APPENDIX A

NATURAL RESOURCES

APPENDIX A1

PEASE PARK NATURAL AREAS MANAGEMENT GUIDELINES

Natural Areas Management Guidelines Pease Park Master Plan

In recent years the Pease Park Conservancy and its partners have realized that a long term commitment to protect the natural setting of Pease Park is essential to preserving it for future generations, and that the degree of thoughtful stewardship is directly related to the quality of the visitor experience. Stakeholders who participated in the public input process for the master plan insisted that the highest priority of the Master Plan should be to "preserve and enhance the natural environment". It is the intention of these guidelines to reflect and support that objective by offering recommendations for the ongoing management of Pease Park's precious natural areas. The following guidelines, both general and specific, will be organized within a process-oriented framework that seeks to initiate natural recovery and self-repair of damaged or diminished areas with realistic management objectives. When these techniques are applied in a steady, incremental, and adaptive manner, the potential outcomes include:

- Repair of primary ecological processes—plant regeneration, soil creation and stabilization, water infiltration and processing, control invasive species, reduce erosion.
- Create healthy, complete plant communities—use of native flora including trees, understory, and groundcover, to create complete riparian, woodland, and savanna plant communities that are diverse, aesthetically appealing, and provide for rich wildlife habitat as a natural refuge in an urban setting.
- Create resilient landscapes—they can adapt and withstand drought, heavy use, and other factors.
- Enhance the user experience—through natural landscapes that are aesthetically pleasing, compelling, exciting, and informative.

As described in the Natural Resource Inventory section, Pease Park has irreplaceable value as an open space corridor, a recreational amenity, a refuge for flora of fauna within an expansive urban core, and an integral part of the Shoal Creek Watershed. The work outlined here recognizes this community and ecological value and builds on the work of previous studies and efforts to improve the site. Numerous organizations have been involved with the caring of Pease Park and the Shoal Creek Greenbelt including: Pease Park Conservancy (formerly Trees for Pease), the City of Austin Parks and Recreation Department, Shoal Creek Conservancy, Austin Parks Foundation, Friends of the Forest Foundation (Eeyore's birthday celebration supporting organization), the City of Austin Watershed Protection Department, as well as numerous individuals and volunteer groups. Recent efforts by Pease Park Conservancy in the park have shed light on effective strategies for the reestablishment of upland forests, the creation of shaded areas for recreation, soil decompaction, erosion control, and invasive species removal. This volunteer effort has been completed with over 10,000 volunteer hours by Pease Park Conservancy and its partners. In addition to these volunteer efforts the City of Austin Watershed Protection Department has completed and is imminently going to begin further work to stabilize the bed and banks of Shoal Creek, restore riparian habitats, control stormwater, reduce erosion, and control invasive species. Work has been completed from the Janet Fish Bridge to the Gaston Bridge with further work planned to 15th street. The guidelines here recognize the substantial efforts by Pease Park Conservancy and the Watershed

Protection Department and recommend practices that will integrate and compliment ongoing and previous efforts. In addition, the guidelines, recognize the power of volunteer efforts in the park and recommend tasks and procedures that will further enhance the effectiveness of volunteers.

ADAPTIVE MANAGEMENT AND PROCESS APPROACH

It is important to remember that Pease Park and the Shoal Creek Greenbelt are dynamic, living landscapes. They are ever changing and will respond differently at different times to the same treatment. In addition, land management practices are processes that often take multiple steps over many years where conditions may change midcourse. For that reason, all information here should be looked at through an adaptive management lens. Adaptive management is an iterative process, which allows land management practitioners to learn about the particular site over time, as circumstances change, and adjust methods accordingly. The recommendations here are based on established best practices by the City, Pease Park Conservancy, Siglo Group, and other entities. As these guidelines are implemented in different areas, years, and circumstances outcomes should be evaluated and practices adjusted to make for the most efficient use of resources to create the most desirable outcomes.

The guidelines consider the need for a resilient, adaptive landscape in three primary ways:

- The guidelines recommend plants and plant communities that naturally evolved in this location and are adapted to the variability that occurs in this area.
- The guidelines recommend diversity in all areas as a measure to react to substantial changes in weather conditions such as the ongoing drought or climate change. This measure realizes that some species and even some genotypes may do better than others as circumstances change.
- The guidelines break the study area down into workable areas for implementation and evaluation of results. The land management tasks are listed per landscape Character Areas in Appendix A2, tasks are prioritized in the landscape schedule in Appendix A3, monitoring forms to evaluate work done and results are provided in Appendix A7.

Even with these measures, the potential of climate change and/or prolonged drought can have substantial impacts on restoration activities.

INTEGRATING NATURAL AREAS MANAGEMENT WITH RECREATIONAL PROGRAMMING AND THE USER EXPERIENCE

Pease Park is a historic district park that is beloved as a place to picnic, play, explore nature, splash in the creek, walk the dog, participate in festivals, along with numerous other activities. The natural areas management guidelines recognize the importance of these user experiences and recommend ways that natural area management will enhance the user experience through interaction with the flora and fauna of Central Texas by creating shade, aesthetically pleasing landscapes, framing views, buffering unsightly

objects, reducing hazards such as erosion, and informing the user experience to create more resilient landscapes. The park already provides and will continue to provide a spectrum of recreational opportunities ranging from ball fields and picnic areas to quiet walks through the woodland trails. This range of natural areas and range of recreational opportunities has naturally evolved into a division of the guidelines between those areas where natural area management supports recreational opportunities (recreation dominated landscapes) and areas where natural area management informs recreational opportunities (natural area dominated). The natural area management zones can be seen in the Natural Areas Management Zone Map (pg. 20).

Vegetation Type	Recreation dominated	Natural Area dominated
Riparian	Specific crossings and access points only	Wooten Woods, Caswell Shoals, Ramble Scramble, Lamar Slope, and Bluffs as well as edges of Custer's Meadow, Polecat Hollow, Big Field, Custer's Meadow, Polecat Hollow, Big Field, and Gaston Green
Savanna, Lawn, and Developed Areas	Lamar Terrace, East Bank, Gaston Green, Custer's Meadow, Polecat Hollow, Big Field, Kingsbury Commons	edges of Custer's Meadow, Polecat Hollow, Big Field, Custer's Meadow, Polecat Hollow, Big Field, and Gaston Green
Woodland	None	North Ramble, Hillside, Bluffs, Ramble Scramble slopes, and Windsor Hillside.

In the Riparian and Woodland Zones, where natural area management informs the user experience, major tasks include: restoring and maintaining ecological processes, establishing native vegetation, invasive species management, widening riparian areas, revitalizing soils, expanding "no-mow" areas and implementing the Grow Zone program, using vegetation to buffer and define views, enhancing vegetative structure (full canopy, understory and groundcover), and creating protocols for the establishment of vegetation. A healthy example of this type of area is the North Ramble where Texas ash is naturally regenerating. Through restoration efforts this area is recovering from over use and provides a natural experience for user's in a regenerating woodland. An example in need of greater or more complex care is Wooten Woods just north of the 24th street bridge on the west bank of Shoal Creek. Looking up, this area has a magnificent Cedar Elm and Live Oak Canopy. Looking at the ground we unfortunately see that the combined effects of undefined use and scouring floods have left the area with little groundcover or understory, a severely widened trail, and invasive species. These areas and others like them will benefit from management practices that understand the user experience, and help inform and define it through land management techniques.

In the Savanna, Lawn, and Developed Areas natural area management will respond to and support recreation and programming. These areas include Kingsbury Commons with the historic picnic area and playground along with the Big Field where informal ball games are played and Eeyore's Birthday Celebration takes over once a year. Key natural area management elements in these areas include: signature plantings, tree care, canopy enhancement, soils revitalization, stormwater absorption, riparian edge enhancement, increase diversity where feasible, and defining user experience in sensitive areas.

ELEMENTS OF NATURAL AREAS MANAGEMENT

Here we describe the general concepts of natural areas management and recommended techniques. These techniques are applied to each of the landscape character areas in Appendix A2 and a recommended schedule of activities is shown in Appendix A3.

The methods here work towards the ecological restoration of the site. Ecological restoration is the act of enhancing natural processes in a landscape where they may not exist or are impaired. We will be looking here at repairing environmental degradation, as well as enhancing plant communities and habitat.

REPAIRING ENVIRONMENTAL DEGRADATION

Environmental degradation can come from many factors both natural and manmade. Before an area can be restored the major issues impacting the area must be addressed or else it is likely the area will fall back into disrepair and restoration efforts will be ineffective. Here we will look at the three main factors degrading Pease Park and Shoal Creek Greenbelt environment: invasive species, erosion, and soil compaction.

Invasive Species

In order to restore the landscape and prevent further damage, invasive plants will need to be removed where possible. By removing invasive species, we set up the opportunity to create increased native vegetation and habitat (City of Austin 2012). There are 32 invasive plant species found at Pease Park that are negatively impacting the property as seen on pg. 13 of Appendix A9 Natural Resource Inventory section along with a more complete description of the impacts of invasive species. The table lists each species, its threat level, and how it is impacting Pease Park. The invasive plants causing the largest impact at the park or having the potential for a substantial impact in the near future are: Arundo, Ligustrum sp. (Chinese privet, Japanese privet, and small leaf privet), bamboo, catclaw vine, Chinaberry, Mexican petunia, and Chinese tallow.

In Appendix A6: Invasive Species Controls-- both physical and chemical controls-- are described in detail along with recommended practices for the species found in the study area. These best practices are an accumulation of best practices used in Central Texas and recommended by City of Austin Watershed Protection Department. ***As these practices are implemented it is critical to remember that invasive species control is a process with multiple steps. After an initial treatment is made, the follow up to that treatment is the only thing that will keep the situation from regressing.***

(Texas Invasives 2013) An example of this was seen recently in the Ramble Scramble where great volunteer efforts were made by Pease Park Conservancy and others to remove golden bamboo. Unfortunately due to some scheduling and budgeting conflicts no repeat mowing or herbicide treatment occurred. As a result, the stand came back in one year. These controls include numerous steps with ongoing management procedures. Their success will directly correlate to repeated treatment and ongoing care and dedication. This is true for all practices outlined here.

Erosion Control

Erosion is a major issue throughout the park associated with creek flows, stormwater, trail design, slopes, and user disturbance. Over fifty erosion problems were documented throughout the site and can be seen in the Invasive Species and Erosion Map (pg.21). In much of the study area erosion caused by stormwater and creek flows has been or is being addressed by major creek bed and bank stabilization projects by the City of Austin Watershed Protection Department. We look at erosion here as it affects trails and stormwater flows within areas not addressed by the City of Austin plans. It is important to note that erosion areas as well as the repair of erosion issues are highly susceptible to invasive plant infestations and should be monitored closely.

Trail and User Traffic Erosion

Trails throughout the park and particularly those in sloping topography must allow for the shedding of water to reduce issues of water accumulation and eventual erosion. This is particularly true on some of the mulched trails within the North Ramble, Hillside, and the Bluffs. Best practices for trail construction call for water bars or other means to create dispersed downhill flow of water without the formation of channels. Currently, most of the trails in the park have no means of shedding water. Water bars—small berms placed at an approximate 60 degree angle to the slope that move water off the trail and into a small rock armored basin—should be placed so that water can disperse downhill. The spacing of waterbars is determined by the grade of the hillside and should be done on a case by case basis with a trained professionals or volunteer. Steps can also be incorporated in steeper areas but limit wheeled traffic.

Unauthorized paths and trails need to be actively discouraged. Informal paths quickly become denuded of vegetation and often become part of the commonly used trail network causing erosion as well as a host of other issues. As part of ongoing monitoring efforts at the park, trained volunteers or professionals should be monitoring for new foot paths or erosion issues four times a year, and creating action steps for closing and restoring areas degraded by off-trail human and pet activity. Brushing impacted areas—using cut vegetation from pruning or invasive species removal to block trail and make walking more difficult-- is one of the simplest and effective ways of doing this (Hockett etal 2010). Cut vegetation should be placed over impacted areas for at least 30 feet from intersections with formal trails. The cut pieces do not need to be large or have great height, only difficult to walk through. Densely branched invasives such as Ligustrum are especially good for brushing off-trail activity.

Stormwater Erosion

Water entering the project area from offsite is causing erosion issues in numerous places (PBS&J 2009). This includes stormwater runoff entering from Lamar Blvd, water flowing in from Parkway and Kingsbury, and water coming directly in from neighboring lots. The Watershed Protection Department has identified where water entering from site edges is causing major erosion problems and will be installing rain meadows and swales to slow the water as it enters the site in Custer's Meadow as well as Polecat Hollow.

For stormwater erosion areas not addressed by the Watershed Protection Department's project, there are a few good options. For smaller issues, there is the potential capacity to simply armor the nick points of erosion, create dispersion, and slow down the water in the immediate area. Small degraded areas can be filled with with organic material from other land management activities. For issues associated with blockage of a water flow through an area, the construction of a simple French drain, or culvert like structure may be appropriate—this solution is appropriate where water is washing out parts of a trail. Finally for larger stormwater issues, the master plan has identified potential areas where rain meadows, like those being installed currently by the WPD work, could be installed in the future.

Soil Degradation

The soils of the park have been degraded with substantial loss due to erosion as well as compaction due to human use. For effective restoration it is necessary to supplement degraded soils in some parts of the natural areas. This is currently an ongoing practice being taken on by Pease Park Conservancy with the use of mulch and Dillo Dirt. The ideal source for the organic material is mulch from onsite which has the added benefits of getting rid of on-site debris—invasives or pruned material—and stabilizing areas recently cleared. With the use of off-site inputs, it is important to make sure no new invasive species have the ability to invade the study area. When considering other sources—other mulch or compost—the use of nutrient inputs should be evaluated on a case by case basis. The native plant pallet within the study area evolved in and is best suited to the native soils (Lady Bird Johnson Wildflower Center 2007). While organic inputs will support better restoration, it is important to remember that substantial increases in soil nutrients may give growing advantage to non-native plants rather than the native plants highlighted in this plan.

In areas where new live planting are being installed and existing tree roots are exposed it is recommended to add 4 inches of mulch. This builds up soil, protects existing tree roots, and protects the soil layer from erosion. In areas where seeding is to take place, fine organic material can be mixed with the soil and seed mix to create a nutrient rich top dressing, again, it is imperative that the nutrient input is at a level that does not put non-native species at an advantage over native species.

ENHANCING PLANT COMMUNITIES AND HABITAT

The vegetation of the park and greenbelt create the structure and rooms through which habitat and our experience are created. Once the degradation of an area has been controlled we can begin to restore

the native vegetation which in turn creates habitat for humans, plants, and wildlife. In many cases, merely stopping degradation will result in the natural regeneration of native flora. In other areas, supplemental seeding and/or planting is necessary as well as a long-term plan for care and management. Here we describe the basics of establishing and caring for native flora, restoration of plant communities, and enhancing wildlife habitat throughout the study area.

ESTABLISHING AND CARING FOR NATIVE FLORA

Here we have broken down the establishing native flora into planting and seeding, trees and tree care, understory and groundcover establishment. While the actual process of restoring flora is an integrated process as discussed in the next section on Restoring Plant Communities, each of these elements are critical to creating complete plant communities and have therefore been broken out here.

Planting and Seeding

In all cases, it is recommended that the seeds and plants are sourced from Texas and preferably Central Texas to insure that plants are viable for use in the Pease Park environment. In addition, planting, care, and seeding should be overseen by experienced professionals or volunteers to insure the survivability of the plant material from initial planting to full establishment in 3 to 5 years.

While a few plants are mentioned here to generate interest, the list of recommended plants can be found in Appendix A5. This list creates a substantial baseline for healthy plant communities in the park and greenbelt. The plants are chosen based on the following criteria:

- They are native to the Central Texas area;
- They are available through the local nursery trade or native plant society groups;
- They have been successfully used in restoration projects within Central Texas and/or they add diversity to the current and future plant palette at Pease Park and the Shoal Creek Greenbelt;
- They are listed in the Texas Parks and Wildlife Department's descriptions of the vegetation types found at Pease Park; and/or
- They have been recommended for this or similar projects by arborists, ecologist, or land management professionals.

Live plantings works to quickly stabilize soils, increase diversity, shade out invasives, better define the user experience, and/or create formal landscapes (City of Austin Urban Forestry Board 2013). Where appropriate, canopy, understory, and groundcover plants are recommended for planting in individual landscape character zones. Because of increased labor and costs, plantings are generally recommended in those areas with high visibility or in areas where degradation is substantial enough that natural generation and/or seeding would be slow or impractical.

Seeding can be used in areas where the need for immediate results is not as critical or where established plantings are being complimented with greater diversity through seeding. As with all practices seeding should be overseen by a trained professional and/or volunteer with a focus on seed bed preparation and insuring that no invasive species in the area will undermine the seeding efforts.

While restoring or augmenting plant species is a task for each of the landscape character areas listed in Appendix A2, it may not be realistic to plant entire areas due to costs, labor, access, or time. Remembering that this is a process, planting or seeding some areas as "Seed Islands" is appropriate. A seed island is an area that has been planted/seeded with the intent of the plant material in that area spreading to surrounding areas. The city of Austin's Watershed Protection Department's Grow Zone program has initiated a "seed island" program that uses this approach. The seed islands are small areas (can be as small as 8ft by 8ft) that have had invasive species removed, compost added, erosion controls added as needed, and native seeds and/or plants introduced. The seed island concept can be used in any of the landscape character areas described in Appendix A2 and all planting and seeding efforts should be thought of as seed islands for the surrounding areas.

Adding to the seed island concept, it is recommended that some areas be fenced off in the landscape character areas for periods of time. This reduces stressors including herbivory and trampling, allowing for a more delicate selection of plant propagation in an isolated area. These exclosures can be used in newly planted areas that have experienced substantial degradation in the past, or in areas that experience large amounts of informal recreational traffic. The goal with creating these exclosures is to reduce major impacts or to allow for very specific plants to become established in specific locations.

Trees and Tree Care

Part of the appeal of Pease Park for users, and a significant part of its ecological value, comes from the many majestic trees found throughout the Park. The 2013 Austin Urban Forest Plan points to the wide public appeal of the urban forest as well as the many benefits of the trees in the city. At Pease Park, the trees are particularly valued by Park users for providing shade, screening the views of Lamar Blvd and nearby homes, and providing wildlife habitat. From an ecosystem services perspective, the trees are important for intercepting rainfall, stabilizing the banks of Shoal Creek, filtering air, and providing shade and relief from the hot temperatures of summer.

Appendix A4 is a tree report by Don Gardner, consulting arborist, compiled as a part of this master planning process. The assessment looked at dangerous trees in highly used areas as well as general tree care, and recommended trees for future planting. Trees needing immediate care within the report and location information for those trees has been provided to the Parks and Recreation Department as a narrative report and in geographic location files (shapefiles). Some portions of the park are in urgent need of tree care for the safety of park users and the longevity of the existing trees. Of note, are the many cedar elms in the Kingsbury Crossing area needing substantial weight reduction due to mistletoe infestation.

The master plan calls for increased tree canopy in all areas where the new canopy does not impact recreation, driver safety, or other infrastructure. Numerous portions of the park will benefit greatly from tree planting and natural tree regeneration. The establishment of trees as recommended below is one of the most effective ways to enhance the user experience and increase the ecological functionality of the park.

Allowing natural tree regeneration is the most cost effective way to increase the number of trees. Hackberry, live oak, Texas ash, green ash, and cedar elm are all regenerating naturally in areas that are not being mown or trampled. Just the simple act of changing visitor use patterns or changing mowing regimes will create new desirable woodlands. The North Ramble is a great example of natural regeneration where Texas ash is currently creating an immature tree thicket that, with proper management, will grow into a full canopy in the coming decades. This contrasts with some of the areas in the Hillside Area were trampling and informal trails are inhibiting natural regeneration.

Using an adaptive management approach and recognizing that the natural establishment of a functional woodland is a many decade process, it important to remember our management role in facilitating and catalyzing healthy canopy establishment through tree planting and care. This is especially true in highly used, relatively rare urban open spaces like Pease Park. The care and planting will compliment natural regeneration to expedite the creation of an ecologically functional, aesthetically please canopy. The diversity of the canopy, as described in the adaptive management section above, will make the canopy more resilient when facing blight, drought, or climate change issues in the future. The Land Management Recommendations by Landscape Character Areas in Appendix A2 recommend tree planting in numerous areas to facilitate the establishment of a resilient canopy.

Numerous decisions will affect the success of tree plantings including: selection of tree species, size of trees planted, season when its planted, where its planted, how its planted, irrigation, and care. Basic tree care and planting recommendations are summarized in Don Gardner's Report in Appendix A4. Here are a few critical things to remember with trees—as with most plants:

- Prepare for Success—insure trained individuals are a part of all planting activities, make sure area is prepared for planting and any ongoing degradation issue has been managed (such as invasive species, erosion, and soil compaction). Plant at the right time of year.
- Plant the Right Plant in the Right Place—The Recommended Plant List can be found in Appendix A5. Insure that if it is a riparian area you are using a riparian species, if it is an upland area you use an upland species. Even beyond these distinctions within the recommended plant list, an experienced professional and/or volunteer should be facilitating decisions about where particular plants are placed. For instance Bald Cypress will likely do best on the banks of the creek or very close to it. Pecans may do best at the bottom of the slopes at the outer edges of the floodplain terrace, and cedar elms could do well throughout the entire floodplain terrace.
- Use the Smallest Size Tree Practical—Planting small caliper and bareroot trees allows resources to go much further because the costs of buying the plant material and costs of putting the plants in the ground is lower (Duncan and Richter 2012). That said, in areas where trampling and/or aesthetics is of immediate concern, larger trees may be appropriate.
- Naturalistic planting design – planting trees in clumps rather than spacing them evenly will create a more natural aesthetic. These trees will grow up to form groves, which is often how trees are encountered in central Texas.

- Care for the Trees—Planting trees is just a part of the process. Caring for the planted material and monitoring progress is critical to a projects success. Monitoring and care should include insuring sufficient irrigation during the establishment phase, invasive species are not outcompeting planted material, and no other outstanding issue is inhibiting success. Trees generally take from 3 to 5 years to become fully established.

The sloping sides and the riparian core of Pease Park and the Shoal Creek Greenbelt suggest that most of, if not all, the study area is most appropriate to be in woodland. Add to this the desire and real need for shade in the park and Don Gardner's words ring true: "Trees are the Answer" for much of the park and greenbelt. Many areas of the park can be moved to greater canopy cover through both natural regeneration, seeding and live planting. This move to woodlands, where feasible, will result in a more aesthetically pleasing, shaded environment that is ecologically functional.

Understory and Groundcover Plants

Healthy understory and groundcover species are critical to the long-term health of the park. These vegetation layers add greater plant diversity, stabilize and build soil, create wildlife habitat, direct the user experience, protect against erosion, and create visual interest. Re-establishing these layers where they have been mowed or trampled is critical for ecological functionality and aesthetics of the site. Understory can be particularly effective as part of the riparian edge to guide users to defined experiences with the creek and to frame views.

As with all components of restoration, it is critical that trained professionals and volunteers are responsible for the tasks associated with understory and groundcover establishment. In places where the simple act of limiting trampling and/or mowing is not effective to increase understory and groundcover basic elements of restoration will include:

- Proper Preparation—The ground should already have been evaluated and potential treated for soil compaction, lack of organic material and invasive species.
- Good Timing—Cool season grasses and spring wildflowers will do better if sown in the fall, while warm season grasses and fall wildflowers may be planted in late winter. Live plantings should be considered from late October to late January so the young plants have an opportunity to become established before the heat of summer.
- Proper Seeding Rates—this rate will vary based on whether the seeding is adding diversity to an area already being restored or an area prepped specifically for seeding.
- The Right plant for the Right Places—as with trees, lists of plants for planting are included in Appendix A5 categorized by upland or riparian, sun or shade, understory or groundcover.
- Proper Practices-- Trained professionals and/or volunteers should supervise all projects.

Live plantings should be considered where there is: immediate aesthetic appeal desired, a history of trampling that will inhibit establishment, a need to stabilize soils, a lack of desirable species in the seed

bank, a need to out compete the reoccurrence of invasives. Plants should be smallest suitable for the site and an irrigation plan should be created.

If "Trees are the Answer" for much of Pease Park and the Shoal Creek Greenbelt, then understory and groundcover restoration is what makes that answer possible. Severe erosion and soil compaction has plagued much of the study area. Through the ongoing practice of understory and groundcover restoration the implementation of this master plan will result in robust habitats that supports multiple layers of vegetation.

RESTORING PLANT COMMUNITIES

The establishment of native flora will occur within the different plant communities and habitats of the study area. As described above these areas can be divided into those where natural area management information recreation and areas where natural area management supports recreation. Here we describe the restoration of the riparian and woodland zones as well as natural area management practices appropriate for the savanna and lawn areas.

Riparian Zone Restoration

The creek bed is an incredibly dynamic, sometimes violent environment. This variability is currently controlled by circumstances outside of the study area as described in the Natural Resource Inventory section – Appendix A9. The high levels of impervious cover within the watershed have reduced base flows and increased flooding events (PBS&J 2009).

The capital improvements conducted in the park to date are stabilizing the banks. In addition to the gabions and boulders put in place, natural stream structures of a tree lined creek occur at numerous stretches along the creek. The natural regeneration of trees in these areas, along with planting of trees is a top priority. The selection of trees as stated earlier should add to the diversity of what is naturally regenerating to create a more resilient riparian canopy. Beyond the ash that is prolifically regenerating in many areas, a combination of fast and slow growing trees should be added to the diversity through planting and seeding including: sycamore and black willow for fast results and to create that long-term cathedral canopy around the creek bald cypress and American elm should be planted along the Riparian Zone. Numerous other plants appropriate for the riparian area can be found in Appendix A5.

Along the banks the understory and groundcovers are critical in the Riparian Zone for soil stability, filtering water, and creating richer habitat for wildlife (NRCS 2012). The implementation of the "grow zones" in these areas along with supplemental seeding and planting is recommended. In those areas where there is a great desire for aesthetic improvements, or trampling will likely inhibit the establishment of plants, live plants are recommended of a size that will direct the user experience.

In the creekbed there is great potential for increased diversity with regards to plants and wildlife. Unfortunately, the current extreme fluctuations of water flow from flooding to drought make this a less desirable area to dedicate resources. This should be evaluated in the future as other tasks are completed and conditions change.

Savanna and Lawn Natural Area Management

In many of the large mown, recreational areas in the park there is the opportunity for more sun loving, plants that call attention to the Blackland Prairie found in the eastern portions of Austin. Plants such as little bluestem, big bluestem, indian grass, switch grass, and eastern gama grass can be planted to shade out Bermuda grass in select formal areas with a mix of Texas wildflowers for seasonal interest. The management of these particular areas will need to be a no mow area except for an annual clean up in winter. These areas of course should not impede recreation but help guide and enhance the user experience.

The areas kept open for recreation at Custer's Meadow, Pole Cat Hollow, the Big Field, and Gaston Green are heavily maintained turf grass fields dominated by Bermuda grass. While there could be opportunities to convert these areas to native turf mixes in the future, it is not currently seen as a priority due to costs, benefit, and proven long-term effectiveness. As PARD best management practices find evidence that native turfs are effective in highly used recreational settings, conversion of the lawns at Pease Park and the Shoal Creek Greenbelt should be considered.

Where lawn is currently being maintained but not used for recreation and/or visual appeal, the areas should be converted to riparian woodland, upland woodland, or savanna. Examples areas include: Live Oak Terrace, the Big Field, and Custer's Meadow. In each of these area current mowing practices are not allowing for the establishment of riparian canopy trees, and are thereby creating invasive species niches, erosion problems, and degrading the user experience.

Wildlife Habitat Enhancement

Pease Park and the Shoal Creek Greenbelt already serves as a refuge for wildlife in the highly urbanized Shoal Creek Watershed. Over 180 animal species have been documented in the study area and the immediate surroundings. The habitat at the park has been substantially impacted by its urban surroundings and its many human uses. That said, the uniqueness of the openspace within the urban landscape and its location in the transition zone between eastern and western species make it valuable habitat and an incredibly accessible place for wildlife viewing. By continuing to enhance the natural areas of the park and creating more resilient native plant communities with an emphasis on plants that are beneficial to wildlife for food or habitat, greater amounts and diversity of wildlife will inhabit the park.

Absent a change to the hydrological flow regime, the best thing for wildlife in Shoal Creek's riparian zone and in-stream habitat is to protect and encourage riparian trees like black willows, bald cypresses, and cottonwoods. Areas where trees hang over the water are good for bird species like the green heron and green kingfisher. Plus, the riparian canopy provides valuable habitat for migratory and nesting birds. For example, the summer tanager is a common breeding bird in intact riparian woodlands in the

Austin area, and can still be found in the park during migration. A more mature, diverse riparian woodland could lead to summer tanagers breeding in the park.

Patches of habitat that include shelter and food sources in the park would go a long way to providing refuge for birds and other wildlife in the canopy, in open areas, and in the understory. In open areas, tall grass and wildflower plantings would provide cover and forage for wintering sparrows and numerous migratory species coming through the area for a few days every year. They also provide habitat and food needed by native species of bees, butterflies, numerous insect species, lizards, and small mammals. The native bumblebees nest on the ground, protected by the structure of native bunch grasses. Even a small bed of native flowers in an area of full sun can attract dozens of butterfly species. Savanna habitat and understory plants, especially along the edges of the woodlands, would increase the potential for painted buntings to breed in the park. This species, one of the most charismatic birds found in Texas, commonly breeds around Austin and could be attracted to breed in Pease Park with appropriate management.

The care and restoration of intact plant communities throughout the park and a reduction in negative human impacts naturally leads to better wildlife habitat. As the plant communities are restored, there is an opportunity to increase shelter for wildlife through nesting boxes, purple martin houses, water sources, and/or other mechanisms to supplement natural structures. The result of the natural area management efforts that include preferences for plants and plant community structures that have known wildlife value will result in better habitat and greater opportunities for wildlife observations by park users.

TOWARDS IMPLEMENTATION

The concepts and desire for preserving the natural environment was made clear during the public involvement process of the master plan that put “Preserve and Protect the Natural Environment” of the park at the top of the list. Further evidence of care in stewardship can be seen by the huge volunteer effort already put into the park by Pease Park Conservancy volunteers and their partners. To continue to protect and enjoy this amazing, dynamic natural resource, active management is necessary. The guidelines and concepts above and in the more detailed appendices layout some of the information needed to work towards the goal of preserving and protection the park. Here we focus on some of the elements that can break the site into practical pieces for land management tasks, a land management schedule that prioritizes tasks over the next five years, monitoring recommendations that insure a clear understanding of resources and time invested and allow for a feedback loop of success, metrics to understand how the complex system of management is working towards overall multi-year goals, and finally we look at resources for building greater capacity of the core volunteer group that has carried out so much work at the park already.

TASKS BY LANDSCAPE CHARACTER AREA

As part of the master planning process Pease Park has been divided into landscape character areas to optimize the user experience, determine land management needs, conceptualize park improvements, and define needed tasks in each area that facilitates implementation. The areas are described in Appendix A2: Land Management Tasks by Landscape Character Area. This set of tasks per area can be thought of as the master plan's "to do" list for natural area management.

As described above, the areas have been put into two overarching groups: 1) areas where natural area management informs passive recreation and 2) areas where natural area management supports recreational programming. This was determined by which land management zones—riparian, woodland, savanna, and/or lawn—make up the majority of each area. In addition, the riparian zone has been made into its own character area that can be thought of as a ribbon connecting the park from end to end.

While there are discrete lists in Appendix A3 that can be accomplished in the coming years, the document must remain dynamic and adapt to successes seen throughout the park, new information from related projects, changes in weather patterns, the availability of resources, and/or changes in user preferences.

SCHEDULE

Again, restoration and land management are not an event, but ongoing processes. A five year land management schedule can be found in Appendix A3: Land Management Recommended Schedule. It is a flexible schedule that suggests the need for adaptive management techniques that alter activities based on what is working best and what is seen as the highest priority based on the needs of Pease Park Conservancy and its partners, degradation concerns, or the potential to build off previous successes. While the actual schedule will by necessity change due to the results of treatments and the availability of resources, the schedule can serve as a baseline of important tasks that should be considered for completion in the coming years. In 2018 to 2019, it is recommended that the entire document be revised to look forward an additional five years.

MONITORING

Monitoring is an important step in judging the effectiveness of management (Tu and Meyers-Rice 2001). Monitoring at Pease Park is recommended through geographic, photographic, and narrative descriptions that include annual photopoints, and early detection evaluation, and land management documentation and evaluation.

Photopoints

Photopoints are a fairly quick and easy way to perform qualitative monitoring. 70 photo points were established at Pease Park. The photographs and descriptions are included in Appendix A8: Land

Management Photopoints. GPS points were taken at each location so that they can easily be found, and the photos can be replicated. It is recommended that photos be taken once a year at each of these points. Comparing the photos over time will provide a sense of how areas are changing- whether they are being actively managed or through unmanaged changes-- and give guidance as to what choices to make in the future. These photos along with the general acreage tabulations of treated areas and reoccurrence of issues will be a means by which the success of management tasks can be determined and suggest actions for future activities.

Early Detection Monitoring

Early detection monitoring is not designed to assess whether or not the management guidelines are having their desired effect, but rather to detect new threats at an early stage of development so that they can be addressed quickly. It is not tied to a specific photo point or vegetation plot, but requires a staff member, professional, or volunteer to periodically walk the entire grounds and observe: new invasive threats, expanding invasive plant issues, areas being over used and denuded, new informal trails, and/or new erosion issues. Once new threats are identified, staff or volunteers can quickly take action and prevent a small problem from becoming a larger one that takes more time and resources to control in the future. To be effective, early detection monitoring requires a staff member, professional, or volunteer who is:

- Adept at identifying invasive plants, even obscure ones;
- Very familiar with Pease Park and the Shoal Creek Greenbelt so that s/he can accurately determine if change is occurring; and
- Willing to walk the grounds a minimum 2 times a year looking for new threats.

Examples of potential early detection monitoring forms can be found in Appendix A7.

Land Management Task Monitoring

Pease Park Conservancy and its partners have been actively managing and improving the natural resources through tree planting, soil amendments, and irrigation installation, and invasive species control. However, piecing together a narrative of their efforts currently relies heavily on the institutional memory of key individuals. A simple, standard stewardship action form should be utilized in the future to help future caretakers understand the actions that have been taken, and provide an avenue by which management successes and failures can be better understood. A recommended form is provided in Appendix A7. The form should be filled out at the time of a land management activity that includes area treated, location of area, size of area how it was treated, resources used (including labor), along with photo documentation. These areas should then be placed on a list of areas to be regularly evaluated along with the existing photopoints.

METRICS

The process of restoration in the coming years at Pease Park and the Shoal Creek Greenbelt will have successes and failures with an overall trend that works towards the goal of preserving and protecting

the natural environment. By following the recommendations here and maintaining an adaptive approach, Pease Park Conservancy and its partners should see measurable successes in the coming years. To document these we recommend adopting as part of the master plan some of the following metrics:

- 30% decrease in mowed areas over 5 years—Currently 27.2 acres of the study area are mowed.
- In 75% reduction in 20 highest priority invasive species populations in 5 years (measured as cover for shrub or vine, trunk count for trees). See Table 1 below for description of 20 high priority invasive species populations.
- 50% increase in riparian zone area in 10 years—The non-mowed riparian zone currently consists of 19.1 acres.
- Increase overall canopy cover in the study area to 80%-- Currently canopy cover is at 65% as seen in the Tree Canopy Map, (pg. 22).
- 20% increase in species count overall and in the following major organism groups in the next 10 years: plants, mammals, reptiles and amphibians, fish, and birds. Currently 394 species are known to occur within the study area as seen in Appendix A10.

These metrics suggest a path towards success and provide a quick articulation of some of the overall reasons for the land management practices laid out in the master plan. They also provide a motivation for people to become more familiar with and committed to the site. For instance, the metrics associated with increased species numbers will motivate restoration and habitat enhancement efforts while at the same time motivating observations and record keeping. With available technologies including ebird.com and inaturalist.com park users, professionals, and volunteers can contribute to the records of species observed as the site that can then be verified by experts. The metrics motivate involvement and resource allocation while allowing for measurable, tangible outcomes.

Point	Latitude	Longitude	Primary Invasives	Notes
1	30.281482	-97.752499	nandina and Chinese privet	Minor amounts, prevent density from increasing.
2	30.282965	-97.753819	Privet, Chinese and glossy	Chinese privet forming dense monocultures. Planting required.
3	30.289671	-97.752837	catclaw	Approximately 80 linear feet of catclaw centered here.
4	30.291919	-97.751371	giant cane and Chinaberry	Riparian area near Wooten Woods.
5	30.292442	-97.750531	Chinaberry	A few large mature Chinaberry in this area create a large number of seeds.
6	30.295492	-97.749064	bamboo	Large stand in Ramble Scramble, follow up on previous control efforts.
7	30.297904	-97.750314	Chinese parasol and privet	Area adjacent to Buda Boulder Springs. Restore native vegetation near springs.
8	30.28686	-97.753536	catclaw	Rapid response to small infestation in Caswell Shoals.

Point	Latitude	Longitude	Primary Invasives	Notes
9	30.28629	-97.753467	nandina and Chinese privet	Area where trees have been planted in Caswell Shoals, protect new plantings from invasive competition.
10	30.283511	-97.752676	giant cane	Large patches in Riparian area by Polecat Hollow.
11	30.282024	-97.752764	catclaw	Rapid response to small infestation, growing on one cedar elm in Hillside.
12	30.285364	-97.754812	giant cane	Several clusters on western and southern edges of Custer's meadow.
13	30.290344	-97.752421	Chinaberry and multiple privets	Woody invasives in Wooten Woods.
14	30.293789	-97.747964	catclaw and heavenly bamboo	Rapid response to catclaw in Ramble Scramble, opportunistically control heavenly bamboo while there.
15	30.294211	-97.748112	glossy privet and Chinaberry	Riparian zone with large amounts of Japanese privet and chinaberry
16	30.296337	-97.749658	Chinaberry, nandina, glossy privet, and English Ivy	Ramble Scramble dense invasive stand. Will require plantings in some locations.
17	30.296749	-97.749533	Chinese privet	Chinese privet in Ramble Scramble.
18	30.299109	-97.747264	glossy privet and Japanese honeysuckle	Japanese privet woodland in Bluffs. Treat other invasives while there.
19	30.296543	-97.749033	Chinese tallow	Scattered mature trees in Riparian area between Gaston Green and 29th St. Prevent downstream seeding.
20	30.287009	-97.753666	giant cane	Large patch in Riparian Area by Caswell Shoals

Table 1: 20 priority areas for invasive species control. The point number is not an indicator of priority level. Within this list, priority should be given to a) small, new infestations whose control will prevent infestation from becoming larger such as many of the catclaw infestations, b)follow up control work in areas where initial removal has already been performed, such as the bamboo infestation in the Ramble Scramble and any invasive removal that occurs during Watershed Protection's Shoal Creek Restoration Project, and c)areas that have experienced a high level of disturbance and/or restoration work that makes the area vulnerable to rapid infestation such as the North Ramble and Caswell Shoals. However, locations may be determined by time of year in which resources are available and skill level of work crews performing the work.

STEWARDSHIP AND CAPACITY

Pease Park Conservancy and its partner organizations have a long history of community involvement at Pease Park with over 10,000 volunteer hours put into the park to date. The land management tasks within Appendix A2 are designed with the input and thoughts of groups that can facilitate the work. By complimenting the volunteer efforts with paid land managers, Pease Park Conservancy, and others will find greater success in their efforts and use their resources more efficiently. For example, volunteers

can pull Ligustrum, cut invasive trees under 6 inches in diameter, and stockpiling the cut material as a defined land management activity. Professionals can then come behind the volunteers, and cut larger invasives, paint all stumps with herbicide, and chip waste material into mulch. Volunteers again can spread usable mulch and prepare the area for planting.

As there is great interest and great strides have been made thus far at Pease Park, there are likely volunteers who are interested in learning more about natural area management, trail care, invasive species, mapping, and erosion issues that are affecting Pease Park. Pease Park Conservancy is encouraged to promote local educational programs including for its volunteer group to build capacity and develop a larger set of leaders within the core volunteer group. Activities that should be immediately encouraged by Pease Park Conservancy to its volunteers include:

- Invasive plant identification and treatment training the Invaders of Texas Program at the Lady Bird Johnson Wildflower Center, http://www.texasinvasives.org/invaders/
- Capital Area Master Naturalists training, http://txmn.org/capital/
- Native Plant Society involvement in Central Texas for educational programming and native plant material sources, http://npsot.org/wp/austin/
- Central Texas Trail Tamers for trail construction, evaluation, and maintenance, http://www.trailtamers.org/
- Travis Audubon for bird identification, habitat maintenance and restoration, http://travisaudubon.org/
- Contributing to Citizen Science (ebird.org and inaturalist.org). Observation can be attached to the new place created for this project “Pease Park and Shoal Creek Greenbelt” (http://www.inaturalist.org/places/pease-park-and-shoal-creek-greenbelt) and can contribute to many projects that will further extend interest and observations in the study area including the following Texas and Parks and Wildlife and Texas Master Naturalist projects: Herps of Texas, Mammals of Texas, Birds of Texas, and Plants of Texas. Note that the results of these efforts and those of others using ebird and inaturalist in the study area can be used as a live feed, guide, and checklist made available on the Pease Park Conservancy website and through other interpretive devices.

These programs and initiatives provide interested volunteers with a means to further their personal knowledge and commitment to the work at Pease Park. In addition, participation in the programs is a great way to cultivate a larger, informed volunteer base.

In addition to programs outside the conversancy it is recommended that a body of knowledge is created through writings and documentation that are shared with volunteers within the organization. Over time these documents can serve as a curriculum to help train interested volunteers at Pease Park and to create a set of highly informed volunteers that can act as crew leaders. This increase in capacity further leverages resources to complete the many land management tasks needed at Pease Park to preserve and protect the natural environment and enhance the user experience.

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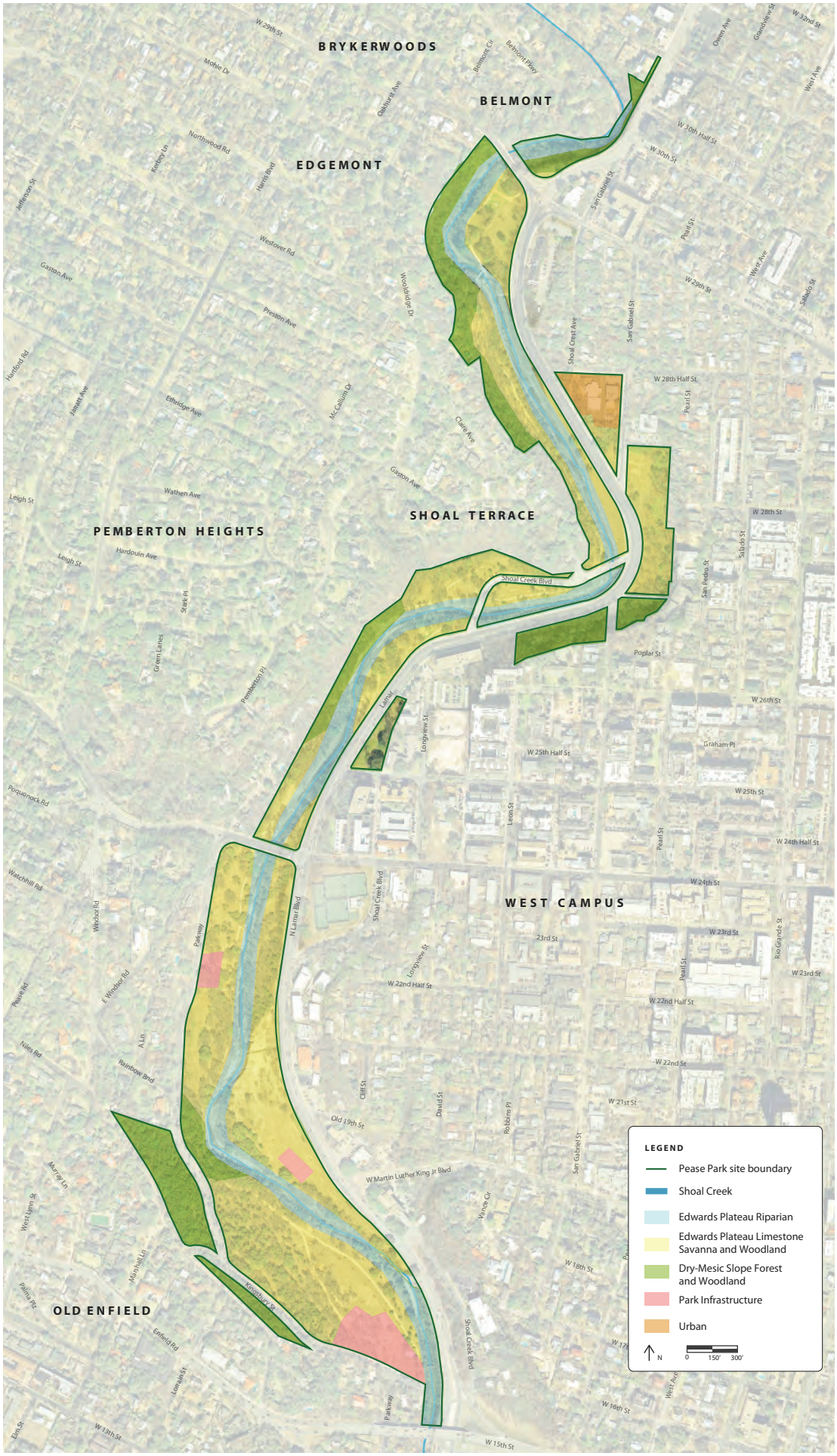
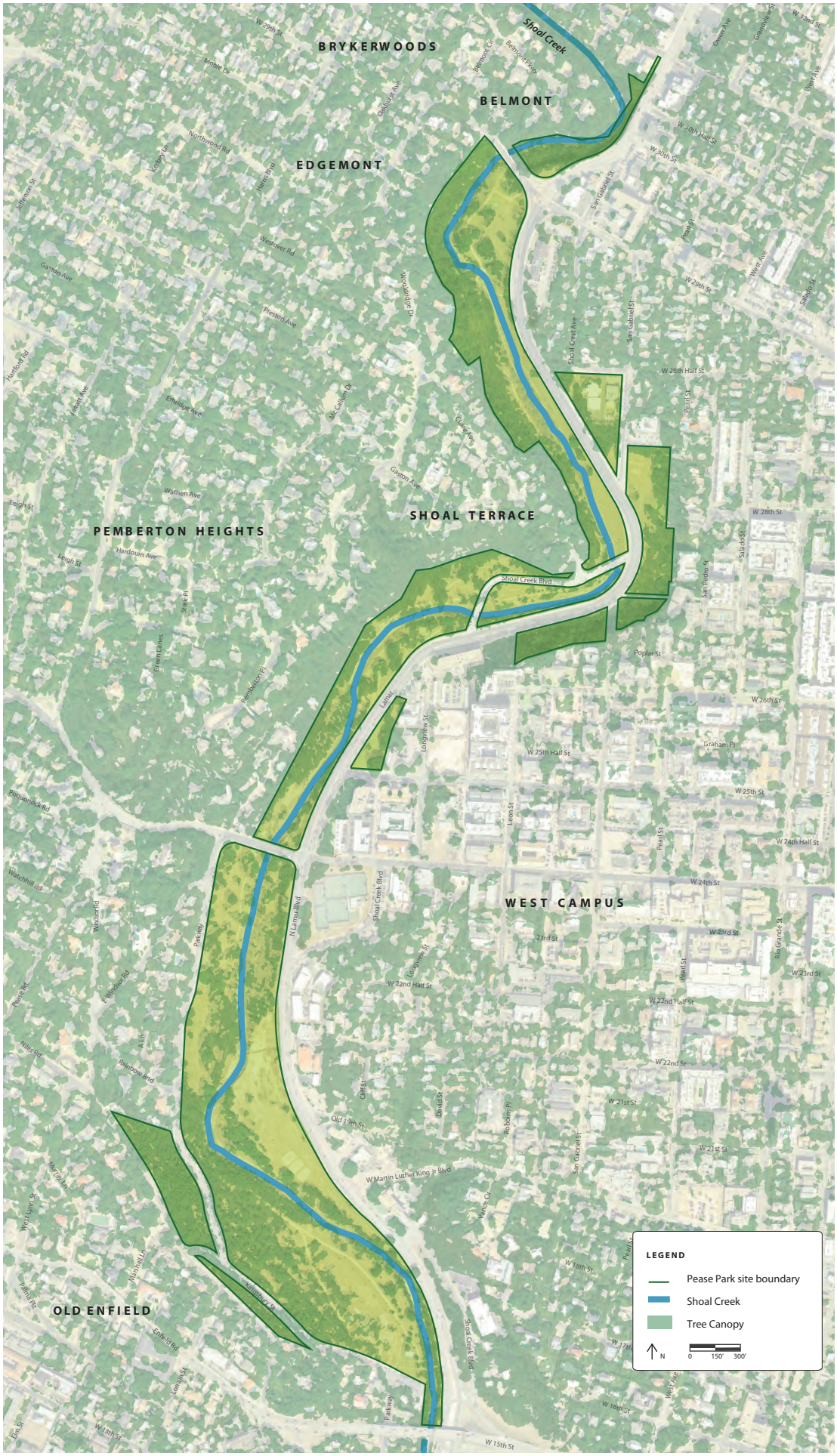


Natural Areas Management Zones

PEASE PARK MASTER PLAN

Invasive Species and Erosion

PEASE PARK MASTER PLAN



Tree Canopy

PEASE PARK MASTER PLAN

APPENDIX A2

LAND MANAGEMENT TASKS PER CHARACTER AREA

Land Management Tasks by Landscape Character Area

As part of the master planning process Pease Park has been divided into sixteen named landscape character rooms (not including Shoal Creek, Lamar Boulevard, Parkway / Kingsbury) to optimize the user experience, determine land management needs, conceptualize park improvements, and define needed tasks in each area. The areas can be seen in the Places of Pease Park Map (pg 19). For the purposes of describing natural area management the areas have been put into two overarching groups: 1) areas where natural area management informs passive recreation and 2) areas where natural area management supports recreational programming. This was determined by which land management zones—riparian, woodland, savanna, lawn, and/or developed parkland— define each area. In addition, the riparian zone has been made into its own character area that can be thought of as a ribbon connecting the park from end to end.

As described earlier, while there are discrete tasks below that can be accomplished in the next coming years, this document must remain dynamic and adapt to successes seen throughout the park, new information from related projects, changes in weather patterns, the availability of resources, and/or changes in user preferences.

Areas where Natural Areas Management Inform Recreation

Riparian Zone

The riparian zone is at the heart of Pease Park and the Shoal Creek Greenbelt and ties together all of the other landscape character zones. Much of the park and greenbelt area is part of the floodplain and floodplain terrace and would naturally be wooded without human intervention. For areas outside of active recreation and/or infrastructure areas, this is what is recommended from the creek's edge extending out to the trails on each side of the creek or until a major slope is encountered—i.e., everything in the floodplain terrace not used for recreation.

Invasive species are common in this zone, with large stretches of giant cane (also referred to as Arundo), as well as Ligustrum (numerous species including Chinese privet, Japanese privet, and others), Chinese tallow, and Chinaberry. These issues will be addressed from the Gaston Bridge south by upcoming Watershed Protection efforts. North of Gaston Bridge invasive species control is a priority management activity.

It is critical that user access is formalized at multiple points along the creek and vegetation complements this hardscaping to direct users to the creek without trampling new growth or established understory within the riparian zone.

Major Objectives

- Provide formal access points and low water crossings to focus recreational impacts to specific areas.
- Increase width, diversity, and overall density of riparian woodland.
- Support the work of Watershed Protection Department.

- Manage invasive species.
- Utilize barriers and interpretation to allow vegetation to establish in highly used areas.
- Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.

Management Recommendations

- Native Planting and Seeding
    - Modify and implement the City of Austin Grow Zone practices except at formal access points.
        - The City of Austin Grow Zone calls for at least a 25 foot wide non-mown buffer along creek banks where passive restoration may occur, although the program acknowledges that a 300ft buffer is required for some riparian areas to be fully functional.
        - When recreational limitations allow, increase the Grow Zone to trail edge or major slope outside the stream bank. In Big Field, Custer's Meadow, and Lamar Lawn some of the areas currently being closely cropped by mowers will be placed into a Grow Zone.
    - Identify areas where natural regeneration or species diversity is low and plant additional riparian trees.
        - Priority should be given to the creek banks but this is critical throughout the riparian zone.
        - As noted in the tree planting section, bare root saplings and small container plants should be favored over large trees to reduce disturbance, minimize resource needs, and reduce the risk of losses in case of a flood event.
        - When planting, focus on species that are not already regenerating naturally. Some recommendations include: bald cypress, pecan, and (in most locations) sycamore.
        - Increase diversity through seeding and live planting plants beneficial to wildlife to improve habitat and increase opportunities for wildlife sighting with special attention to areas around trails, park infrastructure, and the creek.
    - Manage revegetation.
        - Remove invasive species as they arise.
        - Thin common trees away from species that are not currently common.
        - Thin trees when necessary to protect selected view corridors from trail to creek.
        - Existing erosion control mats are inhibiting tree generation. In these areas cut holes in matting to plant saplings with no less than 6ft spacing. Ensure this work is approved by the Watershed Protection Department.
- Invasive Species Management
    - Giant cane is the species of greatest concern in this area, along with Chinese tallow, Chinaberry, Chinese privet, and Japanese privet. Invasives will be controlled from the Shoal Creek Bridge southward as part of the WPD project. Efforts by Pease Park

Conservancy and partners for the next year can focus on areas north of the Gaston Bridge.

- Erosion Control
  - Large patch removal may require use of erosion control fiber mats. Where this is the case the area should be sown with native grasses. Per existing issues, and with the approval of the Watershed Protection Department, holes should be cut in the mat for plantings with a spacing no less than 6ft.

- Recreation Management
  - Recreation access to the creek should be formalized to reduce trampling and erosion.
    - The master plan calls for access points at Big Field, Polecat Hollow, Wooten Woods, Custer's Meadow, Gaston Green, and Lamar Terrace.
    - In areas outside formal access points, vegetation and hardscape elements should be utilized as a deterrent to off-trail recreation. This would include understory trees and shrubs as well as herbaceous plants and grasses 2ft or higher.
    - As vegetation is being established barriers may be needed in high use and off leash areas to protect plantings and seeds from being trampled. Barriers should be accompanied by interpretation that explains the restoration process and long-term benefits.
- Flood Preparation
  - A flood event may destroy or severely alter restoration work and should be considered a potential reality for any work in the riparian zone. This should be taken into account when looking at the timing of year work is being completed, type and size of plant material, as well as supporting infrastructure.

North Ramble and Hillside

North Ramble and Hillside are part of woodland vegetation type. It is beautiful open woodland that is representative of the eastern edge of the Edwards Plateau. The area is an oak, juniper, and Texas ash woodland with seepage in some areas after rains as a result of the underlying Del Rio clays. Both areas experienced major tree damage during storms in 2008. Dead trees were mulched on site and cedar logs that were used as check logs to control erosion can still be found on the ground. A major tree planting effort took place and was largely successful despite the record setting drought of 2011. Irrigation is present. In addition to the planted trees, a large amount of natural regeneration has taken place, primarily Texas ash, cedar elm and hackberry in North Ramble and the southern tip of Hillside. The Hillside area is impacted by numerous informal trails and informal recreational areas. Recreational areas and trails should be formalized where needed and the rest should be retired. Where natural regeneration is effective, additional plantings should be considered to increase diversity. Where there is a lack of natural regeneration, saplings should be planted to promote regeneration of the canopy and add diversity. The northern portions of this area serve as an example of initial restoration success at Pease Park.

Major Objectives

- Manage the area as a closed canopy open woodland by promoting and protecting tree regeneration in North Ramble through invasive species removal and additional tree plantings.
- Increase abundance and number of plant species with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.
- Close informal trails in area through "brushing" method described above.

Management Recommendations

- Invasive Species Management
    - Woody invasive plant control in North Ramble is a high priority. Recent disturbance has left the area vulnerable to new infestations. Removing non-native competition is an easy way to encourage the natural recruitment that is already occurring. Chinese privet and Nandina are the two main invasives present, but their density is low enough that removal efforts will not require revegetation.
- Native Planting and Seeding
    - Identify areas where natural regeneration is not occurring or occurring at low density and add tree diversity. Use species on the recommended species list that are not already present.
    - Increase the abundance and number of species that are beneficial to wildlife through seeding and live planting plants in order to improve habitat and increase wildlife sighting opportunities. Give special attention to areas around trails, park infrastructure, and the creek.
- Trail Management
    - Install waterbars and remove water flow obstacles from trails.
    - Close informal trails through brushing.

Windsor Hillside

Windsor Hillside is part of the slope forest and woodland vegetation found on the steep slopes on the western portions of the study area and is disconnected from the main body of the park. This area has a high density of invasive plant species, including the largest catclaw infestation in the study area. It also contains a closed section of Kingsbury Parkway that is called for restoration in the master plan with a new pedestrian walkway. This area is not considered a high priority at this time because of its isolation and lack of use.

Major Objectives

- Ensure land management efforts are in line with desired programming.
- Control invasive species and restore native habitat.
- Restoration of area surrounding the Kingsbury Spur.

Management Recommendations

- Invasive Species Management and Restoration
    - Invasive species control in this area should be low priority relative to the rest of the study area. It is an infrequently visited part of the park and the high densities and steep slopes will require extensive native plantings associated with erosion control measures, making the work more labor and cost intensive than the rest of the park. Invasive control in this area may be best accomplished by contractors rather than volunteer staff.
    - Woody material can be chipped and used on site. Material inappropriate for chipping will need to be removed.
    - Invasive control work may require the creation of brush berms along contours or the use of erosion control fabric.
    - Native plantings should take place as soon as possible after invasive plant removal.
- Restoration of Kingsbury Trail
    - A full restoration plan should be created that includes erosion control, infrastructure/trail improvements, seeding, and planting. The plan will reduce long-term erosion problems, reduce invasive species impacts, lead to more robust native flora and fauna, and in general lead to a more successful project.

Caswell Shoals

Caswell Shoals contains riparian areas east of the creek just south of 24th Street with steep slopes at Lamar to its east and on its southern end. It consists of relatively flat, open woodland with Bermuda grass on the floodplain terrace. The WPD restoration project will restore the structural bank of the creek in this area. In addition, a bike path is planned to traverse the area from north to south running under the 24th Street Bridge through the middle of the area and into Pole Cat Hollow. Groundcover and understory plants are still recovering from the area's use as a fairway for disc golf. Small trees have been planted in the southern portion and hand watered with moderate success. In addition, a great deal of dead trees have been removed through volunteer efforts.

This zone is an excellent location for the expansion of the riparian forest for visual appeal from Custer's Meadow, to buffer Custer's Meadow from Lamar, create shade for the new bike path, expand the riparian zone, and reduce mowed areas. Bald cypress trees are recommended on the stream bank along with sycamore and willow. Pecans are recommended at the base of the slope leading up to Lamar. In between, cedar elm, green ash, box elder will likely naturally regenerate, but we recommend some bare root seedlings of these along with other species selected from the list in Appendix A5 to increase diversity and facilitate establishment. In addition to canopy trees, understory and groundcover planting and seeding should take place with both color and wildlife attraction in mind. This area is recommended as a high priority within the Pease Park Master plan because of its visual significance and potential of success. Improvements to this area should immediately follow the

completion of work in the area by the WPD project which will include a temporary irrigation system available for at least three years.

Major Objectives

- Continue to reforest open areas to create and expand a closed canopy riparian forest that includes a diverse set of canopy, understory, and herbaceous native species.
- Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.
- Create vegetative buffer along Lamar Blvd.
- Manage invasive species.

Management Recommendations

- Invasive Species Management
    - Invasive species control in this area will be a mixture of both passive and active management depending on the species to be controlled.
    - Catclaw removal is a high priority. Only a few small infestations have been identified here and it is important to treat them before they become large problems.
    - Bermuda grass control can take a passive approach by shading. Tree planting will eventually create enough shade to weaken this grass. Some shaded areas already have a healthy understory of native plants—primarily Canada wildrye and straggler daisy. Where sunny areas are disturbed during infrastructure improvements, planting of trees, understory, and/or bunch grasses that will shade out the Bermuda is recommended.

- Native Planting and Seeding
    - Planting should focus on species that can overtop the Bermuda grass.
    - Identify areas where natural tree regeneration is not occurring or occurring at low density and increase tree diversity using the species recommended in Appendix XX to create a closed canopy riparian forest.
    - Canopy trees along Lamar Blvd right of way should be complemented by ornamental trees such as Mexican plum, redbud, and Mexican buckeye that will add visual interest.
    - Increase through seeding and live planting species that benefit wildlife, improve habitat, and increase opportunities for wildlife sighting with special attention to areas around trails, park infrastructure, and the creek.
    - Irrigation will be present for this area for the next three years through the WPD project and should be utilized for the live plantings in the area.

Wooten Woods

Wooten Woods is dense oak/hardwood forest that includes flat areas next to Shoal Creek and steep slopes that lead to neighborhood properties. One of the identifying features of this area is a gorgeous grove of cedar elm and live oak just north of 24th St. The groundcover and understory in this area are

substantially degraded from previous disturbances that include disc golf and flooding. These previous disturbances are exacerbated by current informal, off-trail recreation and off leash dogs. Understory restoration as well as bank stabilization is part of the WPD plan and will substantially enhance the area. The master plan will complement these efforts by increasing canopy, understory, and groundcover diversity in the restored area, creating formal creek access points, and creating formal and/or informal barriers to allow for plant establishment in highly used areas.

Other issues in this area include: trees in need of care identified in Don Gardner's report in Appendix A4, paving of main trail, removing giant cane and Chinese tallow from the erosion control project at the northern end of the area, and removing catclaw, bamboo, and Chinaberry from the fence line in the southern portions of the study area. This area of the park is considered a high priority in the master plan because of its high use, its great aesthetic appeal, and the need to repair damage from overuse.

Major Objectives

- Complement WPD efforts in the area to add diversity through tree, understory, and groundcover plantings and seeding.
- Manage Wooten Woods to allow for natural tree regeneration.
- Ensure planned user trail alignments will allow for sustainable circulation patterns and formalize creek access.
- Post interpretation explaining restoration process and erect temporary barriers to allow for the re-establishment of groundcover and understory vegetation in areas heavily impacted by human and pet traffic.
- Increase plants with known wildlife appeal to improve habitat and wildlife viewing opportunities.

Management Recommendations

- Tree Care
    - Several unsafe trees were identified in Don Gardner's Trees of Pease Park report in Appendix A4. They need to be addressed as soon as possible.
    - A live oak with hypoxylon has been identified in Wooten Woods. At the moment the tree appears to be dealing with the fungus well, but it will require annual monitoring for disease stress.
- Invasive Species Management
    - Catclaw removal is a high priority. A catclaw infestation is beginning to expand on the west side of the trail near the 24th Street Bridge. Treating this infestation before it spreads is essential.
    - Giant cane and Chinese tallow removal along the hillside in the northern portions of the area will need to be undertaken with great care in a way that will not disturb any existing soil or harm slope reinforcements. Professional contractors should be used for treatment, follow up care, and planting to insure success and lack of harm to slope stabilization work already completed.

    - All other species are of moderate concern and should follow protocols outlined in Appendix A6.
- Native Planting and Seeding
    - To complement the efforts of Restoration plan in this area, additional planting are recommended to ensure the establishment of a robust herbaceous and understory layer that can withstand floodwater. Understory native grasses should be prioritized for both native plantings and seeds.
    - Pease Park Conservancy—through interpretive signage and physical barriers where necessary—must ensure new plantings are not trampled by park users. This can be done in a positive, creative manner that allows for buy-in and compliance from a large percentage of park users.
    - When the trail is paved by upcoming park efforts, disturbed areas will need to be planted. Unlike most plantings, areas recovering from trail damage may require soil aeration (decompaction) and the addition of soil/organic matter brought in from other areas.

Live Oak Terrace

Live Oak Terrace, just south of the Shoal Creek Bridge and north of 24th Street between Lamar and the creek, is currently mowed to the creek's bank with mature live oaks dispersed throughout. The trees appear to be in good health. This area is currently underutilized from an ecological and recreational perspective. We recommend increasing the riparian area through implementing the Grow Zone policy along the creek's edge. Natural regeneration should be complemented by plantings to increase diversity. The result will be a more functional riparian area, reduced mowing needs, and increased visual interest along Lamar Blvd.

Major Objectives

- Increase visual interest along Lamar Blvd with native ornamental trees.
- Establish Grow Zone near the creek extending 50 to 80 feet from the edge of the creek.

Management Recommendations

- Native Planting and Seeding
    - Stop mowing within 50 to 80 feet of the creek.
    - Allow for natural regeneration of trees in Grow Zone area.
    - Manage woody invasive species as they attempt to cross into buffer zone. If passive restoration is failing, develop a planting plan.
    - Increase the diversity of trees, understory, and groundcovers in the riparian zone through planting and seeding after the completion of the WPD work in the area including bald cypress and sycamore.
    - Increase understory trees with aesthetic interest along Lamar Blvd including: Mexican plum, Mexican buckeye, and redbud.

Ramble Scramble

Ramble Scramble is the west side of the creek from Gaston Bridge north to 29th Street. It includes riparian areas at the creek and sloping woodlands where the area widens to the west. In the northern sections there are significant boulders and cliffs much like what is found in the Bluffs area as a result of the composed Buda limestone. Split Rock and Buda Boulder Springs as well as numerous cliffs can be found here. These aspects are all considered critical environmental features and are a unique component of the park area. Buda Boulder Springs is one of the protected locations in the Balcones Canyonlands Preserve system designated to protect invertebrate species of concern. As in the Bluffs area, restoration occurring here should include plant species unique to the escarpment area. Any trails in this sensitive area will require careful planning. Yard debris from neighbors and homeless encampments are also issues that need to be addressed.

The central portion of Ramble Scramble has a substantial bamboo infestation. Past control methods have been largely unsuccessful due to lack of follow up treatments. In addition, large Chinaberry and Ligustrum have been removed from a significant area west of the trail and south of the Janet Fish Bridge. From the east side of the trail to the creek there are relatively young woody species, both exotic and native, creating a thicket that obscures views of the creek. In some areas the erosion control fabric is inhibiting plant regeneration. This area is considered a high priority area in the master plan because of previous efforts and ongoing interest. Efforts should focus on the ongoing work to remove the bamboo infestation, establishment of native vegetation, removal of Ligustrum, creation of view windows to the creek, increasing wildlife food sources, and the live planting of native tree saplings through cuts in the existing erosion fabric.

Major Objectives

- Restore natural area currently infested with bamboo (this is ongoing work).
- Manage invasive species throughout the zone.
- Create window views of the creek through the riparian corridor generally through invasive species management.
- Establish riparian trees where they are being inhibited by the erosion control fabric.
- Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.

Management Recommendations

- Invasive Species Management
    - Follow Appendix A6 management recommendations for bamboo. Begin treatment in spring and treat several times throughout the spring and summer. Follow up removal with plantings. On steeper slopes take measures to ensure that erosion is limited through creation of brush berms along contours or the use of erosion control fabric.
    - Management of other invasive species in this area (Ligustrum and Nandina are two of the worst culprits in this zone) especially in southern portions of the area.
- Native Planting and Seeding

  - The bamboo-infested area will require tree, understory, and groundcover planting to outcompete any remaining bamboo and to jumpstart the restoration process. Seeding mix should be dominated by shade tolerant grasses the first year as these will provide the most competition against bamboo. If successful, shade tolerant forbs and wildflowers can be added in subsequent years.
  - Seeding and planting of larger areas where invasives have been removed. This is necessary in areas where there is not a native seed bank or the area is large enough that getting more desirable plants in would foster a more aesthetically pleasing, ecologically sound plant community. This is particularly the case approximately 300 feet south of the Janet Fish Bridge to the west of the trail where previous removal of Chinaberry and Ligustrum have left a substantial hole in the canopy that will be filled by invasives again if natives are not given a competitive advantage. Irrigation may be necessary in this area.
  - Between the 29th Street and Janet Fish bridges, plant trees and shrubs that are characteristic of the rocky cliffs of the Edwards Plateau. The planting list can include: Lindheimer's silktassel, Mexican buckeye, scarlet buckeye, rusty blackhaw viburnum, Spanish oak, lacey oak, and escarpment black cherry.
  - Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.

- Trail Management
  - A number of informal paths leave the main trail and go into the Split Rock area. They are not heavily used, and some go to homeless encampments. The area near Split Rock is extremely steep, though, and off-trail use in this area could be dangerous and lead to substantial soil erosion. As Ligustrum and other woody species are removed they should be used to block these paths as discussed in the erosion section above.
  - This section of the trail contains few views of Shoal Creek. Clearing small views that act as windows to the creek will provide visual interest without encouraging off-trail traffic. Removing Ligustrum may provide enough openings. In other locations, pruning of native vegetation may be required. As a general rule, any pruning of native species in this area to create views should focus on branches between 3 and 12 feet above the ground. Leaving some low branches to discourage visitors from leaving the trail is essential.
- Human Impacts
  - Yard debris entered the greenbelt from various neighbors in this area. Pease Park Conservancy should work with neighbors to ensure these practices have stopped or will not continue.
  - Regular surveys around Buda Boulder Springs should be made to ensure homeless encampments are not impacting the area immediately around the springs and degrading the water quality of this protected feature.

Lamar Slope

Lamar Slope was altered substantially during the bed and bank improvements implemented on this stretch of the creek in approximately 2009. The area is narrow and has substantial slopes moving down from Lamar to the creek. In the northern sections there are mature trees near Lamar Blvd. Where previous bank stabilization took place there is a lack of woody species regeneration on the floodplain terrace with immature stands of native and non-native trees running the length of the creek. In the southern portions of this area a small floodplain terrace was revegetated with native grasses and trees after serving as a staging area for the bank stabilization. It is unclear why, but it appears numerous trees in the area perished. One possible explanation is heavily compacted soils due to the previous construction activities. This area would naturally return to a riparian woodland in the presents of a healthy seed bank and appropriate soil conditions. Supplemental seeding and planting are recommended here along with soil amendments and decompaction. A more complete evaluation of the soil should be made to determine if mechanical ripping of the soil is necessary to enable woody species establishment. The erosion fabric from previous work is inhibiting tree sapling regeneration as seen in Ramble Scramble. Making cuts in the erosion fabric (made in consultation with the Watershed Protection Department) and planting of saplings within the cuts will enhance the regeneration of riparian canopy trees. This area offers numerous opportunities for improving the user experience through shading for the Lamar sidewalk, aesthetic improvements for drivers and pedestrians, and increasing the vegetative buffer between Lamar and the Shoal Creek Trail. In addition, because Lamar Slope is not part of the Watershed Protection Department's current Shoal Creek restoration project, work can begin immediately. For these reasons this area is considered a moderate priority.

Major Objectives

- Manage invasive species.
- Floodplain terrace to become part of the riparian woodland.

Management Recommendations

- Native Planting and Seeding
    - Increase the riparian vegetation cover by cutting approved holes in erosion fabric, allowing for natural regeneration, and planting saplings.
    - After evaluating and treating soil compaction, Plant trees in southern portion of this area including bald cypress and sycamore at the creek bank with a variety of other riparian trees listed in Appendix A5. Temporary irrigation will likely be needed in this area.
- Invasive Species Management
    - Bastard cabbage is the most serious invasive species threat in this area. Mow when in flower. Its capacity for growth in this area should decrease with added canopy and increased shade.
    - Remove invasive species along the creek.

Bluffs

The topography visible from the trail as it goes through the Bluffs character area is some of the most dramatic found within the study area. A walk through the Bluffs is a lesson in the geologic history of Central Texas that can be accentuated through appropriate interpretation. This area has numerous invasive species infestations within the riparian zone and at the base of the bluffs. Management will focus on replacing these invasive plants with appropriate natives and increasing overall diversity in the area. This area of the park is similar to the steep canyons found in the Balcones Canyonlands on the eastern edge of the Edwards Plateau. As a result, some of the plant recommendations below are unique to this type of habitat. Off-trail recreation and the trail's proximity to the creek are degrading the vegetation in some areas. Through further plantings, a defined creek access point, and some realignments of the trail, the user experience can be enhanced while improving the ecological integrity of the area. Creek and bank stabilization has not occurred in this stretch of the study area and is not currently being considered by Watershed Protection although it may at a later date (bed and bank improvements stop at the Janet Fish Bridge). Because of the uniqueness of this area within the park and within Austin the area is considered a high priority area within the master plan.

Major Objectives

- Manage invasive species.
- Prune back poison ivy from the trail area.
- Restore floodplain forest to the west of the trail, plant species characteristic of the Balcones Escarpment.
- Prevent off-trail recreation.
- Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.

Management Recommendations

- Invasive Species Management
    - The most problematic species in this area are Ligustrum (privet) and Japanese honeysuckle. While many of the Ligustrum may be removed with weed wrenches, chemical control should be favored in steep areas to reduce the potential for erosion. Control work should be accompanied with native plantings.
- Native Planting and Seeding
    - Areas to the east of the trail should use tree plantings from the riparian zone species list in Appendix A5.
    - To the west of the trail, add upland species, but also plant trees and shrubs that are characteristic of the rocky cliffs of the Edwards Plateau. The planting list can include: Lindheimer's silktassel, Mexican buckeye, scarlet buckeye, rusty blackhaw viburnum, Spanish oak, lacey oak, and escarpment black cherry.
    - The rocky ground will most likely accommodate only small plants such as bare root seedlings or 1-gallon containers.
    - Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.

- Recreation Management
    - Decommission informal trails and restore impacted areas.
    - Create a defined creek viewing and interaction area to dissuade off-trail use in other areas.
    - Move main trail away from creek edge where possible.

Natural Area Management Supports Programming

Kingsbury Commons

The Kingsbury Commons area is currently the most used component of the site and will continue to be a central focus of the park in the master plan. The area includes the Tudor Cottage, playground area, basketball area, and historic picnic area. Natural area management should support the recreational activities by providing a healthy and safe regenerating tree canopy along with signature plantings as appropriate. Immediate action should be taken on the tree care recommendations for this area found in Don Gardner's tree report in Appendix A4. In addition, all areas that are not needed for recreation should be actively managed for tree planting and woodland restoration.

Major Objectives

- Provide for health of existing trees and ensure they are safe for the public.
- Signature plantings where appropriate around park infrastructure.
- Increase the overall tree canopy where it supports recreational activities.

Management Recommendations

- Tree Care
    - Numerous hazard trees were identified in Don Gardner's tree report in Appendix A4. His recommendations for these trees should be implemented immediately to mitigate potential safety concerns.
    - Trees planted over three years ago need to have the berms placed around them raked back out into the existing lawn and irrigation should be set back to the canopy edge to encourage their roots to expand further out.
    - Trees planted within the past decade need to be pruned to encourage a healthy, strong form.
- Signature Plantings
    - Native plants can be used in this area to show their diversity and capacity in more formal settings.
- Native Planting and Seeding
    - Where appropriate, expand the tree canopy to provide additional shade and relief from summer temperatures, prepare for the next generation tree canopy, and replace trees removed or substantially pruned.

Big Field

Big Field is a Bermuda grass field with park infrastructure and trail-lined trees. Currently the lawn goes to the top of the creek embankment in most areas, with only a small riparian buffer on the bank slope. It is recommended that portions of the Bermuda grass lawn east of the existing Shoal Creek trail be converted into a riparian woodland and that the woodland be expanded to all of the areas not needed for recreation in order to provide shade and relief from summer temperatures.

Where the turf is to be kept, maintenance should be based on Parks and Recreation Department's best management practices. If native grass alternatives prove effective in equivalent use areas, they should be investigated for Big Field and other turf areas within the study area.

Major Objectives

- Provide for health of existing trees and ensure they are safe for the public.
- Transform eastern edge of big field into a riparian woodland.
- Maintain health of Bermuda grass field.
- Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.

Management Recommendations

- Tree Care
    - Same recommendations as those for Kingsbury Commons area.
- Native Planting and Seeding
    - See Riparian Zone section regarding the widening of the riparian zone.
    - Place areas east of the existing Shoal Creek Trail into the Grow Zone program.
- Turf Care
    - The City of Austin should continue to care for the Bermuda grass lawn using PARD's best management practices.
    - Alternative native turfs may be considered as PARD has evidence of their efficacy and affordability as recreational ball fields.

Polecat Hollow

This area is primarily turf with a riparian edge on the western side and Lamar Blvd to the east. It includes the volleyball court as well as the mesquite grove just north of the intersection of MLK and Lamar Blvd. The implementation of the WPD bed and bank restoration project currently underway will substantially alter Polecat Hollow with major changes to the creek bank as well as the installation of swales. In addition, the master plan calls for substantial changes in user patterns in this area with a formal park entrance from the MLK intersection, an amphitheater, and two new pedestrian bridges connecting to Big Field and Custer's Meadow. Natural area management should support the restoration and recreational uses in the area while focusing on the expansion of the riparian zone, signature

plantings to enhance and define the user experience, creation of creek access points, and invasive species monitoring.

Major Objectives

- Provide support for WPD plans as necessary.
- Transform western edge of field into a riparian woodland.
- Signature plantings where appropriate around park infrastructure.

Management Recommendations

- Support for WPD Project
    - Support restoration efforts through additional planting and seeding to increase diversity and further enhance and define the user experience.
- Native Planting and Seeding
    - See Riparian Zone section regarding the widening of the riparian zone. Expand the Grow Zone in this area to include 50 feet or more next to Shoal Creek.
- Signature Plantings
    - Native plants can be used in this area to show their diversity and capacity in more formal settings.
- Tree Care
    - Maintain and care for the mesquite grove through appropriate pruning and ensure planned swales do not negatively impact the grove.

Custer's Meadow

Custer's Meadow is a major access point to the park and greenbelt and serves a number of recreational purposes. The area has been stressed by human and pet traffic, stormwater flows, bank erosion, and invasive species. The WPD restoration project will dramatically reshape this area through bank stabilization, rainwater meadows, invasive species control, impervious pavement reductions, and landscape plantings. The master plan will support and complement this work by ensuring the plantings between the trail and the creek are of appropriate size to direct user traffic, expanding the riparian zone to include the entire area between the creek and trail, creating formal creek access points, and invasive species monitoring(catclaw has been found and removed from the area).

Major Objectives

- Support WPD restoration plans.
- Invasive species monitoring and management.
- Increase riparian zone to trail edge and ensure plantings direct user experience.
- Support health of existing trees.
- Formalize creek access points.
- Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.

Management Recommendations

- Support for WPD Project
    - Support restoration efforts through additional planting and seeding to increase diversity and further enhance and define the user experience.
- Invasive Species Management
    - While invasive species as a whole in this area should be a medium priority, controlling the giant cane on the edge of the meadow is a high priority. The rain gardens WPD will be installing will be great habitat for giant cane, and the disturbance associated with new construction makes them especially prone to invasion. Controlling nearby infestations is one way to help prevent an infestation from occurring.
    - Continue to monitor for new invasive species issues with a focus on potential catclaw populations.
- Native Planting and Seeding
    - In order to insure riparian restoration integrity, plantings should focus on tall grasses, shrubs, and forbs with a riparian canopy with the intent of focusing pedestrian access at certain defined locations for paths, picnic tables and overlooks. This is a revision of the current Shoal Creek Restoration Project design which calls for native short and mid-size grasses. High human and pet use will potentially trample smaller plants and revert the area back to its current condition. Preference should be given to grasses and forbs that grow taller than 18 inches.
    - Where native plantings are to take place under trees with significant root exposure, a layer of compost should be applied to protect existing tree roots.
    - Unauthorized recreation should be deterred from sensitive areas—such as those between the creek and trail—as the areas recover and plants become established. This can be accomplished through hardscape and planting choices that can focus pedestrian access to defined paths, picnic tables and overlooks. In some cases, newly planted or restored areas may require temporary construction fencing and signage to allow the vegetation to fully establish.
    - Canopy trees should be planted in this area to provide shade for trail users and increase the width of the riparian zone. While natural regeneration will happen along the bank and could eventually happen once mowing and trampling are reduced, because of the major impacts currently existing, and a desire for a greater diversity of species than would happen by natural regeneration alone, live tree plantings are recommended.
    - Increase plants with known wildlife appeal to improve habitat and increase wildlife viewing opportunities.
- Tree Care
    - Four trees in Custer's Meadow were identified by Don Gardner for action in Appendix A4. They pose safety risks, and actions detailed in his report should be undertaken as soon as possible.
    - As noted in the native planting section, a layer of compost and mulch should be spread under the drip lines of trees with exposed roots.

Gaston Green

Gaston Green is a major access point to the park. It is a Bermuda grass field with a road and parking lot in its center. Natural area management in this area includes care for several trees that require removal or extensive pruning due to safety concerns, invasive species control, and expanding the riparian and woodland areas around the parking lot and recreation areas.

Major Objectives

- Invasive species management.
- Increase riparian and woodland zones with native plantings.
- Remove or repair existing hazardous trees.
- Signature plantings where appropriate around park infrastructure.

Management Recommendations

- Tree Care
    - Several hazardous trees were identified in the Trees of Pease Park report in Appendix A4. Actions identified in the report are a high priority as the trees could present safety concerns.
- Invasive Species Management
    - In general, invasive plant management in this area should be a low priority. The area does not have many natural areas. However, the large Chinaberry at the southwest edge of Gaston Green should be a medium priority for removal. It produces copious amounts of seed in an area that is not currently heavily infested with Chinaberry.
    - Other major invasive species include Ligustrum and bamboo that should be controlled as detailed in Appendix A6.
- Native Planting and Seeding
    - Native plantings in this area should provide additional shade and expand the riparian and woodland areas where it does not impact recreation.

Lamar Terrace

Lamar Terrace is a large open field at the corner of 29th Street and Lamar Blvd that moves down to the creek. It is an underutilized access point to the greenbelt. The Master Plan calls for new bathroom and picnic facilities. Natural area management should focus on expansion of the riparian zone to the trail edge as well as signature plantings where appropriate.

Major Objectives

- Invasive species management
- Increase the riparian zone
- Signature plantings where appropriate around park infrastructure.

Management Recommendations

- Invasive Species Management
    - Several Chinese tallow have been planted along Lamar Blvd. Eliminating these seed sources should be a medium priority.
    - View windows to the creek should be identified and created primarily through the removal of invasive species.
- Native Planting and Seeding
    - The area between the trail and Shoal Creek should be placed in the Grow Zone Program, with natural regeneration being allowed to take place. Supplemental plantings to increase diversity should include bald cypress along the creek bank as well as other species listed in Appendix A5.
- Signature Plantings
    - Native plants can be used in this area to show their diversity and capacity in more formal settings.
    - Trees appropriate for Lamar Blvd should be planted to replace the removed Chinese tallow.

East Bank

East Bank is separated from the main portion of the study area by Lamar Blvd. East Bank will provide a transition area between the nearby neighborhoods and the park through the addition of street trees and treatment of storm water before it enters Shoal Creek. The Watershed Protection Department's restoration plan calls for rain gardens to slow storm water as it moves towards Shoal Creek.

Major Objectives

- Tree planting along Lamar Blvd.
- Manage invasive species.

Management Recommendations

- Native Planting and Seeding
    - Increase woodland area on eastern edge of Lamar Blvd for diversity and aesthetic interest.
- Invasive Plant Management
    - Area is heavily infested with invasive species and should be controlled using methods outlined in Appendix A6.

The Places of Pease Park

PEASE PARK MASTER PLAN

Think of Pease Park as a necklace, with sixteen green gems, each with its own character, strung along Shoal Creek. These sixteen gems are defined as landscape character zones, and along with Lamar Boulevard and Kingsbury/Parkway illustrate the variety of places and experiences within Pease Park.

SHOAL CREEK

As one of the seven creeks in Austin, Shoal Creek is the central spine flowing through Pease Park. Its' tranquil and turbulent waters serve as a destination for park users and as a force of nature requiring bank stabilization and riparian reforestation. Over 80% of the Pease Park Master Plan site is within the Shoal Creek Floodplain.

1 THE BLUFFS

A piece of Hill Country in the City, the 40' high bluffs are a natural geologic landmark unique to the rest of the park. Cat Hole and Blue Hole are famous hideouts along The Bluffs that play a prominent role in the cultural lore of Austin. The Bluffs suffer from bank erosion and an infestation of invasive species.

2 LAMAR TERRACE

Characterized by level terrain out of the floodplain, Lamar Terrace is an unprogrammed open space with access to Lamar Boulevard and 29th St. Lamar Terrace is home to a sewer interceptor which runs through the center of the terrace.

3 RAMBLE SCRAMBLE

The steep slope forest canopy of the Ramble Scramble is dominated by the live oak, cedar elm and ashe juniper while the understory is being taken over by young non-native invasive plants. Ramble Scramble is home to Split Rock, a huge boulder that split into two forming a forty-foot canyon.

4 LAMAR SLOPE

Often confused as a right-of-way for Lamar Boulevard, Lamar Lawn is a narrow open space with access only from the Lamar sidewalk. The Lamar Lawn presents an opportunity for riparian restoration and stormwater infiltration along Lamar Boulevard.

5 EAST BANK

East Bank is home to some of the steepest slopes in Pease Park which serve to funnel and direct views while driving along Lamar Boulevard. The wooden hillside is dominated by a cedar elm canopy but suffers from hillside erosion and abundance of non-native invasive plants.

6 GASTON GREEN

As the heart of the dog park, Gaston Green is the central open space north of 24th St. With entrances from Shoal Creek Boulevard and Gaston St., it is one of the few locations where you can park in the park.

7 LIVE OAK TERRACE

The presence of mature live oaks and closely mowed herbaceous vegetation characterize the open riparian space of the Live Oak Terrace. At the heart of the terrace is a stone bench triangle nestled amongst the trunks of three live oaks.

8 WOOTEN WOODS

Cedar elm groves with signature live oaks frame a pedestrian promenade reminiscent of a formal allee. Frequent flooding along with heavy human and dog traffic have eliminated the groundcover and understory necessitating the need for immediate restoration efforts.

9 CASWELL SHOALS

Live Oaks and Cedar Elms dominate this woodland and savannah landscape on the east side of Shoal Creek. This is the site of a new commuter bike trail with access to Lamar Boulevard and 24th St.

10 CUSTER'S MEADOW

Named after the site of General George A Custer's encampment in the 1860's, this meadow is anchored by a stately live oak known as Custer's Oak. Custer's Meadow serves as a vehicular and pedestrian gateway to the park and offers multiple creek access points to explore the waters of Shoal Creek.

11 POLECAT HOLLOW

Home to Lamar Knoll, Mesquite Grove and the popular volleyball courts, Polecat Hollow is the largest open space on the east side of Shoal Creek with stunning views of Downtown Austin. Current creek bank soil erosion will be resculpted and replanted by the City of Austin Watershed Protection Department.

12 WINDSOR HILLSIDE

At one of the highest elevations above Shoal Creek, Windsor Hillside typifies the dry-mesic slope forest and woodland of the Edwards Plateau. This upland hillside suffers from an abundance of non-native invasive plants.

13 NORTH RAMBLE

North Ramble is a Texas ash and ashe juniper dominated slope forest that suffers from hillside erosion. Like its neighbor, Hillside, North Ramble is home to many of the park's hiking and nature trails.

14 HILLSIDE

Live oak trees frame a spectacular view of the State Capitol Building along this slope forest of ashe juniper, hackberry and cedar elms. Starting from the back of Tudor Cottage, Hillside, along with North Ramble, includes the park's largest collection of hiking and nature trails.

15 BIG FIELD

As the largest open space in Pease Park, Big Field serves as a multi-purpose event field and home to Eeyore's Birthday Party. Big Field offers sweeping interior views of the park as well as views of the rising downtown skyline.

16 KINGSBURY COMMONS

Kingsbury Commons is the recreational heart and cultural soul of Pease Park. It is home to the playground and splashpad as well as the Historic Tudor Cottage and iconic picnic tables. The historic Pease Park Gates frame the main entry to the park. The mature tree canopy is dominated by cedar elms and will eventually be joined by the recently planted sycamores, oaks and elms.

LAMAR BOULEVARD

Lamar Boulevard parallels the Shoal Creek for nearly two miles along the eastern frontage of Pease Park. With over 75,000 commuters a day and counting, Lamar Boulevard is a transportation artery that presents several challenges for Pease Park in terms of pedestrian connectivity, stormwater management and utility restrictions.

KINGSBURY / PARKWAY

Together Kingsbury and Parkway form the western frontage of Pease Park. The two lane roads present an opportunity to connect Pease Park with the neighborhoods while defining what the character of a park road can be.

APPENDIX A3

LAND MANAGEMENT RECOMMENDED SCHEDULE

Schedule

Restoration and land management are not an event, but ongoing processes. The five year land management schedule below should be viewed as a guide that allows for flexibility and adaptive management techniques based on what is working best and what is seen as the highest priority for stakeholders, degradation concerns, or the potential to build off previous successes. While the actual schedule will by necessity change due to the results of treatments and the availability of resources, the schedule can serve as a baseline of important tasks as management practices moves forward. In 2018 to 2019, it is recommended that progress recommended in this document is evaluated and the entire document be revised looking forward an additional five years.

The Watershed Protection Department's (WPD) Shoal Creek Restoration Project will improve many of the landscape character areas, but its timing and schedule are beyond the control of the Master Planning Process. Management taking place in areas to be impacted by the WPD restoration project should likely be delayed until it is nearing completion. In this timeline, it is assumed that construction will not be completed until the end of 2015, and that maintenance will be performed by the city until the end of 2018. The WPD project area, once complete, will be a high priority.

As Soon As Possible

- Tree Care
    - Pruning and tree care of critical trees identified in "Trees of Pease Park Report".

2014

<u>Fall</u>

- Expansion of Riparian Zone.
    - Meet with Watershed Protection and Parks and Recreation Department (PARD) staff to determine acceptable width of the Riparian Zone. This is a High Priority as it may lead to small adjustments of WPD restoration plans.
- Low water crossings. Meet with WPD and PARD staff to determine final siting and design.

2015

<u>Winter</u>

- Tree Care
    - Pruning of trees planted in last 10 years as necessary.
- Invasive Species
    - North Ramble and Hillside – Mechanical removal of Ligustrum and small invasive plants with volunteer crews.
    - Herbicide treatment and hand pulling of bastard cabbage in the Lamar Lawn.
- Volunteer training and recruitment –
    - Recruit trail maintenance volunteers and arrange training with local trail building and maintenance experts.
    - Recruit invasive species mapping and early detection monitors.

Spring

- Trail maintenance
    - National trails day is the first Saturday of June. Celebrate by having large volunteer push to install waterbars and other trail infrastructure in North Ramble and Hillside area.
- Invasive Species
    - Catclaw treatment – treat all small patches of catclaw to prevent its establishment. See report for locations. Do not treat extremely large patch on Windsor Hillside at this time.
    - Ramble Scramble bamboo treatment follow up.
- Tree care
    - Rake away water berms on trees that are established, top dress with mulch.

Summer

- Native plantings
    - Develop plant list and irrigation design for pollinator and wildlife focused plantings on eastern edge of North Ramble and Hillside.
    - Identify areas of North Ramble where natural regeneration is not occurring, or where there has been high planting mortality. Decide upon the number and species of trees to be planted in fall.
- Clear and/or maintain view windows from trail to creek at Ramble Scramble.
- Invasive species monitoring and prioritization for coming year.

Fall

- Native Plantings
    - Tree planting in North Ramble area.
    - Tree planting in Kingsbury Common area to replace trees that were removed due to safety concerns.
    - Herbaceous planting in Ramble Scramble where bamboo control occurred.
- Trail maintenance – after fall rains (if they occur) have trail stewards inspect newly placed waterbars and see if they are functioning correctly.
- Invasive management
    - Cut stump and basal bark treatments in Hillside, North Ramble, and Ramble Scramble

2016

Winter

- Invasive management
    - Japanese and Chinese privet control, both mechanical control and cut stump treatment. Priority given to follow up treatment in riparian zone, north Ramble and Hillside, then move onto Wooten Woods and Ramble Scramble.
    - Herbicide treatment and hand pulling of bastard cabbage in the Lamar Lawn.
- Native Plantings

- If not already accomplished by WPD project, follow planting design for understory restoration of Wooten Woods, including supplementing of soil. Ensure area is effectively blocked to foot traffic to allow for restoration's success.

Spring

- Trail maintenance and inspection - Hillside and North Ramble.
- Monitor riparian zone restoration area for unauthorized trails and take measures to eliminate them.
- Invasive management
  - Follow up on previous year's catclaw control.
- Native Plantings
  - Identify areas in Riparian Zone, Caswell Shoals, and Polecat Hollow where natural tree regeneration is lacking and additional trees are desired. Begin planning for fall plantings.

Summer

- Invasive Species management
  - Ensure giant cane treated during WPD restoration project is retreated as necessary.
  - Invasive species monitoring and prioritization for coming year.
- Monitoring
  - Photopoint monitoring, especially of areas where management has occurred.

Fall

- Native Plantings –
  - Install irrigation and plantings for pollinator and wildlife focused plantings on eastern edge of North Ramble and Hillside.
  - Tree planting in Caswell Shoals and Polecat Hollow and the Riparian Zone adjacent to them.
  - Evaluate initial success of Wooten Woods understory restoration.
  - Sowing of native grass and wildflowers in bare patches of Lamar Lawn.
- Trail maintenance and inspection - Hillside and North Ramble
- Invasive management
  - Cut stump and basal bark treatments, follow up to 2015 and continue onto the Bluffs as time permits.

2017

Winter

- Invasive management –
  - Evergreen species such as privet. Location based on previous year's early detection monitoring. Focus on protecting areas previously treated, then move onto Custer's meadow and Gaston Green.
  - Herbicide treatment and hand pulling of bastard cabbage in the Lamar Lawn.
- Native Plantings
  - Wooten woods supplemental planting.

Spring

- Trail maintenance and inspection - Hillside and North Ramble
- Monitor riparian zone restoration area for unauthorized trails and take measures to eliminate them.
- Native Plantings
    - Lamar Right of Way - Identify areas along Lamar Blvd. where additional trees are desired and plan for fall planting. Design signature planting in Polecat Hollow.
- Lawn Care
    - Consider top dressing lawn areas with compost/dillo dirt, especially any lawns that were impacted by WPD project.

Summer

- Monitor tree mortality of all trees planted within the past 5 years and, if necessary, determine why some trees did not survive. Identify areas that will need to be replanted in fall.
- Grow Zone establishment. Inspect areas where mowing has ceased and identify areas where tree planting and tree thinning is required.
- Invasive Species management
    - Ensure giant cane treated during WPD restoration project is retreated as necessary.
    - Invasive species monitoring and prioritization for coming year.

Fall

- Trail maintenance and inspection - Hillside and North Ramble
- Native plantings –
    - Evaluate success and failures of pollinator and wildlife plantings on Hillside/North Ramble, and supplement planting if necessary.
    - Lamar Blvd. Right of Way tree planting and signature planting.
    - Scattered tree planting in areas where mortality was identified in summer.
- Tree care
    - Tree inspection to identify hazard trees.
    - Pruning of all trees planted in last 10 years as necessary.
- Invasive management
    - Cut stump and basal bark treatments, follow up to 2015 and continue onto the Bluffs and prairie area of Lamar Lawn as time permits.

2018

Winter

- Invasive management – evergreen species such as privet. Location based on previous year's early detection monitoring. Focus on protecting areas previously treated, then move onto untreated areas.

Spring

- Trail maintenance and inspection - Hillside and North Ramble
- Monitor riparian zone restoration area for unauthorized trails and take measures to eliminate them.

Summer

- Monitor tree mortality of all trees planted within the past 5 years and, if necessary, determine why some trees did not survive. Identify areas that will need to be replanted in fall.
- Invasive Species management
    - Ensure giant cane treated during WPD restoration project is retreated as necessary.
    - Invasive species monitoring and prioritization for coming year.

Fall

- Trail maintenance and inspection - Hillside and North Ramble
- Clear and/or maintain view windows from trail to creek at Custer's Meadow and Ramble Scramble.
- Native Plantings
    - Scattered tree planting in areas where mortality was identified in summer.
- Invasive management
    - Cut stump and basal bark treatments, follow up to previous years and emphasize riparian zone.

2019

Winter

- Invasive management – evergreen species such as privet. Location based on previous year's early detection monitoring. Focus on protecting areas previously treated, then move onto untreated areas.

Spring

- Trail maintenance and inspection - Hillside and North Ramble
- Monitor riparian zone restoration area for unauthorized trails and take measures to eliminate them.

Summer

- Monitor tree mortality of all trees planted within the past 5 years and, if necessary, determine why some trees did not survive. Identify areas that will need to be replanted in fall.
- Grow Zone establishment. Inspect areas where mowing has ceased and identify areas where tree planting and tree thinning is required.

- Develop detailed restoration plan for Windsor Hillside if rest of park is in good shape. Begin managing catclaw infestation there.
- Invasive Species management
    - Ensure giant cane treated during WPD restoration project is retreated as necessary.
    - Invasive species monitoring and prioritization for coming year.
- Monitoring
    - Photopoint monitoring, especially of areas where management has occurred.

Fall

- Trail maintenance and inspection - Hillside and North Ramble
- Native Plantings
    - Scattered tree planting in areas where mortality was identified in summer.
    - Windsor hillside herbaceous layer restoration and tree planting.
- Invasive management
    - Cut stump and basal bark treatments, follow up to previous years. Begin control work on Windsor Hillside if possible if resources allow.

APPENDIX A4

DON GARDNER'S TREE REPORT

THE TREES OF PEASE PARK

AUSTIN, TEXAS

February, 2014

A REPORT BY
DON GARDNER, RCA
REGISTERED CONSULTING ARBORIST #438
CERTIFIED ARBORIST TX0228

PRODUCED FOR
SIGLO GROUP
WRT
PEASE PARK CONSERVANCY
AUSTIN PARKS & RECREATION DEPT.

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SUMMARY

It is wonderful to have a public place, a park, stretching along a beautiful Hill Country creek right in the middle of the city. This is a precious place that needs more attention in the future than it has had in the past.

This report focuses on the trees in Pease Park, which are going through dramatic times. The extreme heat and prolonged drought years (1998-2011, and perhaps onward) have caused enormous tree losses in Pease Park, similar to all wild-tree areas in Central Texas.

However, due to heroic efforts by the Pease Park Conservancy (and others), the full length of the park is still a forested and wooded riparian wonderland with the native mix of live oak, cedar elm, and ashe juniper still intact.

Tree planting, (a great start has been made), is one of the keys to park sustainability in the future.

Concentrated efforts must continue to remove dead, and especially potentially hazardous trees. A tree risk assessment was completed as part of this study, for all high use areas, including all main trails, and sidewalks.

The most serious tree issue in the entire Park is the condition of the old growth cedar elms in the high-use Kingsbury Commons around the picnic tables, playscape, and basketball court. Some need to be removed soon.

Additional observations and recommendations for future management and tree care are provided for various areas and sections of the Park.

INTRODUCTION/OVERVIEW

This report analyzes Pease Park from an arborist viewpoint and makes recommendations for the master plan.

The decline of the Park has been turned around, but a master plan is now needed.

The report has two main objectives: 1) provide a tree risk assessment and a list of dead/dying and unsafe trees for all high-use areas, and 2) provide observations and recommendations for tree care and the management of trees and wooded areas in Pease Park, with an emphasis on tree planting.

There are, however, two different ways to jump start new trees in Pease Park: plant them or work with the natural regeneration, the volunteers that pop out of the ground. Significant natural forest regeneration of escarpment live oak (*Quercus fusiformis*), cedar elm (*Ulmus crassifolia*), ashe juniper (cedar), hackberry (*Celtis occidentalis*), and Texas ash (*Fraxinus texana*) were found in the Park.

Austin parks went through a period of about 30 years when few trees were planted. This was true in Zilker Park and obviously true in Pease Park as well.

Some of the cedar elm problems being faced now are a consequence of over dependance on cedar elm natural regeneration. Cedar elms are prolific. The easiest thing to do is just let them come in.
In any area not mowed, or stomped down, cedar elms (and hackberries) will come in.

A mix of planted trees and volunteers is best.

Much of Pease Park is being managed for open woodlands, even if by default. Examples are Polecat Hollow, the Hillside and North Ramble. The public loves open woodlands, as many surveys have shown. Open woodlands can be managed with short, often mowed grass, or managed prairie style, by mowing with a tractor bush-hog/schredder once a year.

Managing for open woodlands is a fairly easy management strategy--keep planting trees or locating volunteer trees to replace lost ones and keep planting trees or locating volunteer trees to enlarge the woodland.

This strategy is a good fit for Pease Park.

CURRENT CONDITION OF TREES IN PEASE PARK

The trees as a whole in Pease Park, like all wild land trees in the region, are in a fragile condition.

However, wooded and forested areas are extremely resilient, especially in the eastern half of Texas. Shoal Creek can be said to be one of the eastern most Hill Country streams, sitting near the very bottom of the Balcones Escarpment. Due to its location, it's watershed often gets more rainfall than any other Hill Country creek.

It could also be said that all of Pease Park is riparian.

Natural forest succession/regeneration has kept the Pease Park corridor wooded for a long time. However, this natural volunteering of the native mix of live oaks, cedar elms, and ashe junipers is being threatened by, 1) prolonged drought, 2) the climate getting hotter, 3) increased flooding due to both urbanization in the upper watershed and fewer, but more intense rainfall events, 4) increased severity of storms and high winds, and 5) high use by people.

The loss and degradation of the cedar elm population in the Park would be even more dramatic and alarming if not for the fact that cedar elms are incredibly prolific. Hundreds of cedar elms have been lost, but hundreds of saplings are thriving. Cedar elms and hackberry trees can be found everywhere in the Park where mowing is not done.

Escarpment live oaks are, and will continue to be, the most important tree species in the Park. It is one of the last tree species to be effected by heat and drought.

I found no evidence of the dreaded oak wilt disease (*Ceratocystis fagacearum*)in the Park.

Pease Park contains many old growth (150 years plus) live oaks. These trees are scattered throughout the Park, with a couple of the live oaks along Lamar Boulevard and the Custer live oak being prime examples. These old live oaks are the most important tree element in the Park. The entire Central Texas region does not contain many 150 year old live oaks.

The care and management of them should be one of the highest priorities of the master plan.

As escarpment live oaks (*Quercus fusiformis*), these oaks do not reproduce themselves by acorn, but by root sprouts. In all the wild land areas of Pease Park near any of the old live oaks, I found root sprout live oak saplings. Extra care must be given to protect and care for these young and self-sustaining live oaks. This effort should be a high priority. They are the great live oaks of the future.

In addition, at least 25 percent of all tree plantings should be live oaks. Extra care should be taken to plant *Quercus fusiformis* and not *Quercus Virginiana*, the southern live oak.

It is thrilling to see natural riparian tree regeneration along stabilized sections of the creek bank, such as between 24th and 29th Streets. This regeneration appears to be self-sustaining, but can be greatly enhanced by adding a tree buffer of 20 to 50 feet wide at the top of the creek bank where there is now open grasslands. These tree buffers can also be managed as open woodlands.

As mentioned earlier, the general condition of the planted trees in Kingsbury Commons is pretty good. However, a significant number are not yet truely established and extra care needs to be given to them. Compost them annually and water more if possible.

TREE PLANTING

According to Richard Craig, 100 large trees were planted in February, 2009, 200 large trees were planted in November, 2009, 75 were planted in 2010, and others were added here and there for a total of nearly 500 trees planted! These plantings are impressive and have transformed Kingsbury Commons and the near main trail.

With adequate irrigation, the entire area will have a new shade canopy in fewer than 10 years!

The hand watered small transplants are wonderful. It is relatively easy to establish little trees by hand-watering and this method is encouraged. Keep adding trees here and there and Pease Park will be reforested.

With this great start, it is not hard to have the vision of several thousand more trees reforesting the wooded areas and enlarging the edges for the entire length of the Park.

Managing for open woodlands is a natural fit for Pease Park. This can be achieved both by planting trees (called transplants) and by managing natural regeneration.

Establishing transplants in Central Texas requires know how and a large amount of persistence.

THE RAMBLE SCRAMBLE PROJECT

One of the largest underutilized, and easily accessible areas of the Park is the Ramble Scramble zone, across the creek from the Lamar Lawn. This is an ideal area for early and quick tree planting successes and could be an early, big boost opportunity for the morale of the entire Park conservation effort. The area is relatively flat and has good natural regeneration of cedar elms, cedars, and hackberries. The mix of planted trees and the selection of high quality volunteer trees could turn this unused area into a beautiful, open woodland in just a few years. Invasive species will have to be suppressed, at least long enough to get the tree population reestablished.

APPROPRIATE SPECIES TO PLANT

One of the main lessons learned from the recent ongoing heat and drought is the importance of planting so-called "appropriate" species, which means native and/or well adapted, or in a few instances, other species we feel confident are appropriate. (We need to keep looking for other species that will do well here, primarily in the west and south of Central Texas.) Add to the equation alkaline and shallow soils, low rainfall, and there are few kinds of trees that thrive here.

Get a good list and stick to it. Here's a good list of riparian species and non-riparian. Some, like live oak, cedar elm, and hackberry are both.

Riparian

pecan (*Carya illinoensis*) native
box elder (*Acer negundo*)
Texas sycamore (*Platanus occidentalis*)
black willow (*Salix nigra*)
black walnut (*Juglans nigra*)
bald cypress (*Taxodium distichum*)
western soapberry (Sapindus drummondii)
common hackberry (*Celtis occidentalis*)
anaqua (*Ehretia anacua*)
live oak (*Quercus fusiformis*)
cedar elm (*Ulmus crassifolia*)
American elm (*Ulmus americana*)
Green Ash (*Fraxinus pennsylvanica*)

Non-riparian

Mexican sycamore (*? occidentalis*)
monterrey oak (*Quercus polymorpha*)
chinkapin oak (*Querucs muhlenbergii*)
burr oak (*Quercus macrocarpa*)
Texas persimmon (*Disspyros texana*)
Eve's necklace (*Sophora affini*)
cedar (*ashe juniper)*
durand oak (*Quercus durandii*)
mesquite (*Prosopis glandulosa*)
Texas ash (*Fraxinus texana*)
red mulberry (*Morus rubrum*)
escarpment black cherry (*Prunus serotina*)
Texas red oak (*Quercus texana*)
Texas Mountain laurel (*Sophora secundiflora*)

WHAT SIZE TO PLANT

What size trees to plant is an important decision. In general, trees should be smaller rather than larger because larger trees have been in containers so long that many already have serious circling root problems.

In picnic areas or along main trails, tall trees that have their canopies above people when planted are always going to specified by landscape architects. But arborists are going back to one or five gallon transplants as better because they do not have the circling root problems. They require far less water, and a much shorter time frame to become established. Further, smaller trees do not have to be staked. Trees two-inches in diameter and larger should always be staked in Central Texas due to high winds.

THE PLANTING PROCESS (digging the hole, etc.) must be done by an experienced, well-trained person.

Creating a soil water bowl around the planting hole and filling the water bowl with mulch are also important for relatively short establishment.

TRANSPLANT PRUNING

Transplants should not be pruned for a year after they are planted.
Begin pruning them at year two or three to have a strong, upright form. Pruning them every two to three years is important in order to get the form right. This has to be done by a skilled person.

Many of the trees planted in Pease Park over the last few years need pruning now.

TRANSPLANT WATERING

The tree plantings are impressive. They have been irrigated properly because the rate of transplant success (so far) is unusually high. Many commercial plantings during this same period (extreme heat and drought) have had 25 percent losses.

Water is the key to transplant success.

To insure establishment, put an automatic irrigation head (or two if the tree is three inches in diameter or larger) at the base when planted. The larger the transplanted tree, the more important it is to install irrigation.

Large trees (two inches or larger or 30 gallon containers or larger), require approximately 50 gallons a week. Smaller trees (one-inch or one or five gallon containers), require five to 10 gallons a week.

Newly planted trees should be irrigated once every week there is no major rain--until they are established. In the hottest part of the summer, twice a week is better.

Large trees (two-inches and larger) require four to eight years to establish here. Small trees require two to three years.

Once a tree is established, it needs to be irrigated once a month in hot weather, or twice a month in extreme weather.

In general, in a park situation, trees over 10 years old don't get irrigated.

Unwatered new trees (even seedlings) will not survive the first season without adequate irrigation most years in Central Texas.

However, hand watering works well, especially for establishing smaller trees.

A wonderful, satisfying, and bonding tree planting program could be constructed using almost all volunteer labor. Volunteers carrying water to irrigate young trees will bond those volunteers to the trees and to the program. Few things in life are more satisfying than watering a young tree and watching it thrive. Volunteers have to be able to water in the hottest weather.

A general recommendation for tree irrigation in Pease Park is to continue to extend water lines to as many different areas of the Park as possible in order to have the capability to irrigate as many trees as possible when they need it most. Hose bibs fairly close means trees can be watered.

POST-ESTABLISHMENT MANAGEMENT

The era of container-grown trees has brought with it a set of tree management steps that were not necessary in the past.

First, emphasis must be put on removing both the water bowl soil and the mulch that was in the water bowl, from the base of each transplant, once it is established. This soil and mulch is a good soil blend that can be raked back away from the tree to provide better soil for the area the new roots are now just beginning to grow into.

ADDED EMPHASIS HERE: Mulch and water bowls must be removed or raked or beveled back once the tree is established. This material covers the root crown and trees will not thrive with their crowns buried.

Secondly, irrigation heads must be turned off or redirected outward. Continuing to irrigate at the base of the tree leads to base rot disease, strangling roots, etc.

Thirdly, this is the time to permanently uncover the base and carefully expose the root crown and the buttress roots on each transplant.

Finally, this is when circling and/or girdling roots will be discovered wrapping around the trunk or crossing a buttress root.

An arborist should cut the appropriate roots.

A BRIEF NOTE ON TREE CARE BASICS

For all high value or important trees, implementing the fundamentals of tree care is critical. Three basic treatments are required for tree health in Central Texas: 1) working on the quality and quantity of soil in the critical root zone (that area from the trunk to the drip line or a little beyond), 2) irrigating in hot and/or extreme weather, and 3) proper pruning.

Soil compaction is a big issue in Pease Park. The combination of compaction and heat and drought is a tree killer.

Compost for nutrients (and organic matter) and mulch for organic matter and moisture retention are excellent soil builders and decompacters for trees. Human activities cause soil compaction, which can be mitigated by mulch, or by grass to a lesser extent.

Transplants will not survive unless irrigated. Extra water during extreme weather will carry them through.

Pruning major dead wood and repairing large breaks is essential to trees living longer. Incremental pruning at an early age builds a strong tree. Many tree structure and safety issues can be mitigated by skilled pruning.

BRIEF COMMENTS--MISCELLANY AND ZONE BY ZONE

SHOAL CREEK TREE BUFFERS

Wide (20 feet to 50 feet) plantings of staggered and overlapping future canopies should be planted everywhere along the creek that needs revegetation. Ecologically, there is nothing better for the creek and for erosion than overlapping tree roots. Use appropriate riparian species. Bald cypresses are excellent.

INVASIVE SPECIES

Cat's claw smothers out trees and must be controlled. Little leaf privet (ligustrum) has a foot hold due to dead trees and much more sunlight on the ground. It grows into dense thickets and smothers out trees and must be controlled. Some feel strongly about other invasives.

KINGSBURY COMMONS

Favor transplants over the old elms. Several elms need to be lifted off transplants in order for the transplants to grow straight up. Perform a root collar excavation on the better old elms that have their bases buried, especially those rated #3, or fair.

MAIN TRAIL

Continue planting along the trail all the way to the north end, as has been done in Kingsbury Commons. This will shade the trail and eventually become grand.

HILLSIDE AND NORTH RAMBLE

Keep removing dead trees. Sweetgum trees are not appropriate. Stake young larger trees that are not established. There is great natural regeneration in the area, including a tremendous surge of Texas ash trees. Encourage the stronger ash trees by removing the less strong. Hand lopers work well for thinning and suppressing unwanted volunteers. Some strip mowing has been done in this area, which is a good way to manage for open woodlands. Keep it up.

WINDSOR HILLSIDE

Manage as open woodlands. Contains some beautiful, old live oaks.

CUSTER'S MEADOW
Plant pecans, live oaks and burr oaks along the main trail. Plant more trees around the edges. There are too many even-aged cedar elms. Take special care of the old live oaks.

GASTON GREEN
Remove the many dead cedar elms between the Green and the neighborhood. The whole zone needs more trees.

LIVE OAK TERRACE
This is an iconic area. Plant live oaks and pecans on the edges, but don't change the look.

LAMAR TERRACE
Soil is poor in the clearing, which likely needs to be a high use area. However, plant live oaks and pecans around the perimeter.

BLUFFS
This is a remarkable natural area, with giant broken rocks and environmental features. A large live oak grows on the very tip of one of these rocks, with its giant buttress roots holding on for dear life.

LAMAR BLVD.
Plant live oaks all along both sides of Lamar.

LAMAR LAWN
Another iconic area that should be managed to keep its look. Plant a riparian tree buffer of pecans and bald cypresses which will enhance the look.

PARKS & RECREATION OFFICE BLOCK
One tree (in fair condition) needs major weight reduction in this area. It is on the High Priority Trees list. Many dead trees in the little triangle south of the buildings. And a 200 year old live oak.

EAST BANK
This is a large, underutilized area, ripe for the master plan. Dead trees and tree debris on the ground need cleaning up. There are great tree planting locations. The only pecan grove in the park (25 to 30 mature pecan trees) is located opposite Gaston Green. Plant more.

CITY OF AUSTIN RIGHT-OF-WAY ALONG THE EAST SIDE OF LAMAR BLVD. ABOVE 15TH STREET

This area could be considered part of Pease Park and the grand boulevard concept. It is currently not managed, but could have grand trees along Lamar.

THE MESQUITE GROVE

Mesquite trees are the hardiest trees in the Park. Individual scattered mesquites should be respected and cared for. The Mesquite Grove, along Lamar Blvd. and across from old 19th Street, is an important environmental and ecological feature of Pease Park. It is likely the largest mesquite grove in central Austin. They add significant species diversity and are an important wildlife tree. The Grove contains many healthy mesquites, although they all need pruning, which will greatly enhance their attractiveness and desirability. Bank stabilization efforts and the rain garden design could threaten all or part of the grove. Mesquite trees cannot tolerate their roots under water for many days. Try to design these trees into the master plan.

TREE RISK ASSESSMENT

FOR PEASE PARK HIGH-USE AREAS

PERFORMED BY
Don Gardner, RCA
Registered Consulting Arborist #438
Certified Arborist TX0228
January, 2014
(With the help of Daniel Dietz)

INTRODUCTION

A tree risk assessment for high use areas of Pease Park has been completed.

Public safety is at the top of the list for all who work in the public parks arena. Trees can be downright dangerous. Determining when a tree should be removed, even when it looks good to others, is the cutting edge of arboriculture.

After five years in development, the International Society of Arboriculture has rolled out a brand new national training program called the Tree Risk Assessment Qualification. Your assessor recently successfully completed the program to become a Qualified Tree Risk Assessor.

All trees in high use areas which could impact park users were assessed. This includes all major open areas, trails (and minor trails in the south end), sidewalks, and paved roadways.

Tree risk assessment is defined as "a systematic process to identify, analyze, and evaluate tree risk."

Tree risk assessments are performed in order to facilitate tree risk management, which is defined as, "the application of policies, procedures, and practices used to identify, evaluate, mitigate, monitor, and communicate tree risk." (Both quotes are from the ISA's new Tree Risk Assessment Manual, page 170, 2013.)

Tree risk assessments are one of the standard base-lines for well-managed tree assets and master plans. Trees are dynamic and subject to change. Therefore, risk assessments are on-going.

Arborists assess health issues and structural issues. Either can cause a tree to be a high or an extreme risk. A dead tree within fall distance of a main trail is an example of an extreme risk. A long branch about to break from being too heavy, that extends over the trail is an example of high risk.

A limited visual assessment was performed at Pease Park in order to identify the trees that have significant defects or other conditions of concern. This list, called the High Priority Action Tree Work List, is found after this section. Each tree was evaluated and given a rating. In addition, mitigation recommendations are provided for all trees not requiring immediate removal.

For this study trees were assessed using four ratings: 1) for dead or dying, 2) poor, 3) fair, and 4) good.

For this report and in the enclosed list, all the #1s and #2s are evaluated as high risk.

Two trees were found to have extreme risks. Assessors are duty bound to report to the tree owner or manager those trees which are in imminent danger of failure and hitting people to the tree owner or manager. Those two trees were reported to the Parks and Recreation Department forestry unit for immediate removal. (Both were dead and had been marked for removal, but had been missed or overlooked.)

<u>The most significant finding of the tree risk assessment was the large number of cedar elm trees in poor condition in the Kingsbury Commons area among the picnic tables and near surroundings.</u>

There are approximately 29 large cedar elms in this area. One needs to be removed soon and 22 others are in poor condition.
Several need to be removed in the next few years. Some can be mitigated (made safe) by radical pruning that significantly reduces their size and lightens their crown weight.

The old elm grove should be assessed again next year to determine the second round of removals. The entire old elm grove should be monitored and assessed annually.

This is going to be a blow to some Park users. The trees are old, big, and beloved by many, including your assessor. However, the risk, liabilities, and consequences can be severe and extreme.

<u>These trees must be systematically managed to reduce risk.</u>

The good news is that foresighted leadership has started the transition from old trees to the trees of the future, through mass tree plantings in the same area.

Another reason to be proactive in removing or radically reducing the size of the old elms is so that they will not break apart and tear up young trees under them. Few, if any, Park users are around when the storms come that break up the trees, but the young trees are there all the time.

Recent work removed many dangerous trees from trail sides and in general, the main trail is relatively safe from a tree standpoint.

When the #1s and unsafe #2s listed in this report are taken care of, the trail will be even safer.

All the work in the "High Priority Trees" list should be accomplished soon.

HIGH PRIORITY ACTION
TREE WORK LIST

This is a high priority removal and pruning list. There are 66 trees on the list. They are all high risk and in high use areas. Sixteen are removals. Almost all the others need major weight reduction and/or weight reduction over the main trail. Twenty-two trees on the list are listed in poor condition. They are all in the old elm grove in Kingsbury Commons.

SPECIES	#	RATING	COMMENT
cedar elm	642	2	major (maj.) mistletoe (mtoe.), reduce weight (wt.)
cedar elm	651	2	maj mistletoe, reduce wt.
cedar elm	653	2	repair
cedar elm	654	2	maj. mistletoe, reduce wt.
cedar elm	655	2	maj. mistletoe, reduce wt.
cedar elm	657	2	repair, mtoe, reduce wt.
cedar elm	667	2	maj. mtoe, reduce wt.
cedar elm	669	2	maj. mtoe, reduce wt.
cedar elm	672	2	maj. mtoe, reduce wt.
cedar elm	670	2	maj. mtoe, reduce wt.
cedar elm	117	2	16-inch, mtoe, reduce wt.
cedar elm	552	2	maj. mtoe, radical reduction
cedar elm	588	2	maj. mtoe, reduce wt.
cedar elm	528	3	maj. mtoe, reduce wt.
cedar elm	532	3	maj. mtoe, reduce wt.
cedar elm	524	2	maj. mtoe, reduce wt.
cedar elm	522	2	maj. mtoe, reduce wt.
cedar elm	550	2	maj. dead wood, reduce wt.
cedar elm	58	2	maj. mtoe, reduce wt.
cedar elm	549	3	reduce wt.
cedar elm	118	2	reduce wt.
cedar elm	685	3	repair
cedar elm	119	1	remove--next to court
cedar elm	120	2	maj. mtoe, reduce wt.
cedar elm	469	2	reduce wt. over trail
cedar elm	463	3	reduce wt over trail

cedar elm	456	2	reduce wt.
cedar elm	442	2	reduce wt.
cedar elm	406	3	reduce wt.
cedar elm	6439	2	maj. mtoe, reduce wt.
cedar elm	0095	1	dead/remove
cedar elm	0094	3	reduce wt. over trail
cedar elm	7423	2	reduce wt. over trail
cedar elm	7436	2	maj. mtoe, reduce wt.
mesquite	7496	2	remove cracked branch
cedar elm	7584	2	repair, reduce wt.
cedar elm	121	1	dead/remove
bois d'arc	1228	2	remove, mtoe in all stems
cedar elm	1493	2	major dead wood, repair
Am. elm	1637	1	remove, unsafe, over trail
cedar elm	2923	3	maj. deadwood, repair
cedar elm	2922	3	reduce wt. over trail
cedar elm	2821	2	remove, unsafe.
cedar elm	2828	1	remove, unsafe
cedar elm	14609	2	maj. mtoe, reduce wt.
mesquite	123	2	maj. deadwood, repair
mesquite	124	2	reduce wt.
hackberry	125	1	remove, unsafe
cedar elm	12257	2	reduce wt.
cedar elm	12262	2	remove entire branch w/ mistletoe bulge
cedar elm	3979	2	remove branch with dead end
cedar elm	10879	2	reduce wt.
cedar elm	7957	3	reduce long, low limb 50%
cedar elm	236	1	remove, with cat's claw
live oak	8018	2	monitor hypoxylon
cedar elm	8032	2	remove, dead crown
cedar elm	8330	1	remove, dead
cedar elm	8332	1	remove, dead
cedar elm	8196	1	remove, dead
cedar elm	212	1	remove, dead
cedar elm	213	1	remove, dead
cedar elm	214	2	remove maj. dead over trail
cedar elm	215	2	repair 2 large breaks

Tree Report Map

PEASE PARK MASTER PLAN

0 700' 1400' N

APPENDIX A5

RECOMMENDED PLANT LISTS

Recommended Plants Lists for Pease Park and the Shoal Creek Greenbelt

Plants listed here are recommended for planting and seeding as part of the Pease Park Master Plan. The plants are divided by potential habitat and type.
This list is not comprehensive. It does however create a substantial baseline for healthy plant communities in the park and greenbelt. The plants are chosen based on the following criteria:

- They are native or well adapted to the Central Texas Area;
- They are available through the local nursery trade or native plant society groups;
- They have been successfully used in restoration projects within Central Texas and/or they add diversity to the current and future plant palette at Pease Park and the Shoal Creek Greenbelt;
- They are listed in the Texas Parks and Wildlife Department's descriptions of the vegetation types found at Pease Park;
- They have wildlife benefit; and/or
- They have been recommended for this or similar projects by arborists, ecologist, or land management professionals.

For plant materials and seeds that are not commercially available, there are numerous avenues for acquisition. Trained volunteers may wish to collect seeds from other sites. In order to facilitate this, the Pease Park Conservancy should work with local government entities to develop a Memorandum of Understanding that grants volunteer's permission to collect seeds for specific use in projects in Pease Park and the Shoal Creek Greenbelt. Local Native Plant Society chapters and Treefolks are examples of non-profit organizations that can become partners in acquiring plant material for restoration projects.

*Plant species marked with an asterisk are considered especially good for wildlife and are contained in the Texas Parks and Wildlife Department's Texas Wildscapes plant list

Riparian Canopy Trees
American elm (*Ulmus americana*)
anaqua (*Ehretia anacua*)*
bald cypress (*Taxodium distichum*)*
black walnut (*Juglans nigra*)*
black willow (*Salix nigra*)*
bois d'arc (*Maclura pomifera*)*
box elder (*Acer negundo*)
burr oak (*Quercus macrocarpa*)*
cedar elm (*Ulmus crassifolia*)
common hackberry (*Celtis occidentalis*)*
cottonwood (*Populus deltoides*)*
green ash (*Fraxinus pennsylvanica*)

lacey oak (*Quercus glaucoides*)*
little walnut (*Juglans microcarpa*)*
live oak (*Quercus fusiformis*)*
pecan (*Carya illinoensis*)*
Texas sycamore (*Platanus occidentalis*)*
western soapberry (*Sapindus drummondii*)*

Upland Canopy Trees
burr oak (*Quercus macrocarpa*)*
cedar (*Ashe juniper*)*
cedar elm (*Ulmus crassifolia*)*
chinquapin oak (*Querucs muhlenbergii*)*
durand oak (*Quercus durandii*)
escarpment black cherry (*Prunus serotina*)*
lacey oak (*Quercus glaucoides*)
live oak (*Quercus fusiformis*)*
mesquite (*Prosopis glandulosa*)*
monterrey oak (*Quercus polymorpha*)
red mulberry (*Morus rubrum*)*
retama (*Parkinsonia aculeata*)*
shin oak (*Quercus sinuata var. breviloba*)*
Texas ash (*Fraxinus texana*)*
Texas pistache (*Pistacia mexicana*)*
Texas red oak (*Quercus texana*)*

Understory Trees and Shrubs
agarito (*Mahonia trifoliolata*)*
American beautyberry (*Callicarpa Americana*) *riparian only
anacacha orchid tree (*Bauhinia lunarioides*)
aromatic sumac (*Rhus aromatic*)*
buttonbush (*Cephalanthus occidentalis*)* riparian only
Carolina buckthorn (*Frangula caroliniana*)*
catclaw acacia (*Acacia greggii var. wrightii*)*
creek plum (*Prunus rivularis*)*
desert willow (*Chilopsis linearis ssp. linearis*)*
elbowbush (*Forestiera pubescens*)*
eve's necklace (*Styphnolobium affine*)
evergreen sumac (*Rhus virens*)*
flameleaf sumac (*Rhus lanceolata*)*
goldenball lead tree (*Leucaena retusa*)*
Lindheimer's silktassel (*Garrya ovata ssp. Lindheimeri*) (in Bluffs area)
Mexican buckeye (*Ungnadia speciosa*)*

Mexican plum (*Prunus mexicana*)*
possom haw holly (*Ilex decidua*)*
roughleaf dogwood (*Cornus drummondii*)*
rusty blackhaw viburnum (*Viburnum rufidulum*)*
sabal palm (*Sabal minor*)* riparian only
scarlet buckeye (*Aesculus pavia*)*
Texas mountain laurel (*Sophora secundiflora*)
Texas persimmon (*Diospyros texana*)*
Texas redbud (*Cercis canadensis var. texensis*)*
twistleaf yucca (*Yucca rupicola*)*
wafer ash (*Ptelea trifoliata*)
yaupon holly (*Ilex vomitoria*)*

Groundcover and Herbaceous Species in Riparian Area
blue curls (*Phacelia congesta*)
bushy bluestem (*Andropogon glomeratus*)*
Canada wildrye (*Elymus canadensis*)*
cardinal flower (*Lobelia cardinalis*)*
eastern gamagrass (*Tripsacum dactyloides*)*
emory sedge (*Carex emoryi*)
frogfruit (*Phyla nodiflora*)
golden groundsel (*Packera obovata*)
goldeneye daisy (*Viguiera dentata*)*
indigo bush (*Amorpha fruticosa*)*
Lindheimer's muhly (*Muhlenbergia lindheimeri*)*
pigeonberry (*Rivina humilis*)
riverfern (*Thelypteris ovata var. lindheimeri*)
sawgrass (*Cladium mariscus*)
southwestern bristlegrass (*Setaria scheelei*)
switchgrass (*Panicum virgatum*)*
Virginia creeper (*Parthenocissus quinquefolia*)*
Virginia wildrye (*Elymus virginicus*)*
white avens (*Geum canadense*)
wood oats (*Chasmanthium latifolium*)*

Shaded Groundcover and Herbaceous Species in the Upland Area
blue curls (*Phacelia congesta*)
Canada wildrye (*Elymus canadensis*)*
cedar sage (*Salvia roemeriana*)*
frostweed (*Verbesina virginica*)
golden groundsel (*Packera obovata*)
goldeneye daisy (*Viguiera dentata*)*

straggler daisy (*Calyptocarpus vialis*)
Texas wintergrass (*Nassella leucotricha*)
turk's cap (*Malvaviscus arboreus var. drummondii*)*
Virginia wildrye (*Elymus virginicus*)*
white avens (*Geum canadense*)
widow's tears (*Tinantia anomala*)
wood oats (*Chasmanthium latifolium*)*

Sunny Groundcover and Herbaceous Species in the Upland Area
American basketflower (*Centaurea Americana*)*
annual winecup (*Callirhoe leiocarpa*)*
big bluestem (*Andropogon gerardii*)*
black-eyed susan (*Rudbeckia hirta*)*
blackfoot daisy (*Melampodium leucanthum var. leucanthum*)*
buffalograss (*Bouteloua dactyloides*)*
curly mesquite (*Hilaria belangeri*)*
cutleaf (Engelmann) daisy (*Engelmannia pinnatifida*)*
gayfeather (*Liatris mucronata*)*
green sprangletop (*Leptochloa dubia*)
hairy zexmenia (*Wedelia texana*)
heath aster (*Symphyotrichum ericoides*)*
horsemint (*Monarda citriodora*)
huisache daisy (*Amblyolepis setigera*)*
indian blanket (*Gaillardia pulchella*)*
indian paintbrush (*Castelleja indivisa*)*
indiangrass (*Sorghastrum nutans*)*
Lindheimer's senna (*Senna lindheimerana*)
little barley (*Hordeum pusillum*)
little bluestem (*Schizachyrium scoparium*)*
Maximilian sunflower (*Helianthus maximiliani*)*
mealy blue sage (*Salvia farinacea*)*
old plainsman (*Hymenopappus scabiosaeus var. corymbosus)*
plains coreopsis (*Coreopsis tinctoria*)*
poverty dropseed (*Sporobolus vaginiflorus*)
purple three-awn (*Aristida purpurea*)
purpletop (*Tridens flavus*)
shrubby boneset (*Ageratina havanensis*)*
side oats grama (*Bouteloua curtipendula*)*
silver bluestem (*Bothriochloa laguroides var.torreyana*)*
slender greenthread (*Thelesperma filifolium*)*
standing cypress (*Ipomopsis rubra*)*
tall dropseed (*Sporobolus compositus var. compositus*)

tall rosinweed (*Silphium radula*)
Texas aster (*Aster drummondii subsp. Texanus*)
Texas bluebonnet (*Lupinus texensis*)*
Texas green-eyes (*Berlandiera betonicifolia*)*
Texas skeletonplant (*Lygodesmia texana*)
tumble windmillgrass (*Chloris verticillata*)

APPENDIX A6
INVASIVE SPECIES CONTROL

Invasive Species Plant Control

Mechanical Control

Mechanical control is any method that directly removes the invasive plant without the use of chemicals. Examples include hand pulling, pulling with weed wrenches, cutting, the use of a forestry mower, and repeated mowing. The advantages of mechanical methods include less herbicide use, no need for an herbicide applicator license, and more potential for community involvement. Disadvantages of mechanical methods include: potential for erosion and potential need for repeated treatment.

Chemical Controls

Chemical controls (herbicide) are recommended for many of the invasive species listed in Table 2: Invasive Species Control Strategies. Please note that all herbicide application must be conducted under the supervision of a licensed herbicide applicator and must follow the EPA's Worker Protection Standards. Applicators should also follow the herbicide label directions and maintain pesticide use records. Advantages of herbicide use include: less soil disturbance, more effective for some species that do not respond to mechanical means, ability to treat large areas. The disadvantages for chemical methods include: the use of poisonous material on the landscape, the need for an applicator license, and potential mortality of desired plants from overspray.

Application Methods

Foliar spray the spraying of an herbicide solution on the leaves of plants. Because of the potential for non-target kill through overspray, this method will be recommended primarily in dense monocultures where other methods are ineffective.

Wick applications wiping a highly concentrated herbicide solution onto the leaves. Generally not as effective as a foliar spray, but reduces the danger of overspray and non-target kill. Recommended only in areas where highly desirable plants would be negatively affected by a foliar spray.

Cut stump the cutting of a woody plant and applying an herbicide solution to its stump. This targeted approach is highly effective, but often requires considerable labor if the cut portion of the plant must be removed from the site or chipped.

Basal bark the spraying of an herbicide/oil solution on the lower portions of a tree's or shrub's bark. This method may not be effective for large trees with thick bark, and should not be used on the water's edge where the oil (which serves to penetrate the bark) may be harmful to amphibians or fish eggs. This method results in a standing dead tree or shrub, which may be beneficial to many forms of wildlife, and does not require the labor of plant disposal, but is unsafe if near a trail or area with human use. Basal bark applications are more effective in late summer and fall. In the spring, large amounts of water moves up the stem to support leaf flush, flowering, and fruit production, making it more difficult for the chemical to reach the roots.

Basal frill or "hack and squirt" cutting into the bark of a tree, usually along the entire circumference, and applying an herbicide solution. This has similar pros and cons to basal bark method, but is safer in wet areas since an oil surfactant is not usually required.

Integrating Mechanical and Chemical Controls

Recommended control strategies for each species are shown in the Table 2: Invasive Species Control Strategies. For many of the species, a combination of mechanical and chemical control measures will be necessary, and control methods will vary based on site conditions and the time of year in which the opportunity for control arises. All methods call for monitoring after treatment to insure treatments success and repeat process as needed.

Invasive Control on Steep Slopes

On steep slopes where extensive woody species removal is necessary, erosion control measures will be required. For the most part this can take the form of stacked dead branches along contour lines to slow storm runoff and reduce erosion. Branches should be 2 feet in length or longer. The mounds of branches do not need to be more than a foot in height, but it is essential that they be compacted onto the ground. Where this is not feasible, erosion control fabric should be employed.

A Note on Poison Ivy

Poison ivy is not an invasive species but does pose user experience issues in some parts of the park and greenbelt. It is a native plant commonly occurring throughout the park and is abundant in portions of the Riparian Zone and slope forest. In high use areas such as trail edges, the plant should be cut back or removed from these locations. However in areas away from trail users, poison ivy serves as a strong competitor to invasive species, provides wildlife food, and has foliage that turns a striking red in fall. It's removal benefits Japanese honeysuckle and catlaw vine that compete for the same niche habitats.
If possible, simply cut the vine aggressively away from the trail. All workers need to know how to identify the plant, wear long sleeves and pants, wash with Technu or another poison ivy removing soap directly upon finishing work, and wash clothing separately if acutely sensitive.

Table 1: Invasive Species List

Species	Common name	COA ranking	Pease Park ranking	Impacts
Ailanthus altissima	Tree of Heaven	Moderate	Low	1,2,4
Alocasia macrorhiza	Elephant ears	Moderate	Low	1
Arundo donax	Giant reed	High	High	1,5
Bothriochloa ischaemum	King Ranch Bluestem	"unknown"	Moderate	1
Broussonetia papyrifera	Paper mulberry	Moderate	Moderate	1
Bromus catharticus	Rescuegrass	not listed	Low	1
Bromus diandrus	Ripgut brome	Not listed	Low	1
Cynodon dactylon	Bermuda grass	Moderate	High	1, 4
Firmiana simplex	Chinese parasoltree	Moderate	Low	1

Hedera helix	English Ivy	not listed	Low	1, 7
Jasminum mesnyi	Primrose jasmine	not listed	Low	1
Lantana montividensis	Purple lantana	not listed	Low	1
Ligustrum lucidum and *Ligustrum japonicum*	Glossy privet	High	High	1
Ligustrum sinense and *Ligustrum quihoui*	Chinese privet	High	High	1
Lonicera japonica	Japanese honeysuckle	Moderate	Moderate	1, 3, 7, 8
Macfadyena unguis-cati	Catclaw vine	Moderate	High	1
Melia azedarach	Chinaberry tree	High	High	1, 2
Nandina domestica	Heavenly bamboo	Moderate	Moderate	1
Paspalum urvillei	Vasey grass	not listed	Low	1
Photinia serratifolia	Chinese Photinia	not listed	Low	1
Phyllostachys aurea	Golden bamboo	High	Moderate	1
Rapistrum rugosum	Bastard cabbage	High	Low	1,2
Ruellia brittoniana	Mexican petunia	not listed	High	1
Rumex crispus	Curly dock	not listed	Low	1
Sorghum halapense	Johnson grass	High	Moderate	1
Torilis arvensis	Tall sockbane	not listed	Low	1
Triadica sebifera	Chinese tallow	Moderate	High	1,2
Ulmus parvifolia	Chinese lacebark elm	not listed	Low	1
Vites agnus-castus	Common chastetree	not listed	Low	1
Vinca minor	Common periwinkle	not listed	Low	1

TABLE 2: INVASIVE SPECIES CONTROL STRATEGIES

Species	Common name	Priority for Removal	Control Method	Control Method Details	Where Appropriate	Optimal time of year	Effectiveness	Applicator Required	Labor Required
Ailanthus altissima	Tree of Heaven	Medium	Hack and Squirt	This plant aggressively sprouts from roots when cut down or girdled. This method should lessen the resprouting. Step 1: Cut down to the cambium layer of the tree with hatchet, axe, chainsaw, or other cutting instrument. If possible, cut downward, so a small lip of bark/tree is splaying outward. Do not cut all away around the tree. Cut 3 to 4 inch strips, that cover approximately 50% of the tree diameter. Step 2: Spray or drip with a herbicide solution containing tryclopyr.	Preferred method where distance to trail is further than height of tree	Fall	Moderate	yes	Moderate
			Basal spray	Spray base of tree with a triclopyr and basal oil solution. This chemical girdle may cause increased root sprouting.	Where distance to trail is further than height of tree	Fall, but any is acceptable	Moderate	Yes	Low
			Cut stump	Cut tree down, providing for safety first. Paint top of stump with a triclopyr based solution immediately, taking care to cover edges. This will likely cause root sprouting, and area will need to be revisited in subsequent years	All areas	Fall, but any is acceptable	Moderate	Yes	High, due to resprouting
			Mechanical removal	For small sapling and seedlings, remove plant with weed wrench. Be careful, plant contains a latex which may cause skin irritation to some people.	Where seedlings and saplings are present	Any	Moderate	No	High
Alocasia macrorhiza	Elephant ears	Low	Mechanical removal	Digging out plant and tuber. Will make area susceptible to erosion, so not recommended unless immeadiately followed by native plantings and the installation of erosion control fabric. May be more desirable to let infestation remain.	Highly visible banks where restoration is desired	Any	Low, but may allow for introduction of other plants	No	High
			Foliar spray	During growing season months, spray foliage with an aquatic approved glyphosate solution. Repeat several times throughout growing season as the herbicide label dictates. Plant replacement species in late fall. Planting and installation of erosion control fabric essential to prevent erosion.	Highly visible banks where restoration is desired	Spring, Summer	Low	Yes	Low for application, high for plantings
Arundo donax	Giant reed	High	Foliar spray, Imazamox	Step 1: Foliar spray with Imazamox solution no earlier than mid-June. Step 2: If Arundo is not mixed with desirable vegetation, then spray with a Imazamox and glyphosate solution. Step 3: Wait until stems have completely died before cutting and removing vegetation, which may be several weeks. Step 4: Repeat as Necessary. Note: Do not cut Arundo for at least a year prior to using this method, or effectiveness will be greatly reduced.	Preferred and likely most effective method	Summer	Moderate	Yes	Low to moderate
			Frequent mowing	Frequent mowing may eventually cause roots to lose enough reserves that nearby Bermuda grass and other turf plants are able to take over the area. The first mowing should take place when the giant reed is in flower so that as much of its energy reserve is aboveground as possible. Area must be mown at least several times a month, because Arundo grows very aggressively. Area on shoreline will likely be too muddy and soft to use this method.	Areas to be transformed into turf grass	Will require commitment throughout growing season	Low	No	Moderate, year round
			Digging and root removal	Step 1: Cut and remove tops of plants. Step 2: Dig and remove as much of the roots as possible. Even the smallest stolon left in the ground may take root and grow. Step 3: Wait for new sprouts to show and dig a second time. Digging will cause massive soil disturbance and open the area to erosion. Step 4: Install restoration plantings as soon as possible.	Areas that need to be cleared immediately and where large labor pool is possible	Any	Low	No	High - year round
			Wick or drip chemical application	Step 1: Using a wick applicator, wipe a glyphosate based herbicide mixed with surfactant that aids herbicide penetration of leaves. This will allow for application on the giant cane without any herbicide touching the restoration plantings. OR, cut individual stems and squirt a glyphosate solution into the stem cavity. If near shoreline, product should be labeled for use in wetland or aquatic environments.	Any, but likely in areas where digging and frequent mowing have already been tried	Summer	unknown	Yes	High - first application, moderate - second application
Bothriochloa ischaemum	King Ranch Bluestem	grasslands are to be restored, low elsewhere	Foliar spray	Foliar spray with solution of either glyphosate or a grass-specific heribicide such as fluazifop during growing season months. Will be more effective if area is closely mown and then allowed to regrow before application, and less effective if applied in drought conditions.	Grassland/Savanna areas with passive recreation	Spring, after summer or fall rains.	Moderate	yes	Moderate
			Mechanical Removal	Hand removal or grubbing prior to setting of seed.	Grassland/Savanna areas with passive recreation	Spring/summer	Low	no	High
Broussonetia papyrifera	Paper mulberry	Medium	Basal spray	Spray base of tree with a triclopyr and oil solution. Cover 12 to 18 inches of bark around entire tree. Do apply so much as to allow herbicide to drip onto the ground.	Where distance to trail is further than height of tree	Fall, but any is acceptable	High	Yes	Low

			Cut stump	Cut tree down, providing for safety first. Paint top of stump with a triclopyr based solution immediately, taking care to cover edges.	All areas	Fall, but any is acceptable	Moderate	Yes	Moderate
Cynodon dactylon	Bermuda grass	High where establishing new turf or planting short to mid grass buffer areas.	Foliar spray	Foliar spray with glyphosate solution during growing season months. Will not be effective if applied in drought conditions. Repeat applications will be necessary.	Any	April to June; September to October	Moderate	Yes	Moderate
Firmiana simplex	Chinese Parasoltree	Low	Basal spray	Spray base of tree with a triclopyr and oil solution. Cover 12 to 18 inches of bark around entire tree. Do apply so much as to allow herbicide to drip onto the ground.	Where distance to trail is further than height of tree	Fall, but any is acceptable	High	Yes	Low
			Cut stump	Cut tree down, providing for safety first. Paint top of stump with a triclopyr based solution immediately, taking care to cover edges.	All areas	Fall, but any is acceptable	Moderate	Yes	Moderate
Hedera helix	English Ivy	Low	Combination of cutting and foliar spray.	Step 1: In areas where English ivy is climbing into a tree, cut at ground level. Allow top to die, do not attempt pull from tree or shrub. English ivy latches onto plants and bark damage may result from pulling it off. Step 2: Where English ivy is growing as a ground cover, use foliar spray with triclopyr and a surfactant that is specifically designed to break down waxy coating of leaf surface. Avoid contact with both the bark and foliage of desirable vegetation. Dead surface stems will act to hold soil, and should not be removed except for aesthetic reasons in select areas.	All areas	Winter when desirable deciduous vegetation that may be growing in the same area is dormant.	Winter application - Moderate; Spring and Fall application - Moderate to High	Yes	Moderate
Jasminum mesnyi	Primrose Jasmine	Low	none recommended	These non-native plants are in a few localized areas and are unlikely to spread aggressively. The disturbance their removal causes may lead to more problems than they themselves cause	n/a	n/	n/a	No	none
Lantana montividensis	Purple lantana	Low	Mechanical removal	These non-native plants are limited to a few areas and are not having a significant impact on the area, so control should be low priority, or perhaps not undertaken at all. If control is deemed necessary, hand removal would be effective.	All areas	Any	High	No	High
Ligustrum lucidum, Ligustrum japonica, and *Ligustrum sinense*	Glossy privet, Japanese privet	High	Mechanical removal followed by cut stump application.	Remove plants that are 2 inches or less basal diameter with volunteers using weed wrenches or other mechanical devices. This is a highly effective method for this plant. Once small ones are cleared, control plants greater than 2" in diameter by using a cut-stump herbicide application containing triclopyr. Provide for erosion control if on steep slope or in riparian zone. Hand pulling of new seedlings required in subsequent years.	All areas	Any for mechanical removal, Slight preference for fall for chemical applications	High	Yes, but not for all steps	High
Lonicera japonica	Japanese honeysuckle	Medium	Foliar spray	Step 1: Cut Japanese honeysuckle that is growing into trees at head height. Step 2: Spray with glyphosate solution. Take care not to avoid herbicide contact or drift onto desired vegetation.	When growing as a monoculture and non-target kill minimal	Late Fall, Winter, when other trees have dropped leaves	High	Yes	Low to Moderate
			Cutting followed by foliar spray	Step 1: Cut Japanese honeysuckle at ground level, and remove aboveground biomass from the site. Where vine is tangled in overstory trees and is unable to be pulled down without damaging native tree branches, cut at head height and allow vine in upper branches to desiccate and fall. Step 2: Allow Japanese honeysuckle to resprout from roots. Step 3: When 2 feet in height/spread, use foliar spray with herbicide solution that contains glyphosate.	In areas where non-target kill would be high	Cutting in spring to prevent seed set. Foliar spray in winter	Moderate	Yes	Moderate
Macfadyena unguis-cati	Catclaw vine	High	Combination of cutting and foliar spray	Step 1: Where catclaw is tangled in overstory trees and is unable to be pulled down without damaging native tree branches, cut at head height and allow vine upper branches to desiccate and fall on its own. Step 2 Use a foliar spray with an herbicide solution that contains glyphosate and triclopyr.	Preferred when catclaw is near monoculture in groundcover	When plant is not stressed by drought	unknown, likely more effective than method below	Yes	Moderate
			cutting followed by foliar spray	Step 1: Cut catclaw at ground level, and remove aboveground biomass from the site. Step 2: Where catclaw is tangled in overstory trees and is unable to be pulled down without damaging native tree branches, cut at head height and allow vine upper branches to desiccate and fall on its own. Step 3: Allow catclaw to resprout from underground tuber. When 2 feet in height/spread, use foliar spray with herbicide solution that contains glyphosate and triclopyr.	When catclaw is mixed in with desirable species	When plant is not stressed by drought	Unknown, likely less effective than method above	Yes	Moderate to High

Melia azedarach	Chinaberry tree	High	Cut stump	Cut tree down, providing for safety first. Paint top of stump with a triclopyr based solution immediately, taking care to cover edges.	All areas	Fall, but any is acceptable	Moderate	Yes	Moderate
			Basal spray	Spray base of tree with a triclopyr and oil solution.	Where distance to trail is further than height of tree	Fall, but any is acceptable	Moderate	Yes	Low
Nandina domestica	Heavenly bamboo	Moderate	Foliar spray	Step 1: Foliar spray with a solution containing both glyphosate and triclopyr. Step 2: Once completely browned, cut and remove vegetation. This is an aesthetic consideration rather and an ecologic one.	Preferred if labor is not abundant	Growing season	Moderate	Yes	Moderate
			Cut stump	Step 1: Cut all the stems of a shrub clump. Step 2: Drip or paint a triclopyr solution OR a glyphosate solution on the cut stump. Step 3: Remove cut stems.	Preferred if labor is abundant	Fall, but any is acceptable	Moderate	Yes	Moderate
Paspalum urvillei	Vasey grass	Low	Foliar spray	Foliar spray with glyphosate based herbicide. Plant is not widesrpread and is of low priority. Spray when treating other weeds in area.	Any location	Spring, growing season	High	Yes	Low
			Mechanical Removal	Hand removal or grubbing prior to setting of seed.	Any location	Spring/summer	Moderate	no	High
Photinia serratifolia	Chinese Photinia	Low	Mechanical Removal	All of the known Chinese Photinia may be removed with a weed wrench. Densities and low enough that soil disturbance and erosion concerns will be low.	Any location	Any	High	No	Moderate
Phyllostachys aurea	Golden bamboo	High in Ramble Scramble, Moderate elsewhere	Foliar spray	**Step 1:** Cut bamboo near ground level and remove biomass. **Step 2:** Allow bamboo to sprout from base and reach a height of approximately 2-3 feet. **Step 3:** Apply a foliar spray of glyphosate. **Step 4;** Allow bamboo to completely brown before removing dead foliage.	Any location	Cut in winter, spray in late spring or early fall.	Moderate	Yes	Moderate
Pyracantha coccinea	Scarlet firethorn	low	Mechanical removal	There are less than a handful on site, and all are relatively small. Pull by hand or with weed wrench.	Any Location	Any	High	No	Low
Rapistrum rugosum	Bastard cabbage	Low	Mechanical removal	Dig out rosettes in winter and early spring before the onset of seeds.	Any where they begin to take over herbaceous layer	Winter, early Spring	Moderate	No	Moderate
			Foliar spring	Spray with glyphosate solution before plant flowers	Any where they begin to take over herbaceous layer	Winter	Moderate	Yes	Low
Ruellia brittoniana	Mexican petunia	Medium to low	Riparian Forest Restoration	This plant is dominating the herbacious layer in many parts of the Riparian Zone. Unfortunately, its removal could lead to severe erosion problems without the addition of stabilizing plants. This plant requires sun, so the best long-range plan may be to augment the tree abundance and diversity in the riparian zone, wait for greater canopy cover, and hope that shade loving natives outcompete this non-native Ruellia.	Riparian zone	n/a	unknown, but preferred method	no	High, but tied to other management objectives
			Foliar spray	Foliar spray with aquatic labled glyphosate based herbicide solution. Replanting area with native specie is essential	Riparian zone	Spring/growing season	unknown, presumed moderate	Yes	High
			Mechanical removal	Handpulling and grubbing of plants. These plants spread by both rhizome and seed, so care must be taken to remove all roots. Expect large amounts of soil disturbance. Replanting area with natvie species will be essential.	Riparian zone	Any	Not recommended, high disturbance, low effectiveness	No	High
Sorghum halapense	Johnson grass	Moderate	Foliar spray	Foliar spray with glyphosate based herbicide.	Any	Spring or fall	High	Yes	Low
			Wick application	In areas with desirable groundcover underneath Johnsongrass, apply glyphosate based herbicide with wick applicator. This method tends to actually use more herbicide product, but avoids non-target kill	Any	Spring or fall	Moderate	Yes	Moderate
Triadica sebifera	Chinese tallow	High	Basal bark	Use a basal bark herbicide application using a triclopyr based herbicide OR Imazamox (Clearcast) mixed with mineral oil (NOT diesel). The standing dead snag will be excellent habitat for many insects and birds.	Preferred when tree height is shorter than its distance to the nearest trail	Fall, but any is acceptable	High	Yes	Low
			Cut stump	Step 1: Cut stem. Step 2: Paint entire cut of the stump with a triclopyr based solution OR Clearcast.	Preferred when tree is close to trail or public walkway	Fall, but any is acceptable	High	Yes	Moderate
			Foliar spray	Foliar spray of Imazamox solution. This herbicide is very specific to Chinese tallow and should not harm bald cypress, green ash, hackberry or American elm, if some of the chemical should drift onto their leaves. Be patient. It may take several months for Chinese tallow to show damage.	Preferred when tree height is below 10 feet in height	Growing season	High	Yes	Low
Ulmus parvifolia	Chinese lacebark elm	Low	Cut stump	Cut tree down, providing for safety first. Paint top of stump with a triclopyr based solution immediately, taking care to cover edges.	All areas	Fall, but any is acceptable	Moderate	Yes	Moderate

			Basal spray	Spray base of tree with a triclopyr and oil solution.	Where distance to trail is further than height of tree. Most of these trees are in highly visible areas, so leaving a standing snag will be aesthetically prohibitive.	Fall, but any is acceptable	Moderate	Yes	Low
Vinca minor	Common periwinkle	Low	Foliar spray	Not a large threat and should only be targeted when already working in an area. Spray at same time that English Ivy is being treated (it requires the same surfactant that English Ivy requires).	Any	Any	Low	Yes	Low
Vitex agnus-castus	Common chastetree	Low	Cut stump	Cut tree down, providing for safety first. Paint top of stump with a triclopyr based solution immediately, taking care to cover edges.	All areas	Fall, but any is acceptable	Moderate	Yes	Moderate
			Mechanical Removal	A weed wrench will remove Vitex of less than 2" basal diameter	All areas	Any	High	No	High

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APPENDIX A7

STEWARDSHIP ACTIVITY AND INVASIVE MONITORING FORMS

Early Detection Monitoring Datasheet

Date:_____ **Recorded by:_____**

Type of Threat:

☐ New Invasive Infestation; Species Name(s):_____

☐ Expanding Invasive Infestation; Species Name(s): _____

☐ New or expanding erosion or denuding of vegetation; describe: _____

☐ New or expanding informal trails; describe: _____

☐ Other; describe: _____

General Location (landscape character area or areas if known)**:** _____

Specific Area: _____ latitude **_____** longitude

Disturbance (circle applicable):

Flood Graded Mowing Recently Cleared Recreational traffic
Storm damage Roadside

Patch Type (circle applicable):

Point (one or few invasives or locations) Linear (erosion or invasives extending along a line)
Polygon (of non-linear shape)

Abundance of Invasives if applicable (circle applicable):

Rare (hard to find, other plants more common)
Common (one of the common plants in area)

Notes:

Pease Park Conservancy Stewardship Activity Log

Date:_____

Recorded by:_____

General Activity:_____

(examples include: tree planting, invasive plant inventory or removal, seed sowing, trail maintenance, soil enhancement, monitoring of past activities, monitoring of trail conditions etc.)

General Location:_____

(landscape character area or areas if known)

Specific Area: _____ latitude _____ longitude

Photos Taken and Attached: Yes No

Activity and/or Monitoring Details: (examples include: number of trees planted, method of removal, herbicides used, number of volunteers utilized, time spent, etc. For monitoring, examples may include tree mortality or qualitative description of success.)

Circle Area Described

Circle Area Described

APPENDIX A8

LANDSCAPE MANAGEMENT PHOTOPOINTS

Photopoints

Photopoint Locations

Photopoint	Latitude	Longitude	Collection date/time
1	30.28105692	-97.75166712	26-JAN-14 11:03:56AM
2	30.28127577	-97.75133385	26-JAN-14 11:13:05AM
3	30.2821034	-97.75161624	26-JAN-14 11:16:28AM
4	30.28152622	-97.75209116	26-JAN-14 11:25:28AM
5	30.28152346	-97.75250606	26-JAN-14 11:29:04AM
6	30.28202386	-97.75276439	06-OCT-13 11:13:16AM
7	30.2820138	-97.75324778	22-SEP-13 11:02:11AM
8	30.28183241	-97.7533155	26-JAN-14 11:32:49AM
9	30.28212243	-97.75373845	26-JAN-14 11:34:59AM
10	30.28262819	-97.75407834	26-JAN-14 11:39:35AM
11	30.28296472	-97.75381859	22-SEP-13 11:09:02AM
12	30.28312566	-97.75363485	27-OCT-13 10:18:33AM
13	30.28354676	-97.75436969	22-SEP-13 11:14:54AM
14	30.28421254	-97.75455217	27-OCT-13 10:25:52AM
15	30.28413953	-97.7545712	22-SEP-13 11:19:24AM
16	30.28399126	-97.75470355	26-JAN-14 11:43:39AM
17	30.28293774	-97.75456063	06-OCT-13 11:33:53AM
18	30.28440817	-97.75577811	06-OCT-13 11:46:18AM
19	30.28417985	-97.75527251	26-JAN-14 11:46:47AM
20	30.28380862	-97.75469491	06-OCT-13 11:56:45AM
21	30.28499423	-97.75463951	22-SEP-13 11:24:22AM
22	30.28570468	-97.75480228	26-JAN-14 11:53:15AM
23	30.28697396	-97.75419376	26-JAN-14 11:57:46AM
24	30.28782539	-97.75377726	22-SEP-13 1:16:01PM
25	30.28807936	-97.75409787	26-JAN-14 12:00:41PM
26	30.28837323	-97.75353678	22-SEP-13 11:34:07AM
27	30.28854833	-97.75356109	27-OCT-13 10:48:14AM
28	30.28861027	-97.75338566	26-JAN-14 12:03:37PM
29	30.28836183	-97.75325524	26-JAN-14 12:05:36PM
30	30.28685954	-97.75353586	06-OCT-13 10:34:27AM
31	30.28628991	-97.75346663	06-OCT-13 10:40:54AM
32	30.28575263	-97.75400433	22-SEP-13 1:21:32PM
33	30.28563344	-97.75381045	06-OCT-13 10:48:06AM
34	30.28393233	-97.75367148	06-OCT-13 10:55:46AM
35	30.28383309	-97.75265652	26-JAN-14 12:15:15PM
36	30.28304561	-97.75249081	22-SEP-13 1:29:14PM
37	30.28311384	-97.75246114	06-OCT-13 11:08:09AM
38	30.28098333	-97.75089053	22-SEP-13 1:33:58PM
39	30.28886223	-97.75360644	06-OCT-13 12:14:18PM
40	30.28930488	-97.75270128	06-OCT-13 12:20:35PM
41	30.2896705	-97.75283731	22-SEP-13 11:39:53AM
42	30.28991961	-97.75252467	22-SEP-13 1:11:12PM
43	30.29025254	-97.75223273	22-SEP-13 1:09:36PM
44	30.29098662	-97.75202125	22-SEP-13 11:46:38AM
45	30.29078043	-97.75171791	06-OCT-13 12:24:58PM
46	30.2919192	-97.7513709	22-SEP-13 11:50:33AM
47	30.29244248	-97.75053145	22-SEP-13 11:53:24AM
48	30.29272805	-97.75046767	26-JAN-14 12:46:52PM
49	30.29279762	-97.74918741	26-JAN-14 12:38:42PM
50	30.29253082	-97.749504	26-JAN-14 12:42:39PM
51	30.29244759	-97.74928322	26-JAN-14 12:40:53PM
52	30.29194811	-97.74969628	06-OCT-13 12:33:55PM
53	30.29276275	-97.74743669	22-SEP-13 12:54:56PM
54	30.29339274	-97.74788897	22-SEP-13 12:03:03PM
55	30.29318143	-97.74720979	06-OCT-13 12:39:29PM
56	30.29501463	-97.74883965	26-JAN-14 2:42:33PM
57	30.2962425	-97.74950568	26-JAN-14 2:38:05PM
58	30.29637166	-97.7493486	26-JAN-14 2:34:45PM
59	30.29709812	-97.74951741	26-JAN-14 2:27:16PM
60	30.29790371	-97.75031361	22-SEP-13 12:31:14PM
61	30.2980141	-97.7496516	22-SEP-13 12:21:52PM
62	30.29818626	-97.74900435	26-JAN-14 1:58:12PM
63	30.2981995	-97.74873035	27-OCT-13 12:13:46PM
64	30.29853579	-97.74854159	27-OCT-13 12:11:03PM
65	30.29887073	-97.74784589	26-JAN-14 2:20:11PM
66	30.29899361	-97.74746343	26-JAN-14 2:07:18PM
67	30.29227928	-97.74709295	06-OCT-13 1:07:48PM
68	30.29298236	-97.74675205	06-OCT-13 1:02:49PM
69	30.29437057	-97.74714005	06-OCT-13 12:51:22PM
70	30.29481062	-97.74755144	06-OCT-13 12:46:01PM

Photopoint: 1 Direction: N

Main picnic area at Kingsbury Commons with concrete Works Projects Administration era benches. Large cedar elms have severe mistletoe infestations and will require extensive pruning. Young trees, principally burr oak and cedar elm have been interplanted in the older cedar elm

Photopoint: 1 Direction: N

A diverse assemblage of trees have been planted throughout Kingsbury Commons and the big field since 2000. Species planted include burr oak, honey locust, Monterrey oak, chinquapin oak, sycamore, cedar elm, live oak, and shumard oak.

Photopoint: 2 Direction: SE

The splash pad in winter.

Photopoint: 2 **Direction: N**

The only restroom in the project area is located at this location.

Photopoint: 3 **Direction: NW**

Trails through the big field are decomposed granite and lined with planted trees.

Photopoint: 2 **Direction: NW**

Playground partially ringed with planted sycamore.

Photopoint: 3 **Direction: N**

Representative photo of cement picnic tables located in big field area.

Photopoint: 3 Direction: E
Live oak grove in big field area.

Photopoint: 4 Direction: SW
View of Tudor cottage from playground.

Photopoint: approximately 10m north of 3 Direction: SE
Representative photo of a style of bench found throughout the project area made of green painted metal.

Photopoint: 4 Direction: NE
Basketball court is in background.

Photopoint: 4 Direction: E
Playground with large, mistletoe infested, cedar elm.

Photopoint: 4 Direction: SE
Representative picture of sidewalks that are found in the playground area.

Photopoint: 5 Direction: SE
View of tudor cottage from mulched trail in the park.

Photopoint: 5 Direction: N
Leaving the tudor cottage, a visitor enters the Hillside character zone containing live oak, cedar elm, wafer ash, gum bumelia, Spanish oak, Ashe juniper, southwestern bristlegrass, Canada wildrye, turk's cap, western ragweed, and minor amounts of the invasive heavenly bamboo.

Photopoint: 6 **Direction: N**

Small infestation of the non-native invasive catclaw vine.

Photopoint: 7 **Direction: N**

Representative photo of slope forest below Parkside in Hillside area. Common species include Ashe juniper, hackberry, cedar elm, agarita, King Ranch bluestem, Canada wildrye.

Photopoint: 8 **Direction: E**

An earthen berm is found along the south side of Kingsbury Street.

Photopoint: 9 **Direction: SE**

Old parking area along Kingsbury is now blocked by wooden pylons.

Photopoint: 9 Direction: W

Representative photo of Windosr Hillside slope forest. This portion of the forest is heavily infested with Chinaberry and other woody invasive species.

Photopoint: 10 Direction: SE

Live oak trees frame a clear view of the state capital from this location.

Photopoint: 11 Direction: NW

North Ramble, where dead trees were removed after ice storm. Large Ashe juniper and copious amounts of young Texas ash mixed with soapberry, planted red oak, and scattered Chinese privet.

Photopoint: 12 Direction: NW

Representative picture of mulched trails found in the Hillside and North Ramble areas. These trails do not contain waterbars or other ways for water to exit the trail, which is already leading to minor erosion problems that will likely become worse unless trails are improved.

Photopoint: 13 Direction: SE

Another picture of area where dead juniper were mulched in place. In addition to the large amount of Texas ash and soapberry that is naturally recruiting, the area has been planted with burr oak, Chinquapin oak, and red oak. Some Chinese privet is present.

Photopoint: 14 Direction: NE

Although a cedar log has been placed here to reduce the speed of water, runoff and foot traffic have exposed erosion control blanket and prevented the area from revegetating.

Photopoint: 14 Direction: NW

Section of trail with large amount of exposed erosion control blankets that are beginning to degrade and fold.

Photopoint: 15 Direction: SW

Rock re-enforced slope in area with erosion concerns.

Photopoint: 16 Direction: SE
Representative picture of asphalt spilling off of Parkside into the park. Approximately 8 of these piles exist and their intended function is unknown except in two areas where it appears to have been an effort to stabilize a slope.

Photopoint: 17 Direction: N
Representative photo of live oak-cedar elm woodland with Texas ash, Ashe juniper, Chinese privet, Chinaberry, elbowbush, gum bumelia, catclaw vine, loquat, and velvetleaf mallow.

Photopoint: 18 Direction: E
Invasive species are prevalent in Windsor Hillside character area. Here, catclaw vine, Japanese privet and Chinse parasol tree dominate, although Mexican buckeye is also present.

Photopoint: 19 Direction: W
Invasive exotic catclaw vine overtopping trees, smothering the herbaceous layer, and forming a monoculture.

Photopoint: 20 Direction: NW
Dense ash regeneration.

Photopoint: 21 Direction: S
One of two giant cane stands found in the vegetation that surrounds Custer's meadow. This one is located where an intermittent stream crosses under the main trail.

Photopoint: 21 Direction: NW
Cedar elm live oak woodland surrounding the high use Bermuda grass dominated field at Custer's meadow.

Photopoint: 21 Direction: SE
Ground near main trail has been lined with rock in this area.

Photopoint: 21 Direction: NE
Representative picture of area.

Photopoint: 22 Direction: N
Another view of area that will become a rain garden.

Photopoint: 22 Direction: S
Southwest portion of Custer's meadow where the city of Austin Watershed Protection Department plans to install a rain garden.

Photopoint: 22 Direction: E
View towards Shoal Creek.

Photopoint: 23 Direction: N
Low rock berm installed to reduce sheet erosion through the center of Custer's meadow.

Photopoint: 23 Direction: S
Parking lot and erosion at high use area of Custer's meadow.

Photopoint: 24 Direction: S
Large, linear strip of concrete travelling down the center of Shoal Creek is where current wastewater line is located. This will be removed by the City of Austin Watershed Protection Department project.

Photopoint: 24 Direction: S
Bank erosion had exposed and undercut storm water drainage pipe.

Photopoint: 25 Direction: S
First of three pictures of northern portion of Custer's meadow.

Photopoint: 25 Direction: N
Third of three pictures of northern portion of Custer's meadow.

Photopoint: 25 Direction: N
Second of three pictures of northern portion of Custer's meadow.

Photopoint: 26 Direction: NNE
Rock terraces are slowing soil erosion, but this area has yet to revegetate.

Photopoint: 26 Direction: NNE
Representative picture of armored wall that is found along some sections of Shoal Creek.

Photopoint: 27 Direction: NNE
Informal access point on the southwest side of the 24th Street bridge has led to erosion and destruction of the herbaceous layer.

Photopoint: 28 Direction: S
View of creek from the 24th Street bridge. Many stately live oaks are found in this section of the creek, although erosion is exposing the roots of the live oaks in the right side of this picture.

Photopoint: 29 Direction: S
Live oak-cedar elm savanna in area that had been heavily impacted by the disc golf course, and where a new commuter bike trail is slated to be constructed. The herbaceous layer is primarily Bermuda grass.

Photopoint: 29 Direction: N

Another view of Caswell Shoals.

Photopoint: Approximately 15 m north of 29 Direction: N

Cedar post and rock staircase leading into the park from Lamar Blvd and 24th Street intersection.

Photopoint: 30 Direction: S

Cedar elm, hackberry, planted chinquapin oak, horseherb, poison ivy, silverleaf nightshade, rain lilly, 4o'clock, retama are all present at this location as well as a small infestation of catclaw. Giant cane is in the background of the photo.

Photopoint: 30 Direction: SE

Representative picture of hiking trail in Caswell Commons.

Photopoint: 30 **Direction: NE**
Representative view of area.

Photopoint: 31 **Direction: S**
Top of the Lamar Knoll.

Photopoint: 31 **Direction: N**
Woodland and savanna dominates the east side of Shoal Creek north of this location.

Photopoint: 32 **Direction: SE**
Exposed soil on the east bank of Shoal Creek. This area will be resculpted and replanted by the City of Austin Watershed Protection Department.

Photopoint: 32 **Direction: NE**

East bank of Shoal Creek.

Photopoint: 33 **Direction: S**
Representative view of area.

Photopoint: 34 **Direction: NW**
Bed of Shoal Creek.

Photopoint: 34 **Direction: SE**
Bed of Shoal Creek.

Photopoint: 35 **Direction: NW**
Volleyball courts.

Photopoint: 36 **Direction: E**
Creek dominated by willow and green ash.

Photopoint: 36 **Direction: S**
The big field begins at the top of Shoal Creek's banks. Vegetation buffers are less than 20 feet in width.

Photopoint: 37 **Direction: N**
Mexican petunia dominating herbaceous layer of creek bottom.

Photopoint: 38 Direction: N
Shoal Creek from the pedestrian bridge.

Photopoint: 38 Direction: S
Shoal Creek from the pedestrian bridge.

Photopoint: 39 Direction: N
Storm water drainage with a wall of bamboo on the left and dense stand of Japanese privet on the right.

Photopoint: 40 Direction: N
Manhole cover, armored wall and both Japanese and Chinese privet are found at this location.

Photopoint: 41 Direction: N

Cedar elm grove in Wooten Woods, has had mulch placed over the tree roots, but continues to receive heavy foot traffic, even with the rocks demarking the trail edge.

Photopoint: 42 Direction: S

Unstructured high use has denuded the banks of Shoal Creek at this location. The invasive Mexican petunia is one of the few herbaceous plants left here.

Photopoint: 43 Direction: NE

Herbaceous riparian vegetation has been restored in this location, one of the few places with eastern gamagrass and maximilian sunflower.

Photopoint: 44 Direction: NW

The southern end of an approximately 80 foot long patch of giant cane on the western banks of Shoal Creek. Some American elm and box elder are also growing.

Photopoint: 45 Direction: NE
Southern end of the live oak terrace, which consists of mature trees and closely mowed herbaceous vegetation.

Photopoint: 46 Direction: W
Gabian wall where a seep contributed to slope failure in the past. The slope is now dominated by Giant Cane.

Photopoint: 46 Direction: SE
Giant cane and Chinaberry.

Photopoint: 47 Direction: SE
Large mature Chinaberry with sitting benches at the southern end of the Gaston Green. Behind the Chinaberry is a mesic woodland with green ash, bald cypress, and Carolina basswood.

Photopoint: 48 Direction: S
Seepage entering park.

Photopoint: 49 Direction: W
High use area of Gaston Green.

Photopoint: 48 Direction: W
Pecan , green ash, and Japanese privet are all common in this area.

Photopoint: 49 Direction: E
Bamboo infestation at the northeast edge of Gaston Green.

Photopoint: 50 Direction: NE
Gaston Green parking area.

Photopoint: 52 Direction: NE
Invasive chaste tree and privet under cedar elm and sycamore.

Photopoint: 51 Direction: E
High use area between parking lot and main trail.

Photopoint: 53 Direction: N
Shoal Creek is lined with many young black willow, green ash, chinaberry, American elm, and privet. This section of Shoal Creek is lacking any large legacy trees on its banks.

Photopoint: 53 Direction: SW
View looking downstream from bridge.

Photopoint: 54 Direction: W
Slope forest in the Ramble Scramble with cedar elm, Ashe juniper, and live oak overstory. The understory contains ragweed, turk's cap, pigeonberry, Texas persimmon, and gum bumelia.

Photopoint: 55 Direction: N
The southern portion of the Lamar Lawn is composed primarily of prairie grasses, with switchgrass being the most common.

Photopoint: 56 Direction: N
Bamboo dominates the understory to the west of the main trail for approximately 330 linear feet along the trail. It appears that the bamboo is cut occasionally, but this strategy is unlikely to result in any longterm control.

Photopoint: 57 Direction: NW

Area where many dead trees have been removed over the past few years. Reforestation will need to be carefully managed as many Chinaberry and privet saplings are becoming established, and heavenly bamboo is proliferating.

Photopoint: 58 Direction: S

Area between armored bank and tree line was covered with a green fiber mulch blanket, which is still exposed in many areas. Some small trees are just now becoming established amidst the green sprangletop and other mid level grasses.

Photopoint: 57 Direction: NE

Understory appears to have been cleared a few years ago, and is now primarily young non-native invasive plants.

Photopoint: 59 Direction: SE

Very little tree recruitment is taking place where the fiber blanket was placed, although hackberry and gum bumelia are dense on either side of it.

Photopoint: 59 Direction: S

Shoal Creek at the Janet Fish bridge. Banks are dominated by black willow, but Chinese tallow, chinaberry, Japanese privet, giant ragweed, boxelder, and green ash are also present.

Photopoint: 60 Direction: S

Cliff face with Chinese parasol tree infestation at its base. Homeless encampments are frequently found under cliff overhangs in the project area.

Photopoint: 61 Direction: S

Exercise station is found underneath trees in left side of picture. Trail surface is decomposed granite.

Photopoint: 61 Direction: W

Shoal Creek with live oak motte, black willow, and cottonwood.

Photopoint: 62 Direction: S
Lamar terrace high use area.

Photopoint: 63 Direction: W
Lamar terrace from Lamar Blvd sidewalk.

Photopoint: 62 Direction: NE
Entrance from the intersection of 29th Street and Lamar Blvd.

Photopoint: 64 Direction: NW
Manicured area along Lamar Blvd.

Photopoint: 65 Direction: NW

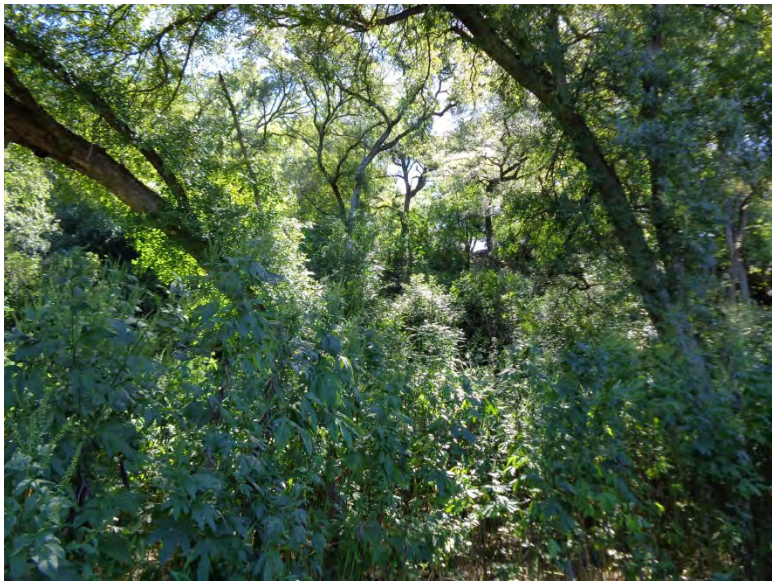
Bank erosion north of 29th Street is not uncommon, this section of the creek has not been armored.

Photopoint: 66 Direction: E

Representative picture of trail in the Bluffs character area.

Photopoint: 66 Direction: W

Area of north of 29th Street is heavily infested with privet and Japanese honeysuckle, but also contains Mexican buckeye and cherry laurel.



Photopoint: 67 Direction: N

Cedar elm overstory with hackberry, Japanese privet, Chinaberry, and ragweed also present.

Photopoint: 68 **Direction: E**

Pecan grove with mown understory and horseherb herbaceous layer. Beyond the mown area is a wall of bamboo, Chinaberry, and privet.

Photopoint: 69 **Direction: SW**

Open areas near San Gabriel and Lamar. An infestation of purple lantana is in the woods to the north of this location.

Photopoint: 69 **Direction: SE**

Open areas near San Gabriel and Lamar.

Photopoint: 70 **Direction: S**

Representative picture of woods outside of Parks and Recreation Department annex.

APPENDIX A9
NATURAL RESOURCE INVENTORY

Natural Resource Inventory and Analysis

Pease Park and the Shoal Creek Greenbelt comprise an 84 acre green corridor that runs through the urban core of Austin. The district park serves a diverse assemblage of park users, ranging from lifetime Austinites to University of Texas students to school children on a field trip to neighborhood families out for a walk. The park is located in a transition zone marked by the Balcones Escarpment that divides the Edwards Plateau to the west and the Backland Prairie to the east. As a result the plant communities and wildlife found here and throughout the Balcones Escarpment are a convergence of these two ecoregions. Within the park and greenbelt, Shoal Creek forms a ribbon connecting the park from north to south and connects the park to the larger Shoal Creek Watershed upstream and to the Colorado River downstream. Walking the length of the park, a person will encounter a rich diversity of landscape areas which have been influenced by topography, geology, hydrology, land management, and use. Unfortunately, the natural areas are not without problems. Invasive plant infestations, erosion, flooding, stream flow, and neglect all threaten the natural areas that make the park so beloved.

GEOLOGY AND SOILS

The unique geology of the Balcones Fault Zone has shaped the contours of Shoal Creek Valley, creating rolling hills, seeps, and dramatic cliffs. The four geologic layers that underlie the study area, as seen in the Geology Map (pg 21), are (Young 1977):

- Kgt: Georgetown Limestone
- Kdr: Del Rio Claystone
- Kbu: Buda Limestone
- Kef: Eagle Ford Formation
- Qal: alluvial deposits

These layers are almost exclusively found within the Balcones Fault Zone, which runs northeast - southwest through Austin. Movement along the faults has raised the rocks to the west and lowered the rocks to the east, for a net difference in elevation of over 1,000 feet. These faults divide the Hill Country of the west from the flatter plains of the Blackland Prairie to the east. While the limestone outcrops in the Shoal Creek Valley look similar to those found in the Hill Country and the hills of west Austin, they are actually distinct geologic formations that do not occur west of the fault zone(Barnes 1974). They are also rarely found at the surface level east of the fault zone.

These geologic layers, along with Shoal Creek, have a tremendous influence on the soils that are present. The eight soil types shown on the Soils Map (pg. 20) and their approximate coverage of the study area are (USDA-NRCS 2013):

- Fs – Oakalla soils, 0 to 1 percent slopes, channeled, frequently flooded (37% of area)
- VuD – Volente soils and Urban land, 1 to 8 percent slopes (15% of area)
- TeF – Tarrant soils and Urban land, 18 to 40 percent slopes (13% of area)
- UsC – Urban land and Austin soils, 0 to 5 percent slopes (12% of area)
- UvE – Urban land and Ferris soils, 10 to 15 percent slopes (11% of area)
- Ur – Urban land, 0 to 6 percent slopes (8% of area)

- TeE – Tarrant soils and Urban land, 5 to 18 percent slopes (4% of area)
- SbA – San Saba soils and Urban land, 0 to 2 percent slopes (<1% of area)

The steep cliffs shown in the Slopes Map (pg.22) and limestone outcrops in the northern section of the park are Buda limestone. This hard rock was primarily formed by oyster and mollusk deposits, although the shells are highly fragmented and most of the fossils have been broken into small pieces. The Tarrant and San Saba soils are primarily associated with this layer. These shallow soils have the least amount of shrink-swell capacity in the park. The Tarrant soils are the only ones that are also commonly found in the Hill Country to the west. Where fractures occur in this limestone, water is able to flow downward through the soil profile.

Bands of Del Rio claystone cross the park and are intermixed with both Buda and Georgetown limestone. The soils over this layer are heavy, thick clays with high shrink-swell capacity. The Ferris and some of the Volente soil types are primarily associated with this layer.

The high clay content of the Del Rio claystone has two important implications for the park. One the very high shrink-swell potential of the Ferris soils makes tree establishment difficult. The soil may push into and pull back from the planted trees, causing roots to have trouble spreading into the soil. Two, the claystone is impermeable to downward groundwater flow. Water flowing downward through fractures in the Buda limestone hits the claystone and then flows laterally through the ground, eventually surfacing in seeps in the North Ramble and Hillside areas. This is surely part of the story origin of Buda Boulder Springs near Split Rock, but the source for the spring flow has not yet been studied in detail (Hauwert 2014).

The lowest geologic formation is the Georgetown limestone, which can be readily seen on the bed of Shoal Creek. The banks and terrace of Shoal Creek are also composed of Quaternary alluvium (soil and gravel that have been deposited by the creek in the last few hundred thousand years). Austin, Volente, and Oakalla soils are most commonly associated with these geologic layers. Oakalla soils are the frequently flooded soils found directly adjacent to the creek. They are the most common soils on the property and the only ones with high loam contents.

HYDROLOGY

The property is bisected by Shoal Creek, an intermittent creek that flows north to south through west Austin. The creek starts near Braker Lane and flows 9.5 miles before it enters Lady Bird Lake. Heavily urbanized, the creek's watershed includes approximately 12.5 square miles or 8,295 acres. Numerous unnamed wet weather channels bring water into the creek within the property boundaries.

Buda Boulder Spring (sometimes referred to as Split Rock Spring) is located at the base of the cliffs at Split Rock. The spring is part of the Balcones Canyonland Preserve system of protected features and is monitored by the City of Austin (Travis County and City of Austin 2011). *Caecidotea reddelli*, a toglobitic isopod (small crustacean that spends its entire lifecycle in the karst environment), is a species of concern at the spring. A 1992 report described the spring as experiencing heavy sewage pollution, but whether this was from nearby homeless encampments or other sources was unclear. A hydrologic study of the spring has not been completed (Hauwert 2014).

Several seeps are located on the property with the largest two being located in Hillside and North Ramble. Pease Park Conservancy members state that these seeps flow almost perennially and that the one located on Hillside did not go dry during the 2011 drought. While most of the vegetation in these areas is not distinct, the Hillside seep does contain a healthy population of frogfruit (Phyla nodiflora), a facultative wetland plant (FAC). FACs may occur in both upland and wetland sites but are considered hydrophytes, preferring wet areas. While no wetland indicator plants were found in the North Ramble seep, there are at least two plants that are normally associated with wetter areas. One, wild onion, (Allium drummondii) is rarely found in large patches in upland areas.

Shoal Creek, of course, is the dominant hydrologic feature, and 80% of the study area is within the 100 year floodplain as shown in the Hydrology Map (pg.23). The high amount of impervious cover and shape of the watershed make the watershed prone to drastic changes of flow rate. The City of Austin Watershed Department website states that Shoal Creek can go from near-flood conditions to almost dry in a matter of hours. The most recent 100 year flood event occurred in 1981 when 11 inches of rain fell in the watershed in a three-hour period. Some witnesses said that a 10 to 20 foot wall of water pulsed down the creek at that time.

ECOLOGICAL SYSTEMS

The vegetation at Pease Park has been heavily modified by land management and the surrounding area's urbanization. The ecological systems and vegetation types below represent the current ecological expression at the park. They are subject to change over time due to changes in management, changes in site conditions (such as climate change), or changes based on the time since the last major disturbance (succession).

Ecological systems are associations of species that are shaped by geology, soils, weather patterns, previous land use, geographic location, and landscape disturbances. Large disturbance events vary throughout the park. In the riparian areas, floods have played a significant role in depositing sediment and affecting the population of water-intolerant plants. In the upland woodlands, windthrow and ice storms promote diversity by creating light gaps and depositing downed woody debris when trees are uprooted or large branches broken. Understory fires, which have historically reduced leaf litter, allow a greater amount of light to penetrate to the ground, which increases the establishment of select plants such as Spanish oak recruitment but reduces Ashe juniper seedling abundance. Drought impacts all the communities. Additionally, human management, including conversion of natural areas to Bermuda grass and alteration of the hydrologic regime, has played a significant role in shaping Pease Park's plant communities.

Ecological systems found at the site were determined through field observations using the Texas Parks and Wildlife Department's Ecological System Classification database (Diamond and Elliott 2010) as shown in the Natural Areas Management Zones Map (pg 24). They include:

1) Riparian
2) Limestone Savanna and Woodland
3) Slope Forest and Woodland
4) Wooded Cliff/Bluff
5) Disturbed Vegetation Types

Riparian

Overview

This ecological system is found in the bed and on the banks of Shoal Creek. It is characterized by loamy Oakalla soils and a rich variety of hardwood species that are either absent from or less abundant in the surrounding uplands.

A wide variety of vegetation types is found within this ecological system. The most common is hardwood dominated woodland. Trees found in this area include green ash (*Fraxinus Pennsylvania),* hackberry (*Celtis laevigata*), black willow (*Salix nigra*), box elder (*Acer negundo*), American elm (*Ulmus americana*), sycamore (*Platanus occidentalis*), pecan (*Carya illinoinensis*), and cottonwood (*Populus deltoides*), with green ash and black willow being the most dominant. Ashe juniper (*Juniperus asheii*), mesquite (*Prosopis glandulosa*), and other trees that do not require mesic conditions are also present. Common invasive species in the canopy include Chinese tallow (*Triadica sebifera)* and Chinaberry (*Melia azedarach)*. Some of the sub-canopy woody species include poverty weed (*Baccharis neglecta*), buttonbush (*Cephalanthus occidentalis*), sesbania (*Sesbania herbacea*), and Texas palmetto (*Sabal mexicana*).

One of the defining characteristics of the riparian woodlands at Pease Park is their youthful appearance. North of Gaston Green especially, the banks contain very few large "cathedral" trees that are normally associated with riparian areas. Where bank stabilization occurred in the past, the plant community is dominated by dense stands of green ash and invasives, most of which are under 12 feet in height, and overall riparian woodland diversity is low. In many locations, dense stands of green ash are closer in structure to shrubland than woodland. Over time, some of these trees will begin to dominate and form a mature canopy, but it may be necessary to plant oaks, pecan, bald cypress, and other riparian trees that are not presently regenerating.

Herbaceous areas of the riparian zone are a mix of native and exotic grasses and forbs. Some of the most common ones include giant ragweed (*Ambrosia trifida*), water willow (*Justicia americana*), switchgrass (*Panicum virgatum)*, frogfruit (*Phyla nodiflora*), and spikerush (*Eleocharis sp.*). A few eastern gamagrass (*Tripsacum* dactyloides) are present, mostly in areas that appear to have been revegetated after erosion control work. The invasive Mexican petunia is also abundant throughout the riparian area, especially in gravel bars.

Botanist Bill Carr evaluated Shoal Creek's riparian area. He noted that the Shoal Creek area does not contain many of the endemic species that characterize Bull Creek and the Edwards Plateau, but is composed almost entirely of generalists. He also mentioned that there are very few reference sites with Buda limestone, and the impact of invasive species and land management is unclear.

Stresses

The size of this ecological system has shrunk from its historical extent, and what remains has many stressors. Major stresses to the riparian zone include:

- Alteration of the hydrologic cycle with lower base flows and more extreme flood events due to upstream development
- Conversion of riparian habitat to a more manicured park setting
- Off-trail recreation
- Invasive plants

Symptoms of these stresses include:

- Downcutting of the creekbed
- Streambank erosion
- Simplified vegetation structure
- Lower biodiversity

Urbanization of the watershed has altered Shoal Creek's hydrology. As impervious cover increased in the watershed, the amount of water infiltrating the ground decreased, and the amount of water flowing into the creek during rainfall events increased. The banks of Shoal Creek show signs of downcutting, a common issue with urban creeks. As Shoal Creek cut down to bedrock, the water table in the loamy bottomland soils surrounding the creek has likely dropped.

Park management has converted some areas that were riparian vegetation into a manicured lawn and/or savanna vegetation. The loamy bottomland soils are mapped beyond the boundary of the riparian zone. However, many of these soils are now dominated by Bermuda grass, and only some of the larger overstory trees remain. In a few areas, fill was brought in to raise the ground level, destroying a portion of the riparian zone.

Off-trail recreation has completely denuded the vegetation along the bank in some areas. The worst bankside erosion is located in the off-leash area and dog tracks are plentiful in these locations.

Invasive plants are lowering plant diversity in the remaining riparian area. The worst culprits include:

- Chinaberry, which is found throughout the riparian area but has not formed any monocultures at this time
- Giant cane (*Arundo donax)*, which is firmly established in a multitude of large patches, some of which run over 200 linear feet along the creek
- Mexican petunia, which is one of the most abundant forbs present and has displaced native species
- Chinese tallow, while not currently overwhelming, is present throughout and will likely increase in abundance

Limestone Savanna and Woodland

Overview

This plant community is found throughout the Edwards Plateau on cretaceous limestone soils on level to rolling topography. At Pease Park it is found between the riparian area and Lamar Blvd., and between the riparian area and the steep slopes that lead to the surrounding neighborhood. Much of this system has been highly manipulated to create recreation areas, although a substantial natural area remains in the southwest corner of the park. Two vegetation types have been identified in this ecologic system, oak/hardwood motte and woodland and savanna grassland.

The oak/hardwood motte and woodland overstory is composed primarily of cedar elm (*Ulmus crassifolia*) and live oak (*Quercus fusiformis)*. Other common trees include Texas ash (*Fraxinus albicans*), Spanish oak (*Quercus buckleyi*), Ashe juniper, soapberry (*Sapindus saponaria*), and hackberry. Tree plantings have increased the woodland diversity by adding chinquapin oak (*Quercus muehlenbergii*), burr oak (*Quercus macrocarpa*), and bald cypress (*Taxodium distichum*).

Understory woody species include Texas persimmon (*Diospyros texana*), gum bumelia (*Sideroxylon lanuginosum*), wafer ash (*Ptelea trifoliate*), agarita (*Mahonia trifoliolata*), and elbow bush (*Forestiera pubescens*). Texas redbud (*Cercis canadensis*), Mexican plum (*Prunus mexicana*), and Texas mountain laurel (*Sophora secundiflora*) are naturally occurring and have been planted. In the more managed areas, the understory has been relegated to the margins of the recreation areas. The most common Invasive species present include both Japanese and Chinese privet (*Ligustrum sp.*), and young Chinaberry.

The herbaceous layer of the mottes and woodlands varies widely across Pease Park depending on whether the area supports recreational activities (currently or previously). For example, areas currently managed for recreation are dominated by either Bermuda grass (*Cynodon dactylon*) or straggler daisy (*Calyptocarpus vialus*). The former disc golf course is still dominated primarily by Bermuda grass, although the presence of the occasional sideoats grama (*Bouteloua curtipendula*) indicates that some seed planting likely occurred in this area in the past, and ragweed (*Ambrosia trifida*) has become well established. As one would expect, the natural areas are much more diverse. Shade-loving native grasses such as foxtail (*Setaria sp.*), Canada wildrye (*Elymus canadensis*), and Texas wintergrass (*Nassella leucotricha*) are plentiful, as are forbs such as turk's cap (*Malvaviscus arboreus*), plateau goldeneye (*Viguiera dentate*), pigeonberry (*Rivina humilis*), four o'clock (*Mirabilis sp.*), and ragweed.

Stresses

Stresses to the Limestone Savanna and Woodland include:

- Heavy recreational use
- Invasive plants

Symptoms of these stresses include:

- Soil compaction and erosion

- Low native plant regeneration
- Displacement of native plants by invasive plants

Soil compaction and erosion are most noticeable in locations near parking areas and just to the north of 24th Street. Many areas heavily impacted by disc golf still have low levels of native plant establishment, with Bermuda grass forming a dense cover.

The worst invasive species of this ecological system are:

- Bermuda grass. which is necessary in areas with high usage but has taken over some areas that do not support recreational activities
- Japanese and Chinese privet, which are both common in woodland areas
- Catclaw vine, which has become established in a handful of locations, most noticeably along the western fence line just north of 24th St.
- Giant cane, which typically prefers wet areas, has formed large patches in disturbed areas or where drainages come in from the surrounding neighborhoods
- Chinaberry is present throughout, although control efforts have removed most mature trees

Notes on waypoints found in this ecologic system(See Waypoints Map, pg 25):

- Waypoint 1: Area not managed for recreation except for trail usage. Contains some of the best native herbaceous cover found in this ecological system. Tree planting has occurred.
- Waypoint 2: Bermuda grass field managed for recreation. Native trees have been planted along footpaths.
- Waypoint 3: Woodland restoration area. It appears that this area was once dominated by Ashe juniper, but that these trees were shredded on site, leaving the mulch on the ground. Native trees such as Spanish oak, burr oak, and chinquapin oak have been planted, but natural recruitment is heavy, especially of Texas ash, cedar elm, soapberry, and hackberry. Invasive Ligustrum and Chinaberry are also becoming established, but amazingly, they comprise a very small percentage of cover. Native understory plants that were cut during juniper removal operations are beginning to re-sprout. Their growth forms are sometimes unusual as they adapt to the sunnier conditions. The herbaceous cover is primarily disturbance-adapted plants such as ragweed, doveweed, silverleaf nightshade, and bindweed.
- Waypoint 4: Savanna managed for recreation. Several giant cane infestations are found along the edges of the managed area. Rock berms have been placed in areas where sheet erosion is taking place. There is much bare soil in this area.
- Waypoint 5: Cedar elm grove does not have any understory or herbaceous layer underneath it and is 100% bare ground for approximately 500 feet. A large catclaw infestation along the western fence extends approximately 80 linear feet.
- Waypoint 6: Herbaceous layer managed for recreation. Extremely large Chinaberry tree located here is likely the mother plant for saplings in area.

- Waypoint 7: Bamboo encroaching into park from neighboring property. It appears some control work has been attempted, but bamboo patches extend for approximately 300 feet along the trail.
- Waypoint 8: Recent invasive species removal efforts in this location appear to have focused on large Chinaberry trees.
- Waypoint 9: Uphill savanna is managed for recreation, primarily Bermuda grass.
- Waypoint 11: Former disc golf area still has large amounts of bare or litter-covered ground and herbaceous layer dominated by Bermuda grass.
- Waypoint 12: While the area near the volleyball court is primarily Bermuda grass, some native bunch grasses are becoming established to the north.
- Waypoint 14: Recovering disc golf area.
- Waypoint 15: Grassland to west of Lamar in this area is in better condition than most and contains large amount of switchgrass.
- Waypoint 16: Open field used for commercial ventures.
- Waypoint 17: The remnants of an old Pecan grove are located here. At edges of clearing are giant cane, bamboo, and Chinaberry.

Slope Forest and Woodland

Overview

This system is found on steep, dry limestone slopes throughout the Hill Country and in larger patches in western Travis County. Although the species present are not radically different than the oak/hardwood woodlands described above, the diverse topography, less intensive management, and slightly different species composition in this area contribute to Pease Park's habitat diversity.

The dominant trees in this ecologic system include live oak and cedar elm, with Ashe juniper, Spanish oak, and Texas ash also abundant. Understory is similar to the system described above, but with a greater abundance of Texas mountain laurel and the presence of Mexican buckeye (*Ungnadia speciosa*). Other species that appear to be unique to these portions of the park include purple leatherflower (*Clematis pitcher*) and yellow passionvine (*Passiflora lutea*). While non-native vines and woody species are present throughout the park, they have a greater percentage of coverage in this ecologic system, presumably due to less frequent control efforts.

Stresses

Stresses to the Slope Forest and Woodland include:

- Human encampments
- Invasive plants

Symptoms of these stresses include:

- Displacement of native plants by invasive plants

- Vegetation removal, erosion near encampments

The slope forest to the east of Lamar Blvd. has the greatest evidence of human encampments, with mattresses, sleeping bags, and other paraphernalia littering the ground. In addition to the direct removal of plants at the encampment site, informal trails are showing signs of erosion. Homeless encampments located at Barton Creek Greenbelt have been linked to the spread of oak wilt, and several oak wilt centers are being found in these locations where oaks are wounded by campers.

The worst invasive species of this ecological system are:

- Catclaw vine has become well established in several locations, some of which are estimated to be close to half an acre in size. In these areas, catclaw has formed a monoculture in the understory and has begun to climb and overtop the canopy trees.
- Chinaberry of all age classes is present.
- Paper mulberry is dense in the slope forest to the east of Lamar Blvd.
- Japanese and Chinese privet are found throughout but have not yet formed dense monoculture.
- Small patches of Chinese parasol tree have become established near neighborhoods.

Notes on waypoints found in this ecologic system(See Waypoints Map, pg 25):

- Waypoint 13: The slope forest between Windsor Rd. and Kingsbury St. is full of invasive species. The largest infestation of catclaw vine is located here along with Chinese parasol tree, Chinaberry, Japanese privet, Chinese privet, and heavenly bamboo.
- Waypoint 18: Large homeless encampment at base of cliff. Large amounts of invasive species.

Wooded Cliff/Bluff

Overview

This ecological system consists of vertical to near-vertical limestone rock faces with pockets and small ledges of soil and plants. They are nestled within the slope forests but are quite distinct. The shallow soils are usually dry but can be wet if moisture seeping through fractures in the limestone can support plants unique to the Edwards Plateau. Additionally, many plants that disappear with heavy deer herbivory find a refuge in these steep, rocky areas.

Stresses

Potential stresses to the Cliff ecologic system include:

- Uphill development altering soil hydrology
- Homeless encampments
- Lawn debris thrown from cliffs into park and greenbelt

Housing developments at the top of the slopes may have altered the soil hydrology of the cliff. Impervious cover does not allow for infiltration, some of which may have seeped through the rock layers and exited fractures in the cliff face in the past.

While no rock climbing areas were observed during the site visits, rock climbing would locally destroy plant communities if it were to occur.

Notes on waypoints found in this ecologic system (See Waypoints Map, pg 25):

- Point 10: Cliff face location. Chinese parasol tree infestation at base of cliff.
- Point 18: Large homeless encampment at base of cliff. Large amounts of invasive species.

Birds, Wildlife, & Habitat

In George Simmons's *Birds of the Austin Region*, published in 1925, Shoal Creek and Pease Park are listed as local haunts for many of Austin's bird species. This diversity was due largely to the fact that the Shoal Creek corridor contained habitat associated with both the Blackland Prairie and Hill Country regions. In addition, Shoal Creek was a significant local stream with good quality riparian habitat. Waterbirds like the American coot and pied-billed grebe could be found along the creek, while barred owls inhabited the riparian forest. The little blue heron was known to forage in Pease Park and the marshy, boggy habitat in Shoal Creek attracted least bitterns and Wilson's snipe. Barn owls roosted along the creek, which is an indication of the proximity to open country (Blackland Prairie) to the east. At the same time, canyon wrens and rufous-crowned sparrows, both species that are indicative of the Hill Country, were found on the bluffs.

Today, Pease Park is surrounded by urban areas and is cut off from both the open prairie habitats to the east and the Hill Country to the west. Also, the creek and associated riparian habitats have been degraded over time, largely due to the development of the watershed. Yet the park still acts as an urban oasis with substantial habitat, making it a great place to see birds and other wildlife. In recent years, birders have reported over 180 species of birds along Shoal Creek, with at least 120 of these species being reported in the Pease Park area. (Sullivan et al. 2009)

Being located in central Austin, Pease Park provides many people with an opportunity to connect with nature on a daily basis. This is especially true during migration season when the bird community changes from day to day. Upwards of twenty different species of warblers alone could be encountered.

Riparian

Of all the park's habitats, the riparian areas have the potential to support the greatest diversity of birds including wintering, migratory, and breeding birds. The Shoal Creek corridor once contained more marshy, boggy habitat than can be found now. A major obstacle to restoring this kind of habitat is the creek's current altered hydrology, which scours the streambed during every flood event

The riparian understory shrub and vine tangles are extremely important for wildlife such as the eastern cottontail and wintering birds like the white-throated sparrow and orange-crowned warbler. The riparian understory also provides valuable nesting habitat for Carolina wrens and the white-eyed vireo.

Savanna

The open areas of Pease Park have the potential to attract wildlife throughout the year, but in most areas they lack the necessary vegetation, such as native bunchgrasses and flowering plants.

Woodland

Like the riparian areas, the woodlands are a great place to encounter wildlife. Fox squirrels and Texas spiny lizards can be seen during the day on the larger tree trunks. This habitat also supports a number of breeding birds, Red-bellied woodpeckers, blue jays, great-crested flycatchers, eastern screech owls, northern cardinals, lesser goldfinches, and Carolina wrens are some of the species that can currently be found breeding in Pease Park woodlands. Some, like the great-crested flycatcher, eastern screech owl, and red-bellied woodpecker, require nesting cavities. This is one reason that not all dead trees and limbs should be removed.

The woodlands are also a great place to see migratory birds. The more structural diversity in the woodland, the more diverse the wildlife will be. The oak canopy is especially important for insectivorous species, while greenbriar thickets and edge habitat will attract species such as the mourning warbler and yellow-breasted chat. These thickets also provide habitat for wintering sparrows like the white-crowned sparrow, Lincoln's sparrow, and fox sparrow.

Wooded Cliffs

The cliffs provide a unique set of microclimates and cover for certain species, including wildlife that may not be found elsewhere in Pease Park. Most notably, the crevices and cracks provide habitat for reptiles, amphibians, invertebrates, and mammals. During the right conditions and time of year, the cliffs would be the best place to find alligator lizards, the largest species of lizard native to Texas. Cliff chirping frogs are also present and western slimy salamander could be encountered.

The two bird species that are directly associated with this type of habitat have receded from the urban core: the canyon wren and rufous-crowned sparrow. Of these, the canyon wren is more likely to return, perhaps following habitat restoration.

SENSITIVE ENVIRONMENTAL FEATURES

The Pease Park and Shoal Creek Greenbelt study area contains numerous sensitive environmental features that contribute to the area's natural beauty. Some of these features are protected by Volume III, Chapter 25 of the Code of the City of Austin; others are not specifically regulated but should still be treated with great care.

Chapter 25 of the code enumerates on "Critical Environmental Features" (CEF), which are deemed "of critical importance to the protection of environmental resources". Three types of CEF are found within the study area: springs, seeps, and canyon rimrock.

- Springs are places where groundwater erupts from the surface in specific areas with enough flow to create puddles and/or rivulets of water. A permanent spring, Buda Boulder Springs, is located just above the large boulder known as Split Rock on the west side of Shoal Creek, just south of 29th Street. As discussed above, this spring flows perennially and contains one rare troglobitic crustacean species, *Caecidotea reddelli* .
- Seeps are areas where groundwater percolates to the surface in a diffuse fashion, usually without enough flow to go beyond its specific location. Seeps have been identified in both the Hillside and North Ramble locations. As discussed above, these seeps are often wet but do not support any wetland obligate plants.
- The City of Austin defines Canyon Rimrock as rock substrate with a 60 percent gradient over a vertical distance of at least four feet and exposed for a horizontal distance of at least 50 feet. By this definition, large amounts of rimrock are exposed in the Bluffs, East Bank, and the northern half of the Ramble Scramble character areas.

The standard regulatory setback for wetland areas and CEFs is 150 feet, but it can be reduced through a WPD director's administrative variance, issued by the Environmental Review staff of the Environmental Resource Management division. Only certain types of development are allowed within a CEF setback, and mitigation may be required based on the guidance in Environmental Criteria Manual 1.3.0.

Shoal Creek is also a sensitive environmental feature that should be treated with care. The City of Austin Grow Zone calls for a minimum 25ft wide non-mown buffer along creek banks where passive restoration may occur, although the program acknowledges that a 300ft buffer is required for some riparian areas to be fully functional. The current management buffer to Shoal Creek is currently less than 25 feet in some areas and is not 300 feet in any location. The management of the Shoal Creek riparian area will be discussed in more detail in the Natural Area Management Guidelines Section (Appendix A1).

THREATS TO NATURAL AREAS OF PEASE PARK

Natural areas are dynamic, living systems that change over time. These changes occur with or without active management. Threats are anything which are causing or have the potential to cause the impairment or degradation of the size, condition, or landscape context of a natural area (TNC 2003). We look here at the threats created by invasive species and erosion within Pease Park and the greenbelt as issues that can be addressed by Pease Park Conservancy and PARD as part of the master

plan implementation.

Invasive Plant Species

Invasive plants are one of the primary threats to the natural communities of Pease Park as shown on the Invasive Species and Erosion Map (pg.26). To maintain ecological function and restore it where feasible, invasive plants will need to be removed and replaced with native plant communities. Invasive species are those that did not evolve in the ecosystem where they are found and cause economic and/or ecological harm. Their aggressive growth and spread can crowd out and replace native plants and can lead to a disruption of natural processes. The impact of invasive species can be very dramatic and ranks second only to direct habitat destruction as the principal threat to rare species, with 49% of imperiled species being negatively impacted (Wilcove 1998).

Some of the ways invasive plants threaten native communities include:

- Altering soil or water chemistry
- Altering natural processes such as fire and flooding
- Direct displacement through competition ("crowding out" of native plants)
- Changing the amount of light in or below the canopy or sub-canopy

Invasive plants also impact native animals and insects by crowding out the native flora they rely on for shelter, protection, and food. A 2006 study in Austin found that sites with intact native plant communities had higher species richness and abundance than sites that were dominated by non-natives (Kalmbach 2006).

Thirty two plant species found within Pease Park and Shoal Creek Valley are considered invasive by the Texas Invasive Plant & Pest Council (TIPPC) and are negatively impacting the natural area of the property. The City of Austin's Invasive Species Management Plan rated the overall danger of individual invasive plants based on their impact, invasiveness, and distribution. The plan has the following rankings for invasive plants within the study area, and a column has been added to highlight the overall problem caused by these plants.

Species	Common name	COA ranking	Pease Park ranking	Impacts
Ailanthus altissima	Tree of heaven	Moderate	Low	1,2,4
Alocasia macrorhiza	Elephant ears	Moderate	Low	1
Arundo donax	Giant reed	High	High	1,5
Bothriochloa ischaemum	King Ranch bluestem	Unknown	Moderate	1
Broussonetia papyrifera	Paper mulberry	Moderate	Moderate	1
Bromus catharticus	Rescuegrass	not listed	Low	1
Bromus diandrus	Ripgut brome	not listed	Low	1
Cynodon dactylon	Bermuda grass	Moderate	High	1, 4
Firmiana simplex	Chinese parasoltree	Moderate	Low	1
Hedera helix	English ivy	not listed	Low	1, 7

Jasminum mesnyi	Primrose jasmine	not listed	Low	1
Lantana montividensis	Purple lantana	not listed	Low	1
Ligustrum lucidum and *Ligustrum japonicum*	Glossy privet	High	High	1
Ligustrum sinense and *Ligustrum quihoui*	Chinese privet	High	High	1
Lonicera japonica	Japanese honeysuckle	Moderate	Moderate	1, 3, 7, 8
Macfadyena unguis-cati	Catclaw vine	Moderate	High	1
Melia azedarach	Chinaberry tree	High	High	1, 2
Nandina domestica	Heavenly bamboo	Moderate	Moderate	1
Paspalum urvillei	Vasey grass	not listed	Low	1
Photinia serratifolia	Chinese photinia	not listed	Low	1
Phyllostachys aurea	Golden bamboo	High	Moderate	1
Rapistrum rugosum	Bastard cabbage	High	Low	1,2
Ruellia brittoniana	Mexican petunia	not listed	High	1
Rumex crispus	Curly dock	not listed	Low	1
Sorghum halapense	Johnson grass	High	Moderate	1
Torilis arvensis	Tall sockbane	not listed	Low	1
Triadica sebifera	Chinese tallow	Moderate	High	1,2
Ulmus parvifolia	Chinese lacebark elm	not listed	Low	1
Vites agnus-castus	Common chastetree	not listed	Low	1
Vinca minor	Common periwinkle	not listed	Low	1

Impacts:
1. Crowds out native plants, forms monocultures
2. Alters soil chemistry, changing system
3. Can girdle overstory trees by wrapping tightly around the trunks.
4. Alleopatic: releases toxins that inhibits growth of nearby plants
5. May use large volume of water relative to native plants, reduce downstream flow in riparian areas.
6. Reduces dissolved oxygen and light levels in aquatic environments.
7. Grows on other plants and weight may cause stem damage.
8. Aggressive root growth competes with native plants, slows growth of overstory trees.

The invasive plant species which have the largest potential to negatively impact Pease Park-Shoal Creek Valley are: giant cane, all Ligustrm/privet species, catclaw vine, Chinaberry tree, Mexican petunia, and Chinese tallow. They are discussed in more detail below.

Notes on Individual Species of High Concern and their Distribution

This section concentrates on areas that will not be impacted by the Watershed Protection Department's Shoal Creek restoration plans, which will alter the riparian area between 15th and 28th Street. In the uplands, Pease Park below 24th Street has the lowest density of invasive plants, with the

exception of the steep slopes to the west of Kingsbury St. and Kingsbury Parkway, which have the highest invasive plant densities on the property.

Giant cane – *Arundo donax*: Giant cane forms dense monocultures in areas where moisture is present, primarily impacting riparian areas, drainages, and seeps.

- Extensive patches along the riparian area south of the bridge at Shoal Creek Blvd. will be removed as part of the COA Shoal Creek Restoration Project. Almost no giant cane is found north of this bridge where previous Watershed Protection Department work occurred in the past.
- Several dense stands exist along a drainage entering Shoal Creek on the south side of the Custer's Meadow grove, and the vegetation surrounding the western edge of Custer's grove. Waypoint 232. (See Waypoints Map, pg 25)
- A slope stabilization project took place at a hillside at waypoint 236 (See Waypoints Map, pg 25). Giant cane is dense in the riparian area here and continues at a lower density up the slope to the edge of the park.

Chinese privet -- *Ligustrum sinense* and/or *Ligustrum quihoui*: Chinese privet is a dense, low growing evergreen shrub found throughout the study area, mostly at low levels. It poses a high threat in some locations due to higher plant densities or because of recent disturbances.

- Especially-dense areas are within the Ramble Scramble. In some of these locations up to 1000 square feet may be in a Chinese privet monoculture.
- The area known as North Ramble has Chinese privet scattered throughout and will need to be prioritized for species removal. North Ramble is still showing the impacts of severe storms and juniper removal in 2008 and 2010 respectively. This disturbance could lead to the rapid spread of Chinese privet if control efforts are not undertaken.

Glossy privet – *Ligustrum japonica* and/or *Ligustrum lucidum:* Glossy privet is a large evergreen shrub/small tree that creates dense shade which prevents the growth of native understory plants.

- It is uncommon below 24th Street except in the area uphill of Parkway and Kingsbury St. The 2012 tree survey found only three occurrences.
- Between 24th Street and 29th Street, it is found principally in the riparian area, although one or two small trees are in the uplands.
- North of 29th street it becomes one of the dominant understory plants.

Catclaw vine - *Macfadyena unguis-cati*: Catclaw is an aggressive,evergreen perennial that grows rapidly and can climb and overtop overstory trees. Difficult to control, it grows from underground tubers with vast stores of energy.

- The largest catclaw infestation is at the northern tip of the land to the west of Parkway and covers approximately half an acre. Waypoint 275 (See Waypoints Map, pg 25).
- Other large infestations can be found at waypoint 234 (See Waypoints Map, pg 25).
- Smaller infestations are found at waypoints 258, 267, 268, 269, 286, and 291 (See Waypoints Map, pg 25).

Chinaberry - *Melia azedarach*: Found throughout the property, Chinaberry is a deciduous tree whose leaf litter has been found to alter soil chemistry. Like most invasive trees, it is most prevalent north of 24th street and west of Parkside, where it is the dominant tree in some areas. Even in areas where mature trees have been removed, numerous small saplings remain (Waypoint 242, See Waypoints

Map, pg 25). Notable specimens are found at waypoints 236 and 237 (See Waypoints Map, pg 25).

Mexican petunia - *Ruellia brittoniana*: is an herbaceous forb growing in the creekbed throughout Shoal Creek. It spreads rapidly from seeds and displaces native creekbed vegetation.

Chinese tallow - *Triadica sebifera*: is sparsely present up and down the creekbed. While not dense at the moment, it has a reputation as a rapidly spreading pest. Waypoint 285 (See Waypoints Map, pg 25).

Bamboo - *Phyllostachys aurea*: is not widespread, but where present forms dense monoculture that severely impacting the site. Waypoints 238, 240, and 241 (See Waypoints Map, pg 25).

Erosion

Soil erosion is another threat to the natural areas of Pease Park as shown on the Invasive Species and Erosion Map (pg.26). Unchecked erosion is unsightly and robs the site of its soil, and with it, the ability of the site to support a healthy plant community. Bank erosion along Shoal Creek is partially due to the high velocity water flow during storm events, but park use is exasperating it. In areas where the Watershed Protection Department has armored the creekbanks with gabions, erosion is almost non-existent, but too often recreation use just above them has denuded the ground of vegetation. Off-trail recreation is the primary cause of non-streambank erosion, although some trail infrastructure is also causing minor erosion. Finally, water entering the site from surrounding neighborhoods is causing some major erosion issues in Custer's Meadow, although the Watershed Protection Department Shoal Creek Restoration project should mitigate this stress.

Erosion Types

Sheet erosion is principally occurring in the grove at Custer's Meadow's where water flows off the parking lot and street and across the field. Temporary fixes have been minimally successful in this area. The Watershed Protection Department Restoration Project should alleviate erosion in this area by reducing the size of the parking lot and installing rainwater meadows.

Rill erosion is the formation of numerous small channels less than 30cm deep, often where sheet flow is being funneled into a single location. Left unchecked, some of the rills may evolve into gullies. Some locations and causes include:

- Numerous locations along Parkway are experiencing rill erosion. Parkway does not have any curbs, gutters, or other water control devices. It is a steep street, and water falling on or flowing across Parkway has high velocity. In many cases, water is kept on Parkway by a soil berm that is located at the edge of the park. Where there is a break in the berm, it is evident that large amounts of water are entering the park and erosion is beginning to take place. In many locations, cedar logs have been placed across the rills in many locations to slow the water as it enters the park and prevent the deepening of the rills.

- Some of the mulched trails on the slopes between the Tudor Cottage and North Ramble are experiencing rill erosion. The mulch currently protecting the soil is beginning to wash away. These trails contain few, if any, waterbars to shunt water off of the trail and disperse it down the hillside. In some locations, cedar logs have been placed on the downhill side of the trails, most likely to prevent mulch and soil from washing off. Unfortunately, these logs prevent water from leaving the trail and dispersing downhill. Instead, they collect water onto the trail, concentrating the flow into a single location.
- The trail that leads pedestrians from 24th Street to the Shoal Creek Trail is eroding due to foot traffic.
- North of Shoal Creek Blvd., there are numerous locations where rill erosion is beginning on the steep slopes to the west of the Creek. This is generally a result of land use on the adjacent land.
- Rills forming along the edge of concrete walkways have been armored with large rocks to slow water and catch soil and do not appear to be growing.

Gully erosion is formed by the same processes as rill erosion, but it is more advanced in its morphology. Only two areas are deep enough to be referred to as gullies, and both are being addressed by the Watershed Protection Department Restoration Project. The most obvious example is in Polecat Hollow, where stormwater enters the park just north of the volleyball courts.

Streambank erosion is principally relegated to the area south of Shoal Creek Blvd. The creek is still adjusting to upstream urbanization by downcutting and stream widening. The riparian area south of Shoal Creek Blvd. will be the primary focus of the Shoal Creek Restoration Plan.

Previous creek stabilization projects have taken place from Shoal Creek Blvd. to Janet Fish Bridge. Many of the creekbanks in these areas are armored with gabion walls that have revegetated with young green ash, black willow, and invasives.

Recreation-based erosion is caused by foot, bicycle, and dog traffic.

- Streambank erosion caused by foot traffic is common between Enfield and 24th Street and will be addressed by the City of Austin Shoal Creek Restoration Plan. Erosion will be controlled with Gabion walls and traffic will be funneled to specific locations that will be armored.
- Access to Shoal Creek is causing vegetation and soil loss at numerous access points; two of the most noticeable locations run along Wooten Woods north of the 24th Street Bridge and along Custer's Meadow south of the 24th Street Bridge.
- Where the primary trail is concrete or crushed granite, ponding and erosion do not appear to be an issue. The natural surfaced trails north of 24th Street experience ponding in some locations. Foot traffic is causing the trail to widen in these areas.

Mass movement occurred near waypoint 236 (See Waypoints Map, pg 25) in the northern portions of Wooten Woods. The site waswas repaired by Watershed Protection over a decade ago. Presumably, the armoring is covering a hillside seep that was creating an unstable slope that gave way. The area is

currently dominated by giant cane. It is highly recommended that Pease Park Conservancy work with Watershed Protection to make the treatment of this slope for invasive species management a part of the current restoration project.

SUMMARY

The Pease Park and the Shoal Creek Valley greenbelt continue to be a valuable resource to Austin citizens who wish to escape to a natural oasis where they can hike in nature, play sports, or simply lounge with a friend. The distinct geology underlies a diverse assemblage of plant communities ranging from riparian woodlands to hillside forests, cliffs, and savannas. Wildlife is plentiful, and the creek provides a focal point for recreation. A diversity of landscape areas can be found as one moves through the park as a result of past land management, topography, hydrology, and diverse soils.

The park is not without its problems. Invasive plant species threaten the natural value of the park and its ability to self-repair. Poor tree care has led to degradation of tree health in highly utilized areas. Erosion and off-trail recreation has caused soil compaction and erosion, leading to parts of the park literally washing away. Tree regeneration is lacking in many areas. The Natural Area Management Guideline section will focus on solutions to these problems as well as techniques for enhancing and restoring the natural areas in the coming years and decades. These include: enabling natural regeneration, planting and seeding, tree care and establishment, understory and groundcover establishment, riparian and woodland restoration, enhancing wildlife habitat, and enabling stewardship.

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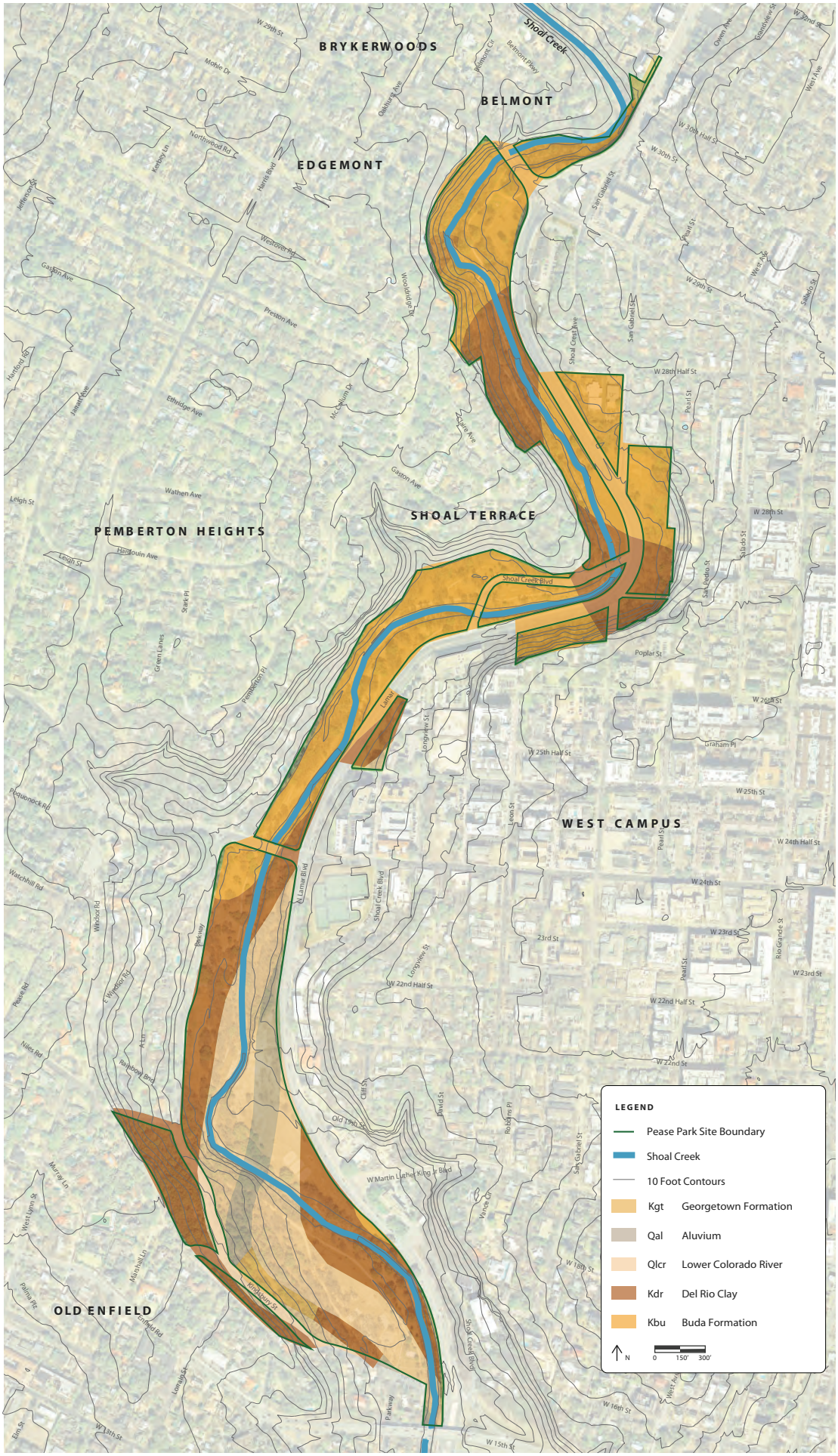
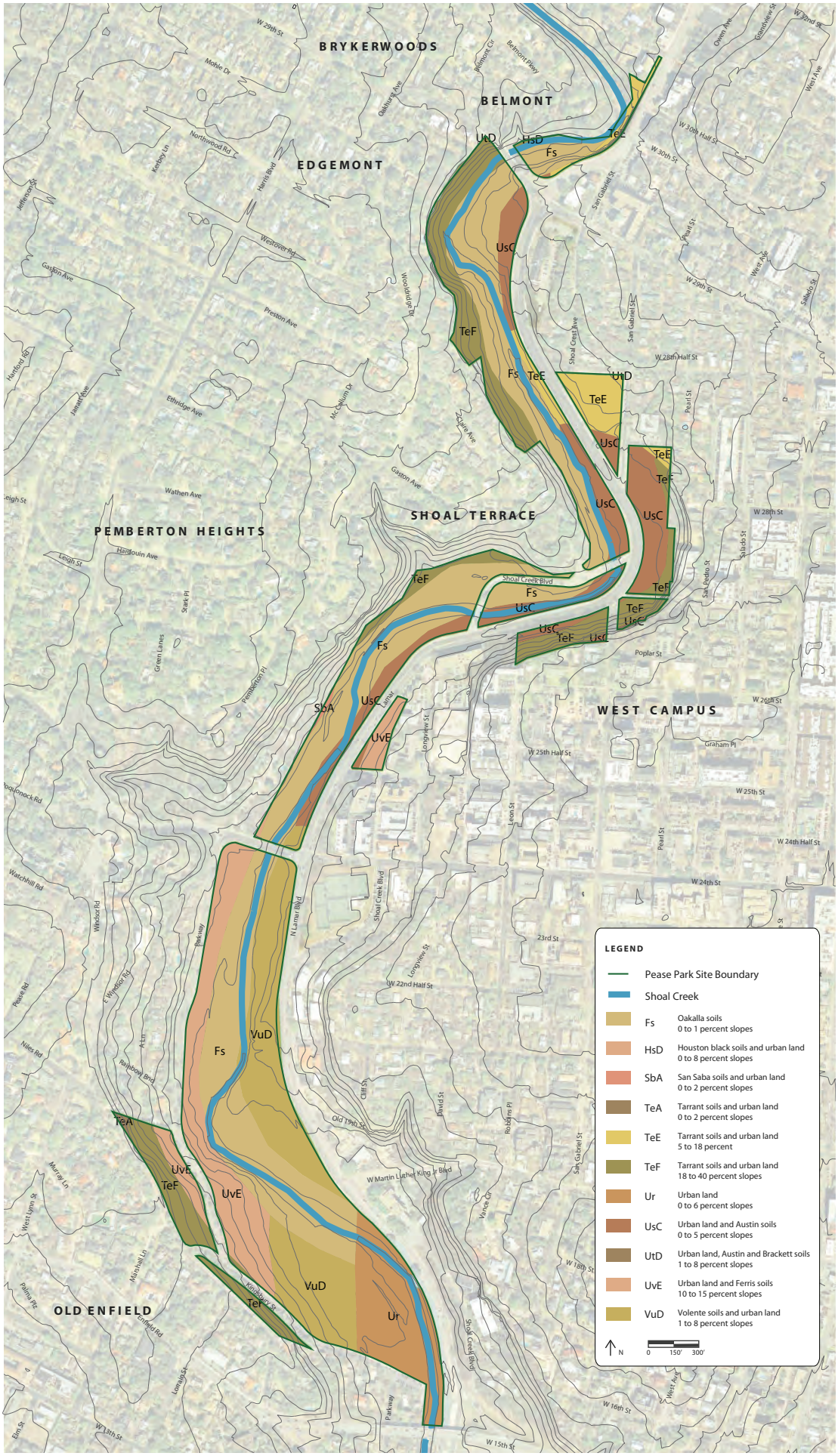


Geology

PEASE PARK MASTER PLAN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BELMONT
EDGEMONT
PEMBERTON HEIGHTS
SHOAL TERRACE
WEST CAMPUS
OLD ENFIELD
UtD
HsD
Fs
TeE
UsC
TeF
UvD
SbA
UvE
TeA
VuD
Ur
LEGEND
Pease Park Site Boundary
Shoal Creek
Fs Oakalla soils 0 to 1 percent slopes
HsD Houston black soils and urban land 0 to 8 percent slopes
SbA San Saba soils and urban land 0 to 2 percent slopes
TeA Tarrant soils and urban land 0 to 2 percent slopes
TeE Tarrant soils and urban land 5 to 18 percent
TeF Tarrant soils and urban land 18 to 40 percent slopes
Ur Urban land 0 to 6 percent slopes
UsC Urban land and Austin soils 0 to 5 percent slopes
UtD Urban land, Austin and Brackett soils 1 to 8 percent slopes
UvE Urban land and Ferris soils 10 to 15 percent slopes
VuD Volente soils and urban land 1 to 8 percent slopes
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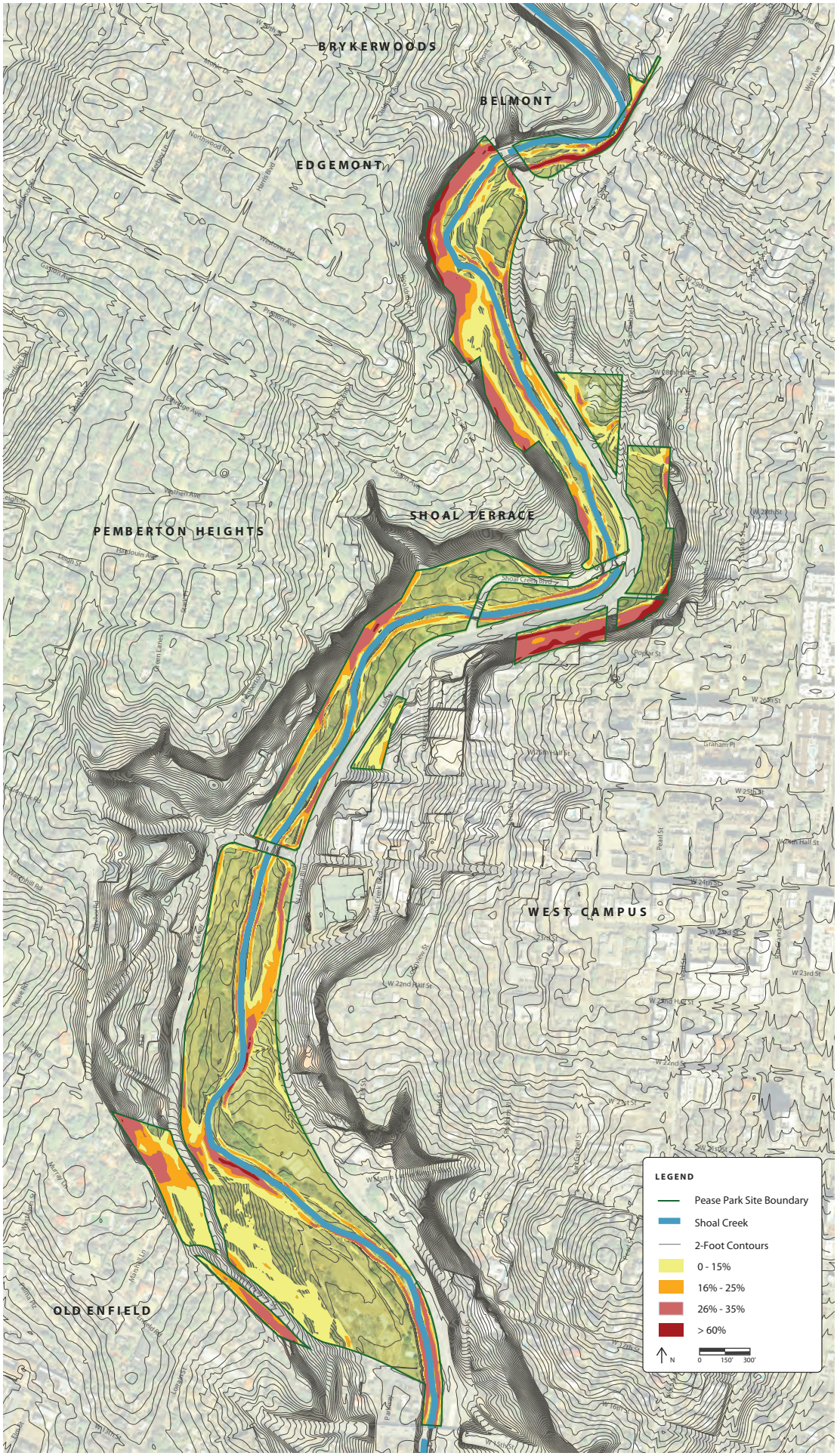

Slopes

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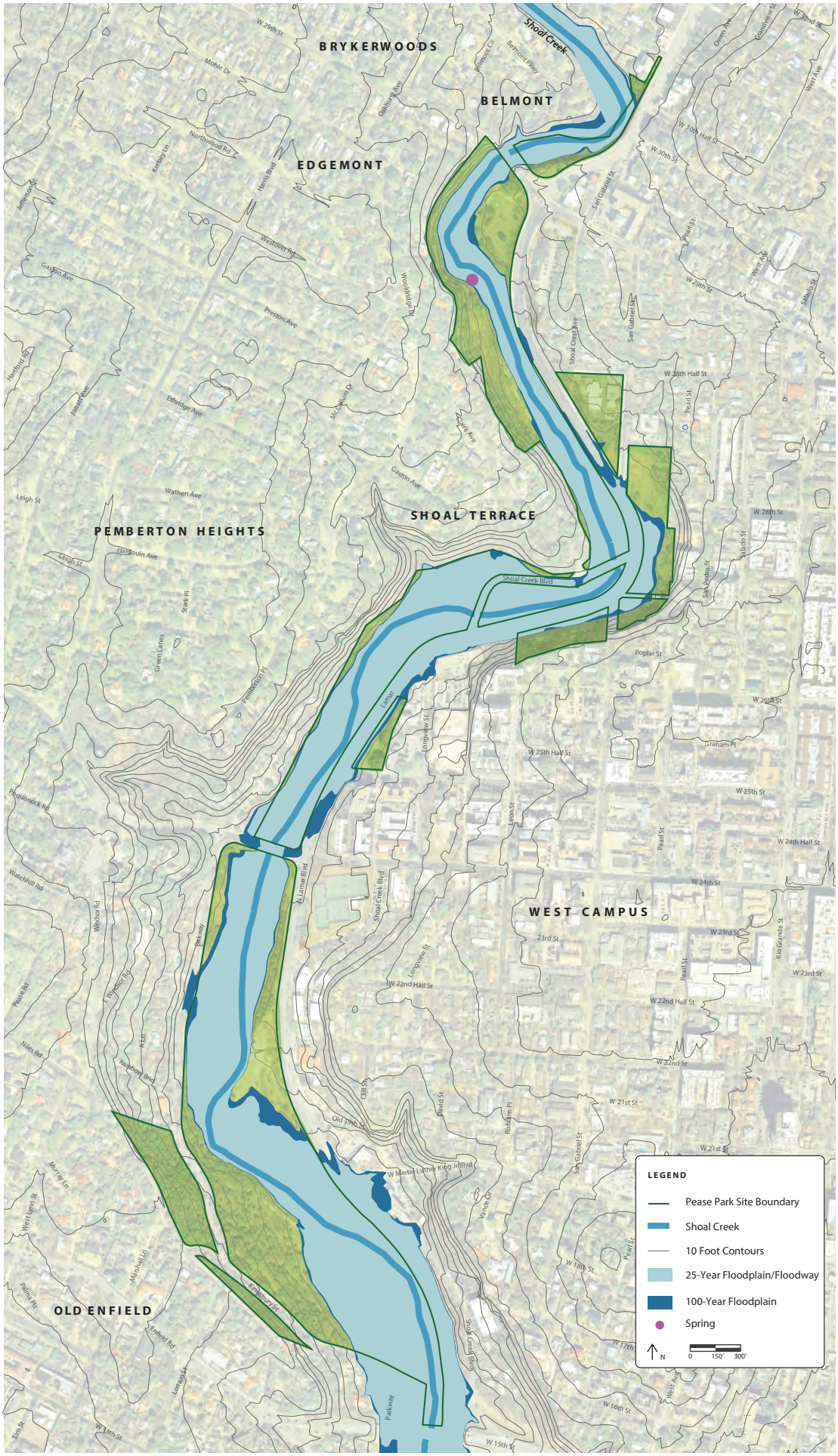

Hydrology

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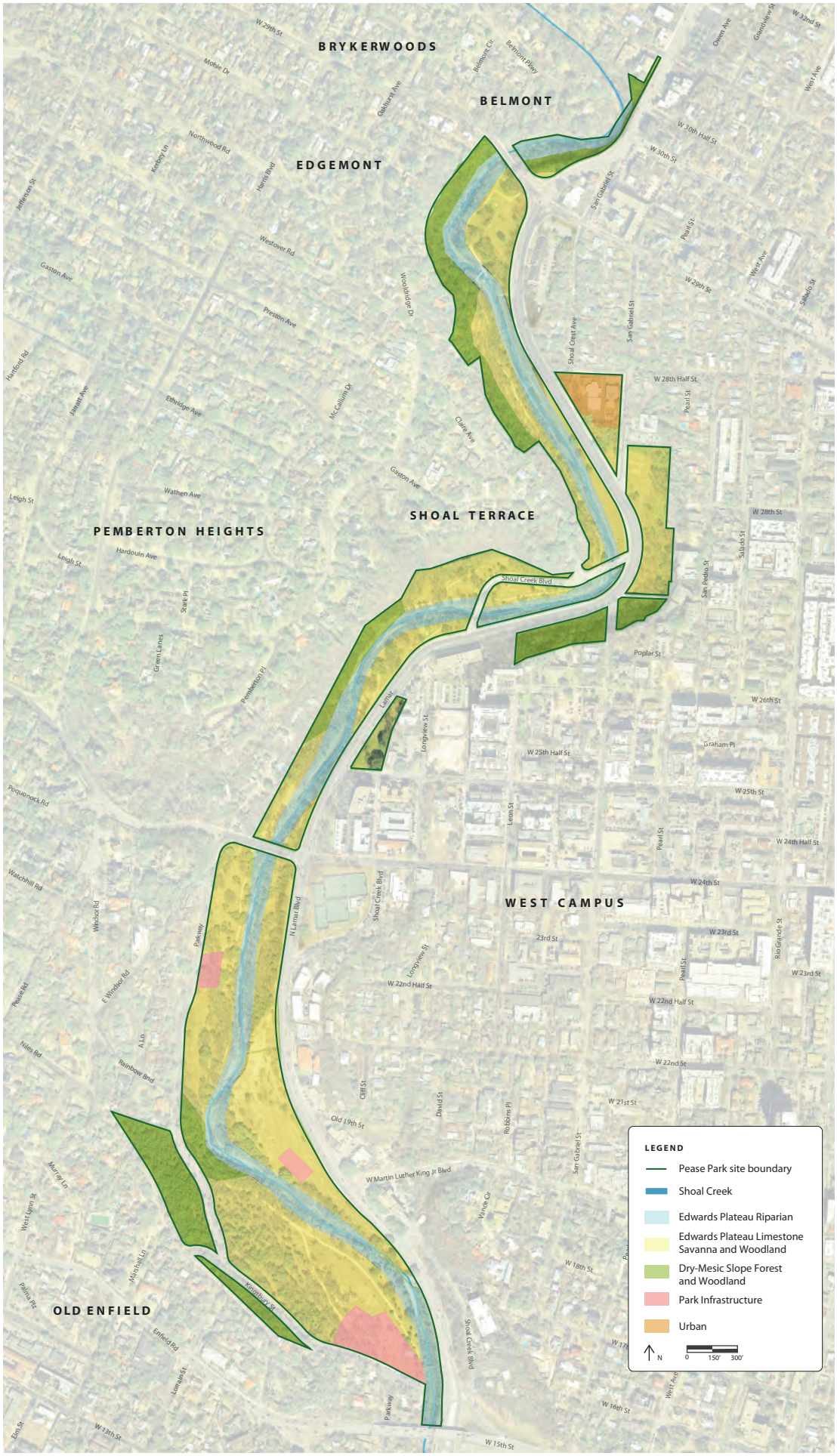

Natural Areas Management Zones

PEASE PARK MASTER PLAN

Waypoints Map

PEASE PARK MASTER PLAN

0 700' 1400' N

Invasive Species and Erosion

PEASE PARK MASTER PLAN

APPENDIX A10

FLORA AND FAUNA SPECIES LIST

Flora and Fauna Species List

Flora

Plant species observed within the Pease Park/Shoal Creek Valley study area. Botanical names follow the USDA Plants database (http://plants.usda.gov/). Three surveys have been conducted over the past eight years, and the columns below show which surveyor encountered which plant.

LBJWFC – The Lady Bird Johnson Wildflower Center conducted a survey in December 2006.
Siglo – Siglo Group conducted several surveys in Fall of 2013.
Carr – Bill Carr conducted a partial survey of the northern portions of the study area in May 2014.
PPC – Trees and shrubs planted by the Pease Park Conservancy, although many are also naturally occurring.

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Acanthaceae	*Dyschoriste linearis*	snake herb	forb		x			
Acanthaceae	*Justicia americana*	water willow	forb		x	x		
Acanthaceae	*Rhus aromatica*	aromatic sumac	shrub			x		
Acanthaceae	*Ruellia brittoniana*	Mexican petunia	forb	x	x	x		
Acanthaceae	*Ruellia drummondiana*	Drummond wild-petunia	form				x	
Acanthaceae	*Ruellia nudiflora*	wild petunia	forb		x	x	x	
Aceraceae	*Acer grandidentatum*	bigtooth maple	tree	x		x		x
Aceraceae	*Acer truncatum*	shantung maple	tree/shrub	x				x
Aceraceae	*Acer barbatum*	southern sugar maple	tree	x				x
Aceraceae	*Acer negundo*	boxelder	tree		x	x	x	
Agavaceae	*Yucca rupicola*	twisted-leaf yucca	shrub		x		x	
Anacardiaceae	*Cotinus obobatus*	American smoketree	tree					x
Anacardiaceae	*Rhus lanceolata*	flameleaf sumac	shrub			x		x

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Anacardiaceae	*Pistacia chinensis*	Chinese pistache	tree	x	x			
Anacardiaceae	*Toxicodendron radicans*	eastern poison ivy	vine		x	x	x	
Apiaceae	*Chaerophyllum tainturieri*	chervil	forb		x		x	
Apiaceae	*Torilis arvensis*	sockbane	forb	x	x	x		
Apocynaceae	*Vinca major*	big leaf periwinkle	goundcover	x	x			
Aquifoliaceae	*Ilex decidua*	possum haw	shrub/tree			x	x	x
Aquifoliaceae	*Ilex vomitoria*	yaupon holly	shrub/tree		x	x		x
Araceae	*Alocasia macrorrhizos*	elephant ears	forb	x		x	x	
Araliaceae	*Hedera helix*	English ivy	vine	x	x	x		
Arecaceae	*Sabal minor*	dwarf palmetto	shrub			x		x
Arecaceae	*Sabal mexicana*	Mexican palm	tree	x	x			
Aristolochiaceae	*Aristolochia serpentaria*	pipevine	vine				x	
Asclepiadaceae	*Matelea gonocarpa*	milkvine	vine				x	
Asclepiadaceae	*Matelea reticulata*	green milkweed vine	vine		x	x		
Asteraceae	*Ageratina havanensis*	shrubby boneset	shrub				x	
Asteraceae	*Ambrosia trifida*	giant ragweed	forb		x	x	x	
Asteraceae	*Aster ericoides*	heath aster	forb		x			
Asteraceae	*Aster sp.*	aster	forb		x			
Asteraceae	*Baccharis neglecta*	willow baccharis	shrub		x	x		
Asteraceae	*Calyptocarpus vialis*	horseherb	forb		x	x	x	
Asteraceae	*Chaptalia texana*	silverpuff	forb		x			
Asteraceae	*Coreopsis sp.*	coreopsis	forb				x	
Asteraceae	*Engelmannia peristenia*	Engelmann's daisy	forb			x		
Asteraceae	*Helianthus annuus*	annual sunflower	forb		x			
Asteraceae	*Helianthus maximiliani*	Maximillian sunflower	forb			x		

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Asteraceae	*Lactuca ludoviciana*	Louisiana wild-lettuce	forb				x	
Asteraceae	*Parthenium confertum*	false ragweed	forb		x			
Asteraceae	*Ratibida columnifera*	Mexican hat	forb			x	x	
Asteraceae	*Rudbeckia hirta*	black-eyed susan	forb			x		
Asteraceae	*Solidago sp.*	goldenrod	forb		x	x		
Asteraceae	*Sonchus sp.*	sow thistle	forb		x	x		
Asteraceae	*Symphyotrichum drummondii var. texanum*	Texas aster	forb				x	
Asteraceae	*Verbesina virginica*	frostweed	forb		x	x	x	
Asteraceae	*Viguiera dentata*	plateau goldeneye	forb		x	x		
Berberidaceae	*Mahonia trifoliolata*	agarita	shrub		x	x	x	
Berberidaceae	*Nandina domestica*	heavenly bamboo	shrub	x	x	x	x	
Bignoniaceae	*Campsis radicans*	trumpet creeper	vine		x		x	
Bignoniaceae	*Macfadyena unguis-cati*	catclaw vine	vine	x	x	x		
Boraginaceae	*Ehretia anacua*	sandpaper tree	tree		x	x		x
Brassicaceae	*Capsella bursa-pastoris*	shepherd's purse	forb	x	x			
Bromeliaceae	*Tillandsia recurvata*	ballmoss	forb		x	x	x	
Bromeliaceae	*Tillandsia usneoides*	Spanish moss	forb		x	x		
Cactaceae	*Cylindropuntia leptocaulis*	tasajillo	shrub			x	x	
Cactaceae	*Opuntia engelmannii*	prickly pear	shrub		x	x	x	
Caprifoliaceae	*Viburnum rufidulum*	rusty blackhaw viburnum	shrub/tree			x		x
Caprifoliaceae	*Lonicera fragrantissma?*	bush honeysuckle	shrub	x	x			
Caprifoliaceae	*Lonicera japonica*	Japanese honeysuckle	vine	x	x	x	x	
Caprifoliaceae	*Sambucus nigra*	elderberry	shrub		x	x		

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Caprifoliaceae	*Symphoricarpos orbiculatus*	coralberry	shrub		x	x	x	
Chenopodiaceae	*Chenopodium berlandieri*	pitseed goosefoot	forb		x			
Commelinaceae	*Setcreasea pallida*	purple heart	forb	x	x			
Commelinaceae	*Tinatia anomala*	false dayflower	forb		x		x	
Commelinaceae	*Tradescantia gigantea*	giant spiderwort	forb		x			
Commelinaceae	*Tradescantia sp.*	spiderwort	forb			x		
Convolvulaceae	*Dichondra sp.*	ponyfoot	forb		x			
Convolvulaceae	*Evolvulus sericeus*	bindweed	vine			x		
Convolvulaceae	*Merremia dissecta*	alamo vine	vine		x	x		
Cornaceae	*Cornus drummondii*	roughleaf dogwood	shrub		x	x	x	x
Crassulaceae	*Sedum sp.*	sedum	forb	x	x			
Cupressaceae	*Metasequoia glyptostraoboides*	dawn redwood	tree	x				x
Cupressaceae	*Taxodium distichum*	bald cypress	tree			x		x
Cupressaceae	*Taxodium distichum mexicana*	Montezuma cypress	tree	x				x
Cupressaceae	*Juniperus ashei*	Ashe juniper	tree		x	x	x	
Cupressaceae	*Thuja sp.*	arborvitae	tree	x	x			
Cyperaceae	*Carex bulbostylis*	sedge	graminoid				x	
Cyperaceae	*Carex perdentata*	sedge	graminoid				x	
Cyperaceae	*Carex planostachys*	cedar sedge	graminoid		x	x	x	
Cyperaceae	*Cyperus alternifolius*	umbrella sedge	graminoid	x	x	x		
Cyperaceae	*Eleocharis sp.*	spikerush	graminoid		x	x		
Ebenaceae	*Diospyros texana*	Texas persimmon	shrub/tree		x	x		x
Euphorbiaceae	*Acalypha phleoides*	three-seeded mercury	forb		x	x		

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Euphorbiaceae	*Croton monanthogynus*	prairie tea	forb			x		
Euphorbiaceae	*Euphorbia dentata*	toothed spurge	forb		x			
Euphorbiaceae	*Tragia sp.*	noseburn	forb			x		
Euphorbiaceae	*Triadica sebifera*	Chinese tallow	tree	x	x	x	x	
Fabaceae	*Cercis canadensis var. Oklahoma*	Oklahoma redbud	tree	x				x
Fabaceae	*Cercis canadensis var. Texana*	Texas redbud	tree		x	x	x	x
Fabaceae	*Eysenhardtia texana*	kidneywood	shrub		x	x		x
Fabaceae	*Gleditsia triacanthos*	honey locust	tree					x
Fabaceae	*Sophora secundiflora*	Texas mountain laurel	shrub			x	x	x
Fabaceae	*Styphnolobium affine*	eve's necklace	shrub/tree		x	x	x	x
Fabaceae	*Acacia farnesiana*	huisache	shrub		x	x	x	
Fabaceae	*Leucaena retusa*	goldenball lead tree	tree			x		
Fabaceae	*Medicago minima*	least burclover	forb	x	x	x		
Fabaceae	*Parkinsonia aculeata*	retama	tree		x	x	x	
Fabaceae	*Prosopis glandulosa*	honey mesquite	tree		x	x	x	
Fagaceae	*Quercus buckleyi*	Spanish oak	tree		x	x	x	x
Fagaceae	*Quercus emoryi*	emory oak	tree					x
Fagaceae	*Quercus fusiformis*	plateau live oak	tree		x	x	x	x
Fagaceae	*Quercus gravessi*	Chisos red oak	tree	x				x
Fagaceae	*Quercus mohriana*	Mohr oak	tree	x				x
Fagaceae	*Quercus laceyi*	lacey oak	tree	x				x
Fagaceae	*Quercus macrocarpa*	burr oak	tree			x		x
Fagaceae	*Quercus muhlenbergii*	chinquapin oak	tree		x	x		x
Fagaceae	*Quercus polymorpha*	Monterrey oak	tree	x		x		x
Fagaceae	*Quercus pungens*	vasey oak	tree					x

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Fagaceae	*Quercus shummardii*	Shumard oak	tree					x
Fagaceae	*Quercus sinuata var. sinuata*	shin oak	tree		x	x	x	x
Fagaceae	*Quercus stellata*	post oak	tree		x	x		
Fagaceae	*Vicia ludovicianus*	dearpea vetch	forb		x			
Garryaceae	*Garrya ovata ssp. lindheimeri*	Lindheimer's silktassel	shrub			x		
Geraniaceae	*Erodium cicutarium*	pin-clover	forb	x	x			
Geraniaceae	*Geranium carolinianum*	wild geranium	forb		x	x		
Ginkgoaceae	*Ginkgo sp.*	gingko	tree	x		x		x
Hamamelidaceae	*Liquidambar styraciflua*	sweetgum	tree	x				x
Hydrophyllaceae	*Phacelia congesta*	blue curls	forb				x	
Iridaceae	*Iris germanica*	garden iris	shrub	x	x			
Juglandaceae	*Carya illinoinensis*	pecan	tree		x	x	x	x
Juglandaceae	*Juglans microcarpa*	little walnut	tree					x
Juglandaceae	*Juglans nigra*	black walnut	tree					x
Juglandaceae	*Juglans major*	Arizona walnut	tree		x	x		
Lamiaceae	*Lamium amplexicaule*	henbit	forb	x	x			
Liliaceae	*Allium canadense var. canadense*	Canada wild-onion	forb				x	
Liliaceae	*Allium drummondii*	Drummond wild-garlic	forb				x	
Liliaceae	*Aspidistra elatior*	castiron plant	forb	x	x	x		
Liliaceae	*Cooperia pedunculata*	rainlilly	forb		x	x	x	
Liliaceae	*Lirope muscari*	lilyturf	graminoid	x	x			
Liliaceae	*Narcissus sp.*	daffodil	forb	x	x			
Loganieaceae	*Gelsemium sempervirens*	Carolina jasmine	shrub			x		

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Lythraceae	*Lagerstroemia indica*	crapemyrtle	tree	x	x	x		
Malvaceae	*Abutilon fruticosum*	Indian mallow	forb		x	x	x	
Malvaceae	*Abutilon wrightii*	velvetleaf mallow	forb			x		
Malvaceae	*Malvastrum aurantiacum*	Wright's false mallow	forb		x			
Malvaceae	*Malvastrum coromandelianum*	three-lobe false mallow	forb		x			
Malvaceae	*Malvaviscus arboreus var. drummondii*	turk's cap	forb		x	x	x	
Meliaceae	*Melia azedarach*	Chinaberry	tree	x	x	x	x	
Menispermaceae	*Cocculus carolinus*	Carolina snailseed	vine		x	x	x	
Moraceae	*Broussonetia papyrifera*	paper mulberry	tree	x		x		
Moraceae	*Maclura pomifera*	bois d'arc	tree			x	x	
Moraceae	*Morus rubra*	mulberry	tree		x	x	x	
Nyctaginaceae	*Mirabilis jalapa*	four-o'clock	forb	x	x	x		
Oleaceae	*Fraxinus texensis*	Texas ash	tree		x	x	x	x
Oleaceae	*Forestiera pubescens*	elbow bush	shrub		x	x	x	
Oleaceae	*Fraxinus pennsylvanica*	green ash	tree		x	x	x	
Oleaceae	*Jasminum mesnyi*	primrose jasmine	shrub	x	x	x		
Oleaceae	*Ligustrum japonicum*	waxleaf ligustum	shrub/tree	x	x	x	x	
Oleaceae	*Ligustrum quihoui*	Chinese ligustrum	shrub/tree	x			x	
Oleaceae	*Ligustrum sinense*	Chinese ligusturm	shrub	x	x	x	x	
Onagraceae	*Ludwigia sp.*	seedbox	forb		x			
Oxalidaceae	*Oxalis dillenii*	yellow wood sorrel	forb			x	x	
Oxalidaceae	*Oxalis drummondii*	Drummond's wood sorrel	forb		x	x		
Passifloraceae	*Passiflora lutea*	passionflower	vine		x		x	

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Phytolaccaceae	*Rivina humilis*	pigeonberry	forb		x	x	x	
Pinaceae	*Cedrus deodara*	deodar cedar	tree	x	x			
Platanaceae	*Platanus occidentalis*	American sycamore	tree		x	x	x	x
Platanaceae	*Platanus occidentalis var. Mexicana*	Mexican sycamore	tree	x				x
Poaceae	*Aristida purpurea*	purple threeawn	graminoid			x		
Poaceae	*Arundo donