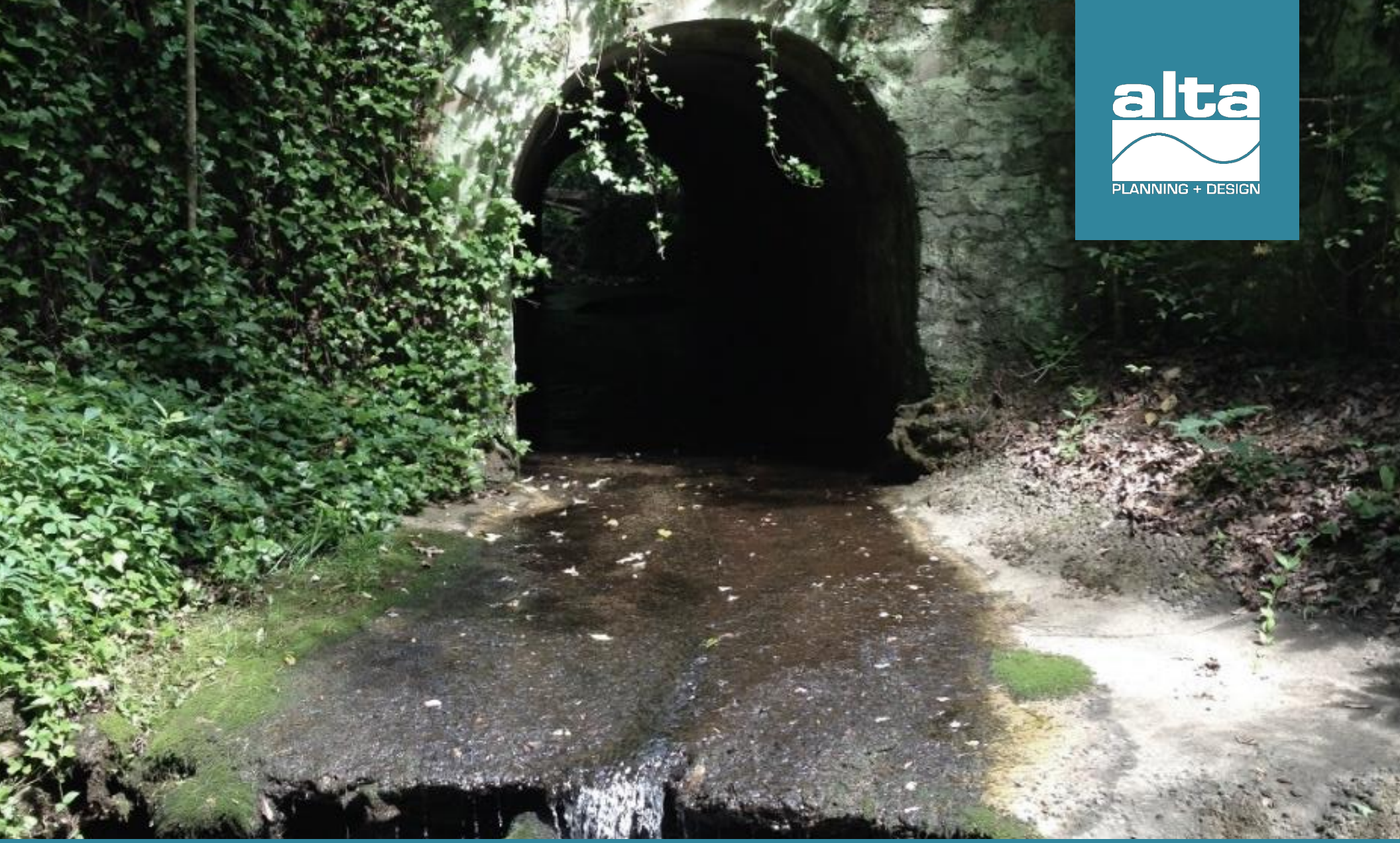


alta
PLANNING + DESIGN

CONVERSE HEIGHTS NEIGHBORHOOD ASSOCIATION

NATURE PRESERVE | Management Plan

1 Existing Conditions

1.1 Project Background

Converse Heights Ravine Nature Preserve

The Converse Heights Neighborhood Association Ravine Nature Preserve is a 16 acre city owned, natural piedmont forest. Considerable amounts of wildlife already exist in the area, including owls, deer, fox, and turkey. A spring-fed stream, originally named Crystal Spring, runs through the greenspace. The stream is recognized by SCDHEC as jurisdictional and would require permitting with USACE for stream enhancements and restoration. The stream ultimately flows to the Cottonwood Trail (1025 Woodburn Road). The stream has had a strong odor in the past, though Spartanburg Water tested it and found no issues. . Existing invasive species are stabilizing the steep slopes along the banks of the stream. Numerous storm drains discharge into the greenspace with larger storm infrastructure at Boyd Street. The City of Spartanburg has additional riparian buffer requirements that will need to be considered through the design and development process.

In the 1970s, a Sierra Club project installed natural trails throughout. Trails at located in 'Pod 1', but are overtaken by invasive species as you approach Crystal Court in Pod 2 and Pod 3. Overall, overgrowth is more significant than it used to be. Earlier attempts to contain these invasive species have not been fruitful.

Norfolk Southern (NS) owns the rail adjacent to 'Pod 3' and have historically been receptive to maintenance concerns. They will require review of any plan created and it is better to involve NS early in the process. For previous projects in the area, NS waived $500 fee required to access railroad property. NS does spray from the rail line to kill weeds and vines within its right-of-way.

Expansive views are found along the stream corridor.

1.2 Resident Meeting Notes

1.2.1 Vegetation Management

- The last City of Spartanburg initiated interior clean-up of the site was around 1970. The City has been loosely involved since and its overall role within this project has yet to be determined.
- General interest to know how invasive species got to the level they are at now.

- There is an immediate need to analyze which trees are in the last stages of life to ensure replacements are included in initial phases.
- Wildlife is a strong theme of what is important to residents; there is a very strong desire to maintain the current feel and habitat for local wildlife. Deer are currently bedding in Pod 1.
- Invasive ivy a concern of most as it is choking out mature trees.
- Concerns about ongoing maintenance costs – who is going to pay for this?
- Vegetation removal should not open up long views to neighboring residences.
- Plan for implementing goats to help clean up the ravine vegetation was quoted at approximately $25,000
- There are potential opportunities to engage the local community college for a vegetative analysis.

Existing Stream has excess sediment, particularly in 'Pod 3'

Drainage features under roadway crossings provide historic interest.

1.2.2 Circulation/Access

- Overall concerns about increased vehicular traffic and non-community pedestrians within neighborhood if the ravine becomes a City Park.
- Overall concerns from the adjacent property owners included:
    - Do not want parking areas
    - Do not want to clear vegetation that would allow for undesired views
    - Do not want space to become large public space for surrounding communities
    - Not interested in large signage
- Remnants of existing trails throughout the site could potentially be built upon, or used as a guide for future network. New natural trails, if desired, will work with natural topography to minimize land disturbance.

- Overall consensus that there is no interest in turning this into a citywide destination park.
- Multiple residents adjacent to ravine have strong opposition to areas becoming parking lots.

Parking Area adjacent to 'Pod 3'

1.2.3 Action items

- Consensus of the need to develop a strong plan for phasing to ensure both successful goal fulfilment, as well as not changing the landscape too quickly.
- Residents are concerned about where construction funding will be coming from, as well as how the funding determines overall maintenance and programming.
- Agreement that Phase One should include a general cleaning of the ravine and removal of invasive species as directed by Alta.
- Immediate action plan should include:
    - Assessing overall mature vegetation health
    - Strategic removal of invasive species
    - Understory tree placement to maintain privacy once invasive species are removed
    - Stream restoration and erosion control
    - Perimeter plantings
- What if nothing is done?
    - Invasive species will keep growing, native vegetation will die
    - Views will decline every year that invasive species are allowed to overtake larger vegetation
    - The stream will continue to erode, and water quality will continue to degrade
    - Potential for failing infrastructure because of scouring
- There are some key Crime Prevention Through Environmental Design (CPTED) principles that can be put into place to encourage a more visible perimeter while maintaining the aesthetic feel of a nature preserve.
- Perimeter plantings along area on Sherwood Circle was approximately $34,000.
- If the CHNA does not want or need to seek public/foundation funds, the money would likely come from within the community.
- Overall goal of association is to create and maintain a safe, beautiful, and fun community.

1.3 Site Inventory + Analysis

1.3.1 Opportunities + Constraints (Figure 1.1)

Infrastructure

- The existing drainage structures under roadways provide historic architectural interest, while the existing landscaping creates park-like facade and mirrors residential landscaping.

- The existing storm drainage flows directly to stream, creating a potential for pollution and for future pre-treatment or filtering of stormwater.

Vegetation

- Current vegetation is a combination of native and exotic shrubs, ferns and trees. Selective clearing is required, particularly invasive species throughout the site.

Stream

- Erosion of stream banks was observed, ranging from 6-10' vertical bank walls and exposed tree roots.

- The stream water was observed with excess sediment due to erosion.
- Intermittent rock outcroppings are found throughout site.
- Many of the banks are covered with invasive groundcover. Proposed clearing should include replanting and stabilization efforts.

Resident Impact

- Dumping of yard and some construction debris was observed along the periphery of the Ravine. Clean up and regulation will be required.

Much of the forest floor is covered in invasive plant species.

1.3.2 Observed Plant Species that require Management:

The following plant species were preliminarily observed throughout the Converse Heights Ravine Nature Preserve. An environmental survey will be required to definitely determine all plant species found within the Ravine. Various management processes are discussed in later chapters of this Management Plan.

Chinese Privet (Ligustrum sinense Lour.)

- Semi-evergreen, thicket forming shrub growing to 30 feet in height.
- Distinguishing features are the leaves that grow opposite in two rows at right angles to the stem, white flowers that grow in panicles, and small abundant fruit that range from green in summer to almost black in the fall.
- Spreads by abundant bird and animal dispersal and root sprouts.
- Privet is shade tolerant and forms dense thickets particularly in bottomlands and along fencerows and rights-of-way.
- Very few plants are found growing beneath thick stands of privet (http://www.clemson.edu/psapublishing/pages/forestry/forlf28.pdf).

Eastern poison ivy (Toxicodendron radicans)

Poison Ivy is a woody, perennial vine or small shrub that can be found in fields, pastures, woodlands, farms and home landscapes. As a vine, it attaches itself to trees or other structures with hairy, aerial roots borne along the stem. Eastern poison ivy foliage exhibiting smooth leaf margins.

- Poison ivy has compound leaves that occur in threes (trifoliate or three leaflets). The edges of the leaflets can be smooth, wavy, lobed or toothed. Some leaves may resemble oak leaves. Most mature poison ivy plants will flower and produce clusters of white, waxy fruit.
- Poison ivy grows fairly quickly and propagates itself by underground rhizomes and seeds. Seeds are quickly spread by birds and other animals that eat the small fruits. Poison ivy can get started in the landscape from a seed dropped by a bird and may quickly become a widespread problem. It often grows in shrubs and groundcovers making it difficult to control (http://www.clemson.edu/extension/hgic/pests/weeds/hgic2307.html).

English Ivy (Hedera helix L.)

- Widely planted as an ornamental.
- Evergreen, woody vine climbing to 90 feet by clinging aerial roots and trailing to form dense ground cover. Spreads vegetatively and by seed.
- Thick, dark-green leaves with whitish veins and 3 to 5 pointed lobes when juvenile. Matures in about 10 years into erect plants with unlobed leaves and terminal flower clusters.
- Very adaptable, thrives in moist to dry areas and can tolerate shade.
- Amasses on infested trees, decreasing vigor and increasing chance of windthrow.
- Inhibits regeneration of native wildflowers, trees, and shrubs forming a monoculture (http://www.clemson.edu/psapublishing/pages/forestry/forlf28.pdf).

Japanese Knotweed (Polygonum cuspidatium)

- Habitat Type: Wetlands, along streams and rivers, ditches, utility right-of-ways, old home sites; can tolerate shade, high salinity, high temperatures, and drought. Can escape gardens to invade undisturbed natural areas.
- Able to quickly establish, displacing and shading native plants, thus reducing diversity and altering wildlife habitat structure.
- Provides no wildlife value
- Threat to riparian areas where it can survive severe floods and recolonize scoured banks and islands to form persistent thickets.

Japanese Stiltgrass (Microstegium vimineum (Trin.) A Camus)

- Sprawling annual grass growing to 3 feet in height.
- Prominent features – alternate, flat, two- to four-inch leaves and thin, spikelike flowers.
- Prolific seeds remain viable for up to 3 years. Spreads by water and hitchhiking on animals and people.
- Will overtake and dominate sites on floodplains, streamsides, forest edges, trails, damp fields, swamps and lawns (http://www.clemson.edu/psapublishing/pages/forestry/forlf28.pdf).

Kudzu (Pueraria montana (Lour.) Merr. var. lobata (Willd.))

- Deciduous woody leguminous vine 30 to 100 feet long.
- Distinguishing features include three-leaflet leaves, yellow-green stems with erect golden hairs, lavender pea-like flowers, flattened and hairy seed pods.
- Colonizes by vines rooting at nodes and by wind-, animal-, and water-dispersed seeds. Seed viability is generally low.
- Rapid and dense growth completely overwhelms all other plant species including large trees. Must have direct sunlight for rapid growth (http://www.clemson.edu/psapublishing/pages/forestry/forlf28.pdf).

Japanese Stiltgrass and Kudzu visible.

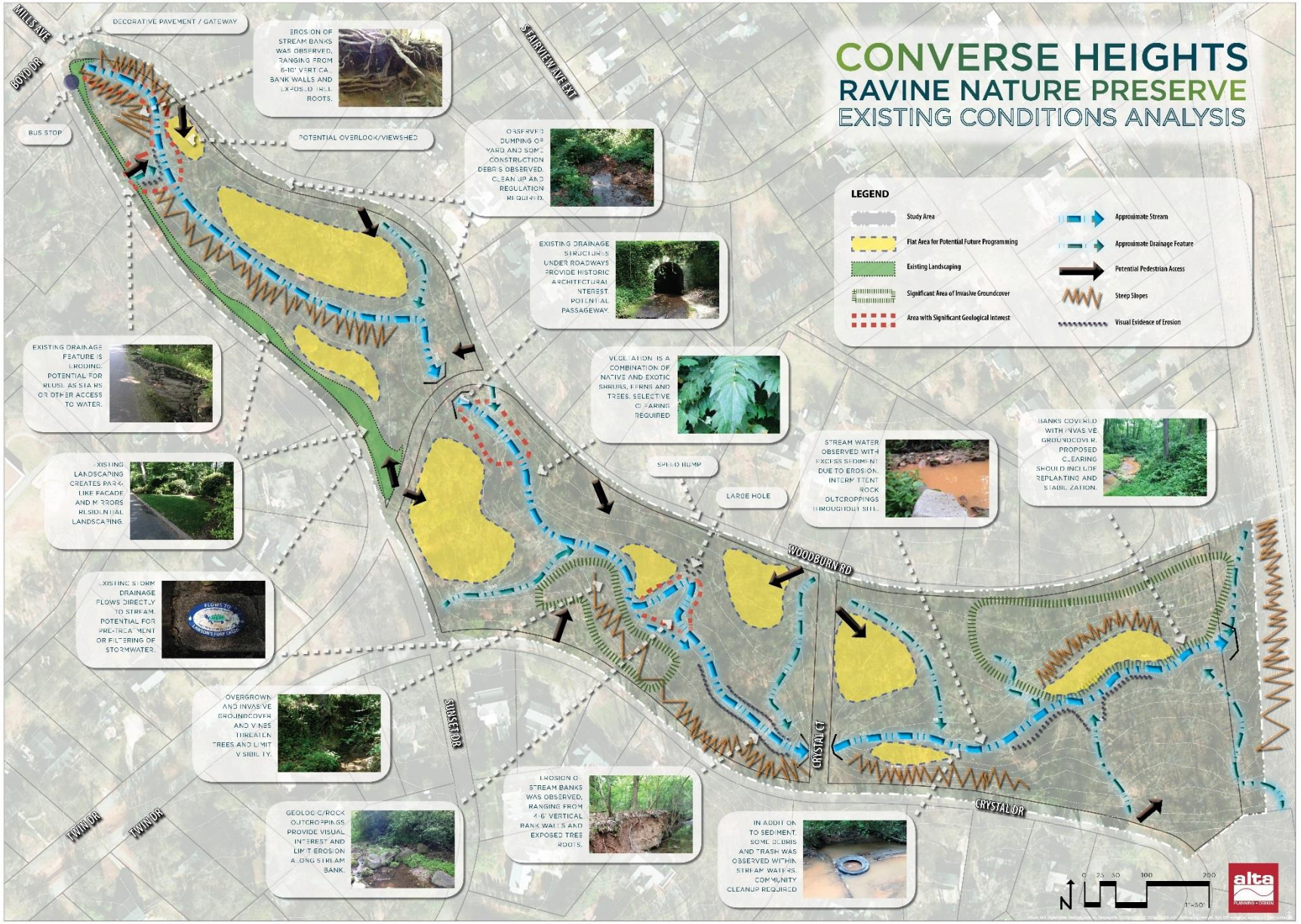


Figure 1.1: Opportunities + Constraints

2 Clearing + Maintenance

Table 2-1: Schedule of Annual Activities (Repeat as Necessary)

	Spring	Summer	Fall	Winter
Trees	Visual inspection for insects of disease. Prune winter damage. Remove invasive species.	Visual inspection for insects or disease.	Visual inspection for insects or disease. Prune damaged limbs.	Visual inspection for insects or disease. Prune damaged limbs.
Shrubs	Visual inspection for insects of disease. Prune winter damage. Remove invasive species.	Visual inspection for insects or disease.	Visual inspection for insects or disease. Prune damaged limbs. Apply antidesiccant.	Visual inspection.
Grasses	Visual inspection. Cut back vegetation to 1" of existing grade. Remove invasive species.	Visual inspection.	Visual inspection.	Visual inspection.
Perennials	Visual inspection.	Visual inspection.	Visual inspection.	Visual inspection.

2.1.1 COMMON PROBLEMATIC/INVASIVE SPECIES

Eastern poison ivy (Toxicodendron radicans)

- For light infestations, dig up small plants. You can also repeatedly cut back the plants to ground level. Eventually they starve to death. Start cutting early in the spring, about the time leaves unfold. When new growth appears, cut again. Inspect the plants every week or two. Whenever you see green growth, cut the shoots back to the ground.
- If you choose to eradicate poison oak or poison ivy by cutting back the plants, you should protect your hands and arms to avoid being contaminated with urushiol, the oil that causes the allergic skin reaction.

Poison Ivy. Source: http://www.todayshomeowner.com/poison-ivy-oak-and-sumac-understanding-the-itch/

- To eradicate poison oak and poison ivy chemically, use an herbicide that contains glyphosate, triclopyr, or a 3-way herbicide that contains 2,4-D amine, dicamba and mecoprop. These herbicides can kill desirable plants, so be careful. If the poison ivy or poison oak is growing among plants you want to save, you can cut back the poison ivy or poison oak and spray or paint the herbicide only on the freshly cut stems or stump. Repeat applications may be necessary.
- Herbicides work better when you spray at the right time. Poison ivy and poison oak are most sensitive to 2,4-D amine and dicamba

treatments in late spring or early summer when the plants are actively growing rapidly. Triclopyr offers the best control after the leaves fully expand in the spring and before leaf color changes in the fall. Glyphosate offers the best control when applied between 2 weeks before and 2 weeks after full bloom (early summer) and should be mixed to a 2% solution.

English Ivy (Hedera helix L.)

English Ivy. Source: http://www.todayshomeowner.com/how-to-control-english-ivy/

- The first step is to sever the vines of the English ivy that have climbed trees in the landscape. The viney stems of the ivy are attached tightly and must be pried up from the trunk to be cut. A large flat-bladed screwdriver can lift and help make the vines easier to cut with pruners. Cut these vines several feet up the trunk at a height that is comfortable to attain. Then loosen the vines below these cuts and pull them downward from the trunk. Cut them off at the base of the tree.
- Larger vines may require the use of a saw, but be careful not to damage the tree trunk. Removal of the vines can be done at any time of the year. The hotter and drier the weather, the faster the remaining sections of vines up the trunk will die.
- English ivy on the ground is usually easier to pull up after rains have softened the soil. If pulling is done during the winter, any perennials in these beds are less apt to be damaged while they are dormant. The ivy stems are strong and not deeply-rooted; so long sections can be pulled up at a time.
- Chemical Control of English Ivy
    - Herbicides may be required for the control of large areas of English ivy. The spring is the best time to apply an herbicide when 3 to 5 new leaves appear on the English ivy vines. This new growth does not yet have the waxy cuticle covering present on the older leaves, which allows for better penetration of herbicides. Alternatively, the English ivy can be mowed or cut back with a string trimmer. When new growth appears, herbicides can be sprayed. Mix and spray a 2 or 3% solution of glyphosate for best results.
    - Triclopyr is the active ingredient in many brands of brush killers and is a systemic, broadleaf plant herbicide that can be used for English ivy control. Apply a 2 to 5% triclopyr solution in the spring as new growth appears (3 to 5 new leaves per vine).
    - Caution: Pollinating insects, such as honey bees and bumblebees, can be adversely affected by the use of pesticides.

Japanese Stiltgrass (Microstegium vimineum (Trin.) A Camus)

Japanese Stiltgrass . Source: http://illinoiscapsprogram.blogspot.com/2013/10/japanese-stiltgrass-alert.html

- Once introduced along trails or other disturbed areas, the grass moves into the understory of forests. It spreads quickly, and will out-compete and displace native plants and tree seedlings. Abundant populations of white-tail deer may facilitate its invasion by feeding on native plant species and avoiding stilt grass.
- Once it is established in an area, the species can be controlled in a couple ways:
    - Manual/Mechanical – For very small infestations, simply pull the plants out of the ground before they flower. For larger areas, weed-whack the plants to the ground in September, shortly before it produces seed but too late for it to regrow before the first frost. Since it is an annual, preventing the plants from setting seed is all you need to do to eliminate the species from an area. Of course, it will be necessary to pull or mow areas again each year until all the seeds are gone from the site.
    - Chemical – For extensive infestations, where mechanical methods are not practical, systemic herbicides such as glyphosate (tradename RoundUp, or Rodeo in wetland sites), or grass-specific herbicides like fluazifop-p-butyl (tradenames Fusilade or Fusion) are effective. Spraying areas with a very dilute solution of Fusion (1/2%) plus a surfactant has been very successful at killing stilt grass without impacting other species, even perennial grasses. Plants should be sprayed between June and August, when the plants are actively growing but before flowering. Spraying is generally more effective earlier in the summer and less effective during drought periods. (http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/indiana/journeywithnature/japanese-stiltgrass.xml).

Kudzu (Pueraria montana (Lour.) Merr. var. lobata (Willd.))

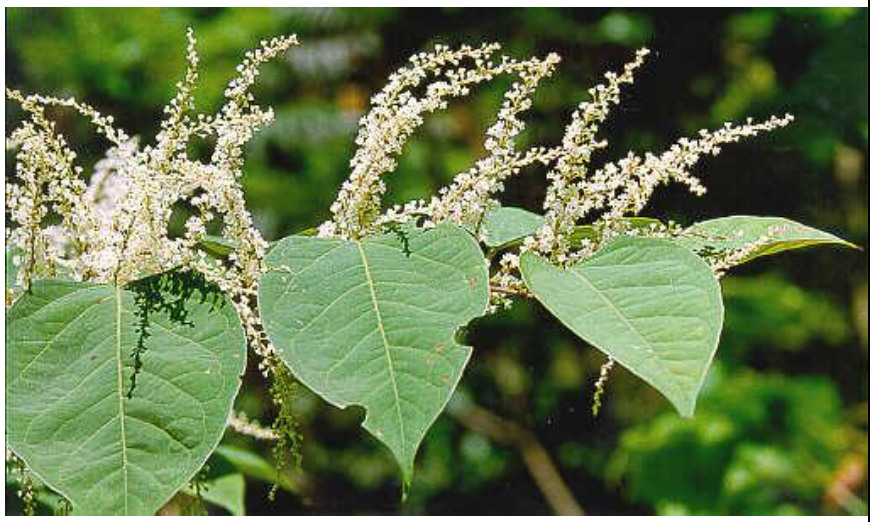
Kudzu. Source: https://www.eddmaps.org/ipane/ipanespecies/vines/Pueraria_montana_var_lobata.htm

- Kudzu (Pueraria lobata [Willd.] Ohwi.) is one of the most difficult weeds to control in the Southeastern United States. Overgrazing

and repeated mowings have provided effective control in certain situations. Recently, herbicide treatments have been developed for this purpose.

- Eradication of kudzu involves a long-term commitment in time and money. Because of its rapid growth (up to 60 feet per year), a single surviving kudzu plant can spread and re-infest a site within a few growing seasons. Eradication requires multiple broadcast applications of herbicide and follow-up spot treatments over a period of 4 to 10 years. Establishment of pine trees or other crops should not be attempted for at least 4 years after control measures are initiated.
- In order to develop an effective kudzu control program the site should be carefully inspected. Factors such as age and vigor of the kudzu, terrain, and the presence of sensitive crops, high value trees, and streams should be considered in selecting herbicides and method of application.
- Burning the kudzu patch in the spring prior to treatment is often recommended. Prescribed fire will provide control of small, recently established kudzu plants, sever plants to ground line in tree draped areas, and make visible hidden gullies or obstructions. Herbicide application should be conducted after regrowth is 2 to 3 feet deep.
- After the broadcast treatment the first year, it is recommended that nothing be done the second year if complete coverage and "brown-up" was achieved with the first application. A broadcast treatment in June of the third year (1 gallon of Tordon 101 per acre) will then control most, if not all, resprouting. Inspection of the patch at the end of the third year and the beginning of the fourth year along with spot application with a back-pack sprayer when required (1 pint of Tordon 101 Mixture in 2½ to 5 gallons of water) will give complete control under most circumstances. However, sites should be monitored for several years to assure that eradication is complete.
- Tordon 101 Mixture will kill pines and hardwoods if they are sprayed, but up to 1 gallon per acre can be applied under pines older than 15 years. It should not be applied in a young plantation or to older plantations that are stressed from drought or overstocking. Furthermore, pines should not be planted for 6 to 9 months after the last application. Tordon products should not be applied near streams or gullies where the herbicide may leach into running water sources.
- As mentioned previously, Tordon products should not be used near streams. An alternative compound, Veteran 720® at a rate of 2 to 3 gallons per acre can provide good control in this situation, but it should not be used directly over water. Labeled rates of glyphosate formulated in the products Accord® and Rodeo® can also be used near water. However, these products are not likely to give complete kill of well-established kudzu. A handgun nozzle on a tractor sprayer can be used to apply these products into deep draws or along branch heads. Several successive broadcast applications plus spot applications will likely be required to achieve complete control.
- Kudzu vines growing up large trees should be severed before treatment. If pines are greater than 15 years old or greater than 8 inches d.b.h., treatment of kudzu with 1 gallon per acre of Tordon 101 Mixture is suggested. Tordon 101 will likely cause temporary damage to pines. Damage may be greater in trees already stressed by drought, disease, etc.
- In young pine plantations older than two years, Oust at 8 ounces of active ingredient per acre can be broadcast over the seedlings. As above, several treatments will be necessary for effective control. For treating over 3 to 4 year-old loblolly pines, apply Escort® at 3 to 4 ounces per acre. Another product that can be used over pines and many hardwood species is Transline®. Apply Transline at 21 fluid ounces per acre. This herbicide will injure legumes including redbud, honey locust and black locust. Use a nonionic surfactant at 1 qt per 100 gal of spray with each of the above herbicides.

Knotweeds



Knotweed. Source: http://www.skamaniacounty.org/noxious-weeds/homepage/knotweed-species/

Japanese knotweed (Polygonum cuspidatum)

Giant knotweed (P. sachalinense)

Himalayan knotweed (P. polystachyum)

Bohemian knotweed (P. bohemicum)

- These knotweed species and their hybrids are tall shrub-like, perennial herbaceous plants that are listed as a Noxious Weeds. The basal root crown will produce 30-50 stout bamboolike shoots that may reach to 15 feet tall or more (giant knotweed). The hollow shoots may be an inch or more in diameter with swollen nodes three to five inches apart that are reddish-brown in color. The leaves are produced on upper stems and on the limited side branching. The leaves size and shape vary between species. Japanese knotweed leaves have a truncated base; giant knotweed has huge elephant ear shaped leaves; and Himalayan knotweed has elongate triangular-shaped leaves. The smooth-edged leaves are green and occur singly at each node in an alternate pattern.
- Tiny white or greenish flowers appear in open sprays near stem ends during July and August and produce a small winged fruit. The tiny seeds (about one tenth of an inch long) are transported by water, short distances by wind, and in attached mud. The seeds are not thought to be fertile from these knotweed species, but the seeds of hybrids are considered fertile. The Nature Conservancy has germinated knotweed seeds in the laboratory. Plants arise from fibrous roots and produce a spreading rhizome system, possibly from each major shoot, that may extend to 25 to 40 feet or much more. The rhizomes can penetrate more than seven feet into the soil. Individual plants may be 8-15 or more feet in diameter and often occur in large clumps of several hundred square feet to several acres or occupy an entire shoreline. These plants die back after a hard frost, but bare stalks often remain through the winter.
- Knotweeds regrow very rapidly in the spring, often reaching 15 feet by June (giant knotweed). Japanese knotweed typically grows to ten feet with the smaller Himalayan knotweed only reaching four to six feet. Himalayan and Japanese knotweeds are known to form a viable hybrid called Bohemian knotweed (Polygonum bohemicum). Growth of the knotweed plants starts in April or earlier in warmer regions, or as late as June in higher elevations. New plants can establish from seeds, broken off stem parts, or from any node along rhizomes. As little as a half inch plant piece can start a new plant. Young knotweed shoots resemble red asparagus.

Control Methods:

Listed below are ranges of options, or a combination of options, that may be suitable for site-specific control of knotweeds. These control methods are listed in the following order, and include: Prevention, Mechanical, Chemical and Biological Controls.

- EARLY DETECTION, PREVENTION, FOLLOW-UP
    - The knotweeds are very widespread throughout South Carolina, and they continue to spread. Learn to identify these knotweed species and remove any new infestations.
- MECHANICAL CONTROL
    - Mechanical Removal: This technique can be used on single plants to larger infestations, but will be costly to contract suitable equipment.

- Hand pulling and digging: Hand pulling knotweeds is an option only if the soil is soft, the plants are young, there are only a few plants, and the effort is persistent and ongoing for an extended time period. Once the plants have developed extensive roots and rhizomes they will be nearly impossible to completely remove. Any rhizomes remaining in the soil will produce new plants at each node. It can take up to three years of consistent effort to eradicate a small patch of plants using this method.
- Covering: There have been anecdotal reports of successful control of small patches of plants using a combination of cutting, hand pulling, and/or tilling, followed by covering. After cutting the plants down to ground level, cover the area with several layers of black plastic or several layers of cardboard. Extend the area of coverage to at least 20 feet or more around the outside of the plant and check at intervals to make sure that shoots are not coming up outside of the cover or through the cover.

- CHEMICAL CONTROL
  - Herbicide Treatment: Glyphosate (Rodeo® and other glyphosate brands with aquatic labels) has been used to effectively control Japanese knotweed in aquatic situations. Cut stem application can result in up to 95 percent mortality. In the summer or fall, cut each stem within one to three joints of their base (internodes). Add herbicide into the exposed hollow stem cavity following label recommendations. Cut stem application is labor-intensive, both to cut each stem and to apply herbicide, but it will assure that the herbicide is only applied to target weeds and not to other desirable vegetation.

Tree-of-Heaven (Ailanthus altissima)

Tree-of-Heaven. Source: http://www.mlenvironmental.org/?page_id=290

Tree-of-heaven, also known ailanthus, Chinese sumac, and stinking shumac, is a deciduous tree in the quassia family.

Ailanthus has smooth stems with pale gray bark and twigs which are light chestnut brown, especially in the dormant season. Its large compound leaves are 1-4 feet in length, alternate, and composed of 10-41 smaller leaflets. Each leaflet has one or more glandular teeth along the lower margin. The leaf margins are otherwise entire or lacking teeth. Ailanthus is a dioecious ("two houses") plant meaning that male and female flowers occur on separate plants. Flowers occur in large terminal clusters and are small and pale yellow to greenish.

Flat, twisted, winged fruits each containing a single central seed are produced on female trees in late summer to early fall and may remain on the trees for long periods of time. The wood of ailanthus is soft, weak, coarse-grained, and creamy white to light brown in color. All parts of the tree, especially the leaves and flowers, have a nutty or burned nut odor.

Tree-of-heaven is a fast-growing tree and a prolific seeder, that can take over sites, replacing native plants and forming dense thickets. Ailanthus also produces chemicals that prevent the establishment of other plant species nearby. Its root system may be extensive and has been known to cause damage to sewers and foundations. Tree-of-heaven is a common tree in woodland edges and forest openings. It occurs as seedlings that pop up by the hundreds in recently planted fields and as persistent thickets in rocky, untillable areas.

Control Methods:

Listed below are ranges of options, or a combination of options, that may be suitable for site-specific control of Ailanthus.

- MECHANICAL CONROL
    - Cutting: Cutting alone is usually counter-productive because ailanthus responds by producing large numbers of stump sprouts and root suckers. However, for small infestations, repeated cutting of sprouts over time can exhaust the plants reserves and may be successful if continued for many years or where heavy shade exists. If possible, the initial cutting should be in early summer in order to impact the tree when its root reserves are lowest.
    - Hand Weeding/Pulling: Young seedlings may be pulled or dug up, preferably when soil is moist. Care must be taken to remove the entire plant including all roots and fragments, as these will almost certainly regrow.
- CHEMICAL CONTROL
    - Herbicide Treatment: The most effective method of ailanthus control seems to be through the use of herbicides, which may be applied as a foliar (to the leaves), basal bark, cut stump, or hack and squirt treatment. Keep in mind that it is relatively easy to kill the above ground portion of ailanthus trees, you need to kill or seriously damage the root system to prevent or limit stump sprouting and root suckering. Both glyphosate and triclopyr should be mixed with water and a small amount (0.5%, or as per label) of a nonionic surfactant (except for Roundup®, which contains a surfactant) to help the spray spread over and penetrate the leaves. The mixture should be applied to leaves and green stems, including sprouts and suckers, until thoroughly wet but not to the point of runoff. With backpack sprayers, concentrations of 2% of a typical glyphosate product such as Roundup® or Accord® applied June 15 - September 15, or 1.5% of a 4 lb./gallon triclopyr product such as Garlon® 4, or 2% of a 3 lb./gallon triclopyr product such as Garlon® 3A applied June 1-September 1 have worked well in the Southeastern United States. Other herbicides which have shown to be effective in stump treatment of ailanthus are the same as those listed above for hack and squirt or injection.

3 Stream Bank Stabilization

3.1 Erosion Control

Existing erosion issues were observed along the banks of the stream within the Converse Heights Ravine. Removal of existing invasive groundcovers is expected to further exacerbate erosion issues throughout the corridor. Generally, three approaches may be undertaken to stabilize soil and to promote plant growth: live plantings, bioengineering, and hard armoring.

3.1.1 Live Plantings

You may be able to stabilize shorelines or prevent erosion problems by planting appropriate types of vegetation, then allowing nature to heal itself. Costs of this approach are relatively low, and homeowners can implement this approach on their own. A small investment of time and money can prevent a serious erosion problem that in the future could be very expensive to correct (http://www.tva.com/river/landandshore/).

3.1.2 Bioengineering

Bioengineering relies on a combination of structural components and plant material to produce a dense stand of vegetation that serves as a "living system" to protect streambanks and shorelines. This technique works to stabilize many, but not all, erosion problems. One challenge in bioengineering is protecting the bank from erosion until the vegetation becomes established. This could take one to two years. There are a number of structural components available to provide temporary protection while

the plant growth becomes established. One example is the use of coconut fiber rolls (flexible "logs" made from coconut hull fibers). These can be effective in providing the structural component which protects the "toe" or base of the streambank or shoreline most vulnerable to erosion. Another example is erosion control blankets, useful for protecting the slope of the bank above the toe. Bioengineering may require bank shaping to reduce the slope of the bank (http://www.tva.com/river/landandshore/).

3.1.3 Hard Armoring

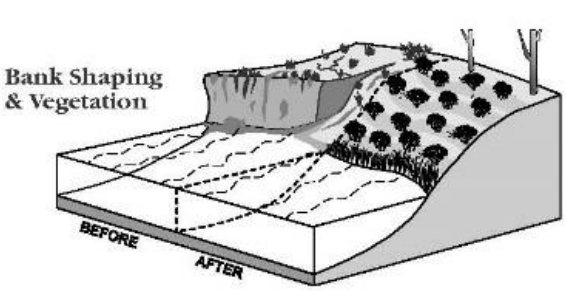
Hard armoring includes a variety of techniques including rock riprap (large stones placed along the slope of a streambank or shoreline) and gabions (rock-filled wire baskets placed along a streambank or shoreline). Hard armoring typically involves grading the bank to a gentler slope. If done properly, these techniques provide very good protection and will work in severe situations where bioengineering will not. However, hard armoring techniques can be relatively expensive, and may require professional assistance. These techniques are often used in situations where less expensive, more environmentally friendly and aesthetically pleasing alternatives would have been successful (http://www.tva.com/river/landandshore/).

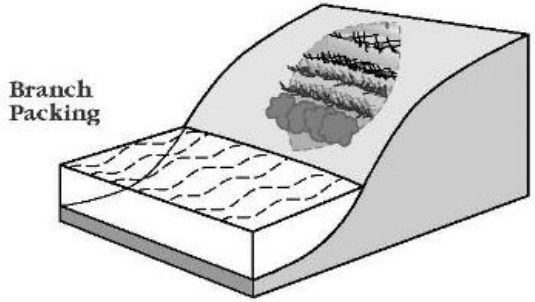
3.1.4 Stabilization Techniques

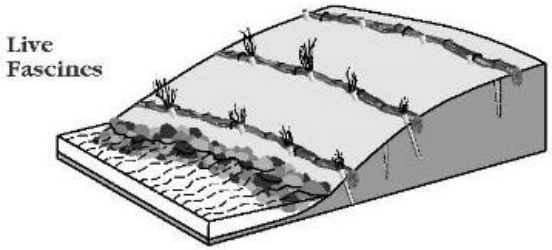
The following pages present a few examples of the many techniques being used as bank treatments for streams and reservoirs. Illustration source: (http://www.tva.com/river/landandshore/).

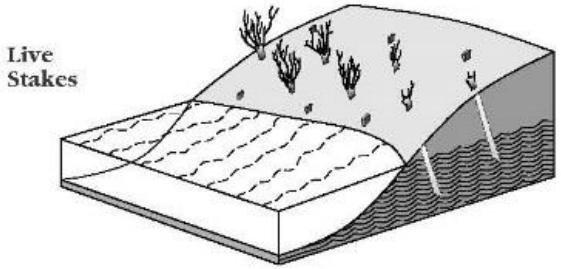
Stabilization Techniques

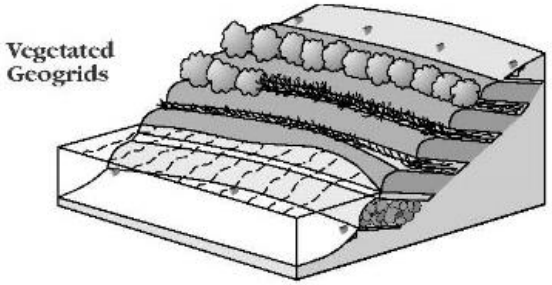
Treatment	Description	Costs	Equipment Required	Stabilization Purposes			Comments
				Toe protection	Upper bank protection	Runoff control	
Preparation							
Bank shaping	Removal of soil to reduce the slope of very steep banks to a more stable angle.	Moderate to high	Hand tools or power machinery	Used in conjunction with other techniques			Stabilization techniques can be more successful with a stable slope.
Live Plantings							
Vegetation	Trees, shrubs and other vegetation used to stabilize banks.	Low	Hand tools or light power machinery	✓	✓	✓	May require protection from flowing water (stakes, erosion control matting) during root establishment.
Live stakes	Branches of rootable plants inserted into the bank.	Low	Hand tools		✓		A flexible technique with many applications.
Branch packing	Live branch cuttings incorporated into compacted soil.	Moderate	Hand tools		✓	✓	Used to fill depressions in soil.
Live fascines	Bundles of live branch cuttings that are buried into the bank and staked in place.	Moderate	Hand tools		✓	✓	Enhances conditions for colonization with native vegetation; often used with other bioengineering techniques and vegetative plantings.
Bioengineering							
Vegetated geogrids	Alternating layers of live branch cuttings and compacted soil layers wrapped in geotextile fabric to rebuild and vegetate eroded banks.	High	Hand tools	✓	✓	✓	Can be installed for steeper and higher slopes; useful in restoring outside bends where erosion is a problem.
Brush mattress	Live branch cuttings covering entire stream bank and secured in place.	Moderate to high	Hand tools		✓	✓	Provides immediate complete cover and long-term stabilization.
Tree revetments	Rows of cut trees (usually cedar trees) anchored to the toe of the bank.	Low	Hand tools or light power machinery	✓			Often used as toe protection with other bioengineering techniques.
Coconut fiber roll	Flexible "logs" made from coconut hull fibers, staked at the toe of the bank.	Moderate	Hand tools	✓			Used in conjunction with native plants to trap sediment and encourage plant growth.
Hard armoring							
Rock riprap	Large stones along the slope of a bank to stabilize the soil.	Moderate to high	Light to heavy power machinery	✓	✓	✓	Requires good design and construction.
Gabions	Wire baskets filled with rocks.	High to very high	Light to heavy power machinery	✓	✓	✓	Can reduce or eliminate the need for bank sloping by creating a vertical wall.

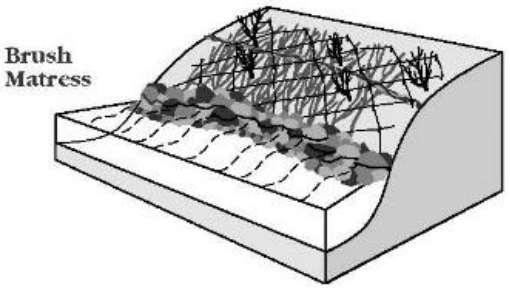


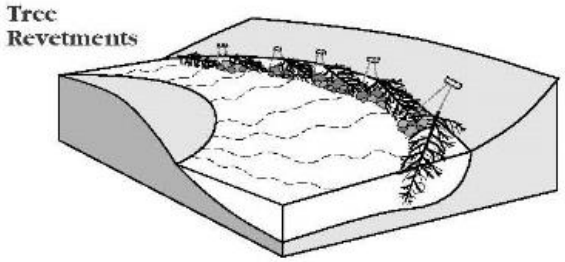


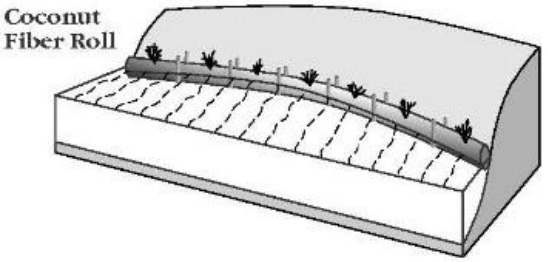


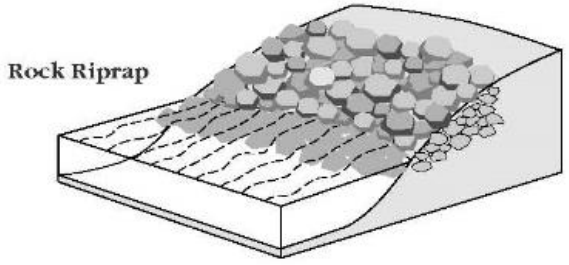


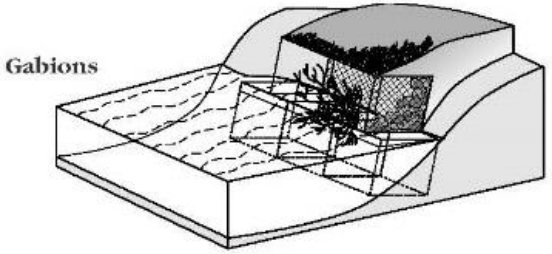












Illustrations were adapted with permission from "Stream Corridor Restoration: Principles, Processes, and Practices," by the Federal Interagency Stream Restoration Working Group

Existing erosion observed on site.

3.2 City Engagement

The City of Spartanburg and Spartanburg County shall be engaged in the stream restoration/slope stabilization process, particularly as any mitigation efforts will affect stormwater control and runoff. In order to fully address unfunded federal and state mandates, the City of Spartanburg adopted a storm water utility fee in May of 2010. The fee provides reliable and stable resources to adequately fund the City's mandated storm water management program and help fund drainage improvement projects that will help to alleviate flooding problems and protect streams from erosion and sedimentation. More information about the Stormwater Fee and the City's Stormwater Infrastructure Improvement Plans can be found at: http://www.cityofspartanburg.org/public-services/streets-stormwater/stormwater-fee.

4 Landscape Enhancements

The perimeter of the Converse Heights Ravine Nature Preserve varies significantly. Some sections have evidence of invasive species encroachment, while others show evidence of illegal dumping of landscape and building materials. Along the western edge of 'Pod 1', plantings and landscape improvements were installed to better mirror the adjacent residential development, while emphasizing a park atmosphere.

It is recommended that as trash and invasive species are removed from the site, additional landscape improvements should be planned and planted along the perimeter of the preserve lands. Maintaining the plant palette that was established by the initial landscape project will create a consistent aesthetic for the entire area.

Existing landscaping along 'Pod 1'

5 Reforestation/Regeneration

Once the abundant invasive shrubs and groundcovers are removed, natural succession processes can once again rejuvenate the Ravine Nature Preserve. It is recommended that the neighborhood association encourage native plant species, through specific planting programs and/or selective clearing of unwanted nonnative species.

5.1 Suppressed Succession

Succession is the natural change of an ecological community through time. In forest ecosystems following a disturbance (fire, flood, human land clearing), a community is colonized by early successional species that grow well in disturbed areas and full sunlight (e.g. cottonwood, aspen). Over time (years to decades) the forest will become dominated by late successional species (e.g. maple, beech) that require more stable conditions and can reproduce in the shady understory of the forest. Saplings and young trees of shade tolerant species such as red maple will need to be planted at the preserve since natural colonization is unlikely. Given the above constraints, improving tree regeneration will be a challenging prospect with no guarantee of success, but due to the importance of the woodlands at the preserve, attempts should be made.

In addition and concomitant with improving tree regeneration, native woodland understory vegetation and shrubs could be planted. Herbaceous species such as wild geranium, trillium, meadow rue and wild leek, as well as ferns, grasses and sedges would all be suitable and attractive additions. Native woody shrubs include several types of dogwoods and viburnums, among others. Similar to tree saplings, woodland flowers and shrubs would also require protection from deer and control of invasive species. A wide variety of native species will need to be planted to see which thrives and results should be closely monitored. Tree species that are adapted to wet soils such as red maple, silver maple, swamp white oak, pin oak and green ash, as well as more cottonwood and black willow, are all species that should be tried. This trial and error approach to determining the best woodland tree and plant species mix for the preserve would be an excellent opportunity to engage students and volunteers in ecological monitoring and data collection

5.2 Wildlife

Reforestation efforts can also encourage wildlife species diversity. Clemson University Cooperative Extension recommends the following in regards to Forest Regeneration Practices:

Many animals need several stages of plant succession available to them in order to live, reproduce and flourish. That is why wildlife are abundant in areas that have a balance of older forest and regenerating forest. Several things can be done to enhance wildlife habitat when a forest is regenerated. During site preparation, efforts should be made to save living trees as well as snags. Living trees continue to provide dens and mast. Soft mast trees such as dogwood, sassafras and black cherry should not be destroyed. Retain some groups or clumps of mature trees in clearcut areas. These

islands should be about one-third acre in size and contain mast-bearing trees such as oaks or beech.

Habitat diversity can be improved by regenerating pine stands in areas of mostly hardwood forests. These stands provide escape cover and other benefits and should be randomly placed throughout the preserve. Similarly, hardwood stands can be retained or allowed to develop in areas managed for pine. Forested corridors between clear cut and regenerated pine stands and along streams are logical places to manage for hardwoods (http://www.clemson.edu/extension/natural_resources/wildlife/publications/fs20_managing_for_wildlife_diversity.html).

6 Management Action Plan

Table 6-1: Three Year Management Action Plan

	Year One	Year Two	Year Three
Consultant and Design	Environmental Survey	Evaluation of Ravine Nature Preserve Master Plan/Perimeter Landscape Design	
Invasive Maintenance and Management	Clearing of invasive species as indicated in the environmental survey	Seasonal evaluation and maintenance of invasive regrowth (See Table 2:1)	Seasonal evaluation and maintenance of invasive regrowth (See Table 2:1)
Stream Bank Restoration	Erosion control and bank stabilization after removal of invasive species	Reforestation and replanting of stream bank	In-stream rehabilitation and restoration.
Perimeter Landscape	Removal of yard debris and enforcement of dumping along perimeter.	Installation of perimeter landscape Phase 1	Installation of perimeter Landscape Phase 2

As the Converse Heights Neighborhood Association begins the process of maintaining and enhancing the Ravine Nature Preserve, it will require both monetary and physical investment from the community. Partnerships with local research institutions, the City and County, as well as local residents will provide the expertise and manpower to mitigate the existing ecological and environmental challenges on the site, while enhancing the stunning existing landscape features.

Table 6-2: Anticipated Management Costs

	Unit Cost	Quantity	Total
Environmental Survey (Wetland delineation and plant species massing)	$5,000	1	$5,000
Clear Invasive Species (Average Estimated per Acre)	$5,000 (Manual) $12,000 (Mechanical)	10 Acre (Approximate acreage of site covered in invasive species)	$50,000-$120,000
Stream Restoration (Estimated per linear foot – additional design requirements based on Environmental Survey)	$125	12,000	$1,500,000
Perimeter Landscape Enhancements (Average Estimated per linear foot: Assumes 1 Ornamental Tree, 6 shrubs, and 25 groundcovers per 20 linear feet)	$40	3,750	$150,000

Reforestation (Average per Acre)	$5,000	14	$70,000
Maintain Invasive Species and Undergrowth (Average Estimated per Acre)	$1,500	16	$24,000

7 Additional Resources:

USDA

http://www.fs.usda.gov/main/r8/forest-grasslandhealth/invasivespecies

A Field Guide for the Identification of Invasive Plants in Southern Forests

http://www.srs.fs.fed.us/pubs/gtr/gtr_srs119.pdf

A Management Guide for Invasive Plants in Southern Forests

http://www.srs.fs.fed.us/pubs/gtr/gtr_srs131.pdf