement**



## **Residential Analysis and Recommendations**

### Level of Support for Greenways

Among all the communities surveyed, the **Glen Eagle** community completed the most surveys and had the highest average level of support for the proposed greenway project (Figures 2 and 3). The **Masterson Station** area provided the second highest average level of support (4.1), a particularly high result for an area that had previously exhibited some opposition toward the LFUCG Greenways project (Figure 3). The **Russell Cave** area had the lowest number of returned surveys (9%), the lowest level of support (Figure 3) and the highest degree of unawareness (Figure 4) regarding the proposed greenways project. The high degree of unawareness in **Russell Cave** (44%) indicates a clear priority for targeted education and promotion of greenways materials (i.e. youth educational materials, materials dealing with the benefits of greenways, and promotion and marketing materials for the greenways project). These particular responses signify a need for promotion of the benefits of greenways, in addition to increased communication and dialogue between LFUCG and the residents of the **Russell Cave** area.

### Understanding of ‘Non-Native’ and ‘Invasive’

As a whole, the communities had relatively high percentages of understanding the terms, non-native and invasive, when describing plants. In the **Glen Eagle** community, 77% of the respondents had an understanding of non-native plants (Figure 6). However, when asked to assess their familiarity with invasive plants, 61% of the respondents were knowledgeable (Figure 7). Of those who responded from the **Russell Cave** and **Tates Creek** areas community, over 80% had an understanding of non-native plant species, but only about half understood the term, invasive (Figures 6 and 7). These results indicate that the respondents had a general understanding that of what non-natives “are”, but perhaps less awareness of the threat that they pose to native species and communities. Educational materials focusing on invasive species and their environmental and economic impacts should be distributed to these communities.

## Support for LFUCG Management of Greenways with Native Plants

The majority of all respondents supported the notion of managing LFUCG greenways by removing non-native vegetation and establishing native plant species. Favorable support ranged from 91% in **Tate's Creek** to 69% in **Glen Eagle**. **Russell Cave** (80%), **Reynolds Rd** (78%), and **Masterson Station** (88%) had intermediate levels of support.

In addition to the low level of support for management, the **Glen Eagle** community had the second lowest understanding of the terms “invasive” and “non-native.” The **Glen Eagle** area as well as the **Wolf Run** community (second lowest percent community in favor of management with natives) could greatly benefit from educational materials focusing on the ecological degradation of invasive, non-natives as well as the environmental enhancements that may result from native vegetation management. While support at **Masterson Station** was high, the respondents were concerned with how management is performed (Figure 4). This indicates a need to promote confidence that LFUCG (Division of Parks and Recreation and Division of Engineering) can manage the greenways to this community's satisfaction.

## Primary Concerns

It was illustrated through the survey process that all communities feel some apprehension toward the management aspect of the proposed greenways. Where management of facilities and vegetation was not chosen as a top concern, safety was.

The top concern at **Glen Eagle** related to management of facilities and vegetation. **Reynolds Road** community had the highest percentage of all communities concerned with management (Figure 4); therefore, there is a need in this community for promotion of the local government's ability to manage the area satisfactorily. The low return from this community along with their average level of support for Greenways may indicate a lack of awareness; education should be targeted on promoting the advantages of greenways. **Tates Creek** area's top-ranked concern was safety, and their second was loss of property (Figure 4). The **Tates Creek** area had the highest level of concern with loss of property. It is recommended that LFUCG work with this community to design a neighborhood greenway that will give these residents a sense of safety and privacy. **Wolf Run's** first concern was safety, and their second was management of facilities and vegetation (Figure 4). In order to educate this community about security issues in greenways, materials addressing crime statistics and other safety issues from various greenway communities should be researched and distributed to **Wolf Run** residents. Interestingly, **Masterson Station** ranked loss of personal property as their third concern (safety being the second); therefore, the issue of property was not as prominent of a concern as previously perceived.

## Recommendations for LFUCG

The survey results indicated a need for targeted information focusing on different aspects of greenways and vegetation management for each community. Our outreach materials were targeted to fulfill this need. While all communities will benefit from increased awareness, based on the survey responses, the **Russell Cave, Tates Creek, and Glen Eagle** areas should be prioritized for outreach activities and information campaigns regarding the proposed greenways plan.

To address citizen concerns regarding greenways management, LFUCG should highlight their technical abilities and their concern for safety and the environment. The local government should promote their past and current successes with community-based projects (i.e. Reforest the Bluegrass) in these areas, and focus on implementation of projects within these communities.

To address safety concerns, LFUCG should develop materials that reference the successes of other greenway communities and offer crime information about those communities to the areas of Fayette county that are the most concerned about safety.

## DEMONSTRATION AREA

### Background

The location chosen for the demonstration area was an older neighborhood, situated in a floodplain along Wolf Run Creek at Furlong Drive. LFUCG has bought several residential properties within the floodplain and demolished those houses. This area was a prime candidate for a demonstration due to its infestation with invasive non-natives. Bush honeysuckle (*Lonicera maackii*) had a density of 775 stems/acre (~111 stems in the plot); winter creeper (*Euonymus fortunei*) and garlic mustard (*Alliaria petiolata*) both accounted for almost 25% each of the groundcover, dominating the herbaceous layer.

### Objective

The purpose of the demonstration area was to test the recommended vegetation management that is recommended. As many invasive species as possible were removed and replanted with native tree species according to the national Rails-to-Trails standards. The invasive species removed include bush honeysuckle, garlic mustard, and winter creeper. The native tree and shrub species planted were pawpaw (*Asimina triloba*), spicebush (*Lindera benzoin*), eastern redbud (*Cercis canadensis*), silky dogwood (*Cornus obliqua*), and wild plum (*Prunus americana*).

### Design

The design of the native species planting was complicated by poor, compacted soil. Because the area previously contained houses, there was heavy grading and debris (i.e. bricks, concrete blocks) from demolition, which results in poor planting site conditions. Originally, the planting layout for the demonstration plot included wildflower gardens, and was only (40' x 40') 1600 square feet. The cost of three 3' x 7' wildflower beds would have cost \$500. The lack of funding for this project forced the exclusion of wildflowers from the plan. However, because the tree and shrub seedlings that were donated, the size of the demonstration plot design was increased to (250' x 25') 6250 square feet.

The species planted were all small trees and shrubs. Pawpaw, spicebush, eastern redbud, silky dogwood, and wild plum were chosen because they occupy the same niche as bush honeysuckle, which dominated the site previous to removal. They were also the only small tree and shrub species available. David Gabbard, co-coordinator of Reforest the Bluegrass (RTB), donated leftover seedlings from this year's RTB event (*Note: The seedlings were donated to LFUCG from National Tree Trust for reforestation of public land.*).

National Rails-to-Trails standards were used to determine where to replant the native species, so future trail construction would not interfere with the trees and shrubs planted.

In order to comply with the Rails-to-Trails national standards, a distance of twenty-five ft. from the stream was measured, as well as an additional five ft. buffer between the area and the proposed trail location.

## **Methods**

The method of removal used for bush honeysuckle was the cut stump and spray technique. This involved using a chainsaw to cut larger shrubs while smaller shrubs were lopped or hand pulled. After cutting, an herbicide mixture of Garlon-4 (2 oz.), soybean oil (8.5 oz.), and water (27.9 oz.) was applied to the stump only. The herbicide was applied using a small spray bottle so that chemical application would be minimal due to the close proximity of the stream. Additionally, foam brushes were used to “paint” the cut stump and prevent any herbicide runoff. Due to the close proximity of garlic mustard and winter creeper to the stream and their required foliage spray technique, the removal method did not incorporate any chemical application; therefore, these species were hand-pulled.

The seedlings planted were done so with the use of a dibble bar. They were then surrounded by the installation of a 3-foot tree mat with a staple in each corner (4 per mat). This was done to hold the mat taut against the ground. The tree mats aide the newly planted seedlings by discouraging the growth of adjacent, competing vegetation.

## **Results & Discussion**

It took a total of 75 labor hours (15 people x 5 hours each) to convert the invasive non-native infested plot into Lexington’s first native species restored greenway. All invasive non-natives were removed with the use of 17 ounces of herbicide mix, except fescue. Fescue was not a target species of the vegetation management demonstration. The native species that were planted in place of the non-natives will eventually shade out the fescue, not making it a great concern. During the two-day event, 230 trees and shrubs were planted along Wolf Run in the 250’ x 25’ plot.

Several neighborhood residents approached the removal/planting team throughout the demonstration project. The homeowners were informed about the project and its objectives. Their responses were all supportive, and they were glad to see native species restoration, especially so close to their homes.

This demonstration plot is a good example of an activity joining eco-volunteers with the city’s management needs. This type of partnership between volunteer groups and LFUCG could be crucial to long-term management of the vegetation in the greenways. One reason for this is labor costs of removal and replacement.

If LFUCG had paid for the labor for the demonstration plot, it would have probably cost at least \$600. This was just for a fraction of the Wolf Run greenway; so one can realize

how much funding would be saved when those costs are multiplied by the amount of all the greenways.

All materials used were donated to the demonstration plot project, and thus the only cost was the removal of the debris (i.e. removed bush honeysuckle), which was incurred “in-house”. The estimated total cost of the demonstration plot would have been over \$1000 (Table 8).

**Table 8: Projected Costs of Demonstration Plot.**

<b>Supply</b>	<b>Cost</b>	<b>Amount</b>	<b>Total Cost</b>
Labor	\$8.50/ hour	75 hours	\$637.50
Herbicide Mix	\$3/ oz.	17 oz.	\$51.00
Seedlings	\$15/ 50 seedlings	230 seedlings	\$69.00
Tree Mats	\$239/ box of 400 mats	230 mats	\$137.50
Mat Staples	\$42/ box of 1000	920 staples	\$38.50
Hauling Debris	\$150/ chipping and hauling	1 haul	\$150.00
		<b>Grand Total:</b>	<b>\$1083.50</b>

## **AWARENESS AND OUTREACH**

Our stakeholder analysis found that while certain groups are familiar with non-native species in general, concern regarding the effect of invasive species on Kentucky's native plant diversity is significantly less. We targeted this lack of concern and produced outreach and awareness materials tailored to specific stakeholder groups. The brochures and educational materials are intended to both inform the public and encourage public involvement. Such information should help to build a link between the community of Lexington and the Greenways project by raising awareness pertaining to the concerns of non-native, invasive species. The stakeholder groups considered to benefit most from the outreach materials include garden enthusiasts, educators, volunteer groups, the tourism industry, and the general public.

The "Why Plant Natives?" brochure was designed to inform the general public about vegetation issues, the benefits of native plants, and the threat of non-native, invasive species within Lexington's Greenways (Appendix M). This brochure also provides a list of invasive species of concern and native alternatives. The "Landscaping with Native Plants" brochure is geared towards garden enthusiasts and nursery patrons including similar information as the "Why Plant Natives?" brochure, as well as an extensive list of native trees, shrubs, perennials, and grasses (Appendix M).

The "Kentucky's Native Species Activity Book" was created to provide educators a strong foundation concerning Kentucky's native species, Lexington's greenways, and how to incorporate them into the classroom (Appendix N). The goal of "Kentucky's Native Species Activity Book" is to raise awareness in the school system and to provide educational materials to make it possible. The native plant component provides activities, which includes information on riparian areas and native plant species that are found throughout the state. The information presented in the booklet also provides a link between education and the greenways program. Lexington Fayette Urban County Government can use this information to promote the use of the greenways for educational purposes, with few modifications. Information was gathered from sources around the state and around Fayette County.

Two volunteer programs, "Green-Clean" and "Adopt-a-Greenway", were developed to integrate community involvement in the Greenways. Green-Clean is a program based on the Reforest the Bluegrass design and is designed to preserve and maintain Lexington's greenways through volunteer workdays. Green-Clean volunteers would participate in general maintenance such as trash pickup, native tree and flower plantings, and removal of invasive species. Adopt-A-Greenway was adapted from the popular Adopt-A-Highway program. It allows individuals, families, or groups to adopt certain areas of greenway where they would maintain litter control, facilities and vegetation maintenance. This activity is aimed at groups such as 4H clubs, boy scouts and girl scouts, environmental and neighborhood organizations. Program brochures were designed to introduce each program to potential volunteer groups and to provide background on the benefits of greenways, and a sign up sheet with a return address (Appendix M).

The proposed LFUCG Greenways planted with central Kentucky native plant species have the potential to positively impact the tourism economy of the Lexington area. The greenways systems in Indianapolis, Indiana, Maryville, Tennessee, and Greensboro, North Carolina have capitalized on the public's added interest in native plant vegetation. They find that native plants restore our natural heritage, which promotes community pride. Such a native plant greenway in Lexington would improve the quality of life in the area and also may attract tourists and new businesses.

With this in mind, a prototype brochure was designed for future use in highway rest stops and recreational business within and outside the Lexington area (Appendix M). The brochure contains information on native plant species and greenway benefits along with a map of the proposed trails. Upon completion, the LFUCG native plant species greenways can become nationally recognized as a National Recreation Trail. Through this designation, LFUCG trails could be a part of America's National Trail System which are considered exemplary trails of local significance.

## CONCLUSIONS

The mechanical and chemical methods of non-native species removal are tried and true. The costs and labor are easily determined. Though the cost of a one time, all inclusive non-native eradication along greenways is staggering, if areas are prioritized and replanted according to the Vegetation Management Plan, they become more feasible. Due to the level of community involvement in this project, a stakeholder analysis was necessary to address community concerns. The analysis revealed critical issues. For example, the public did not oppose non-native species management as expected. The stakeholder surveys revealed that citizens were concerned about the issue and were willing to get involved. Public involvement is critical to the implementation and success of proposed vegetation management. The proposed Citizen Oversight Committee, if applied, would encourage participation and genuine input. The success of local events, such as Reforest the Bluegrass which has received national attention as a model program involving both local government and citizens, testifies to the eagerness of the community to help

The surveys also showed that the public was not informed about the non-native, invasive species problem in the Lexington area. To address this problem, outreach and awareness materials were developed. Examples of these materials include teaching manuals and brochures.

Ideally this project could take non-native vegetation management to a higher level for the Bluegrass Region. Another regional program, Rails-to-Trails, has expanded into a national program. This project is similar with regards to its recreational aspects, yet it also allows LFUCG to become a leader for ecological restoration and native biodiversity in the Bluegrass Region. Along with changing landscape trends, native species demand will increase with awareness of their benefits throughout the community. Furthering public interest in native species will encourage greater supply of native plants from local nurseries.

The ribbons of LFUCG Greenways will provide a demonstrational model for surrounding communities to discover the possibilities of native restoration. These examples may then ripple outward from public landholdings to privately owned areas throughout the entire region. Successful implementation of the recommended goals will require a long-term commitment. With this plan, LFUCG now holds the tools to take the first step in protecting Kentucky's native species treasure.

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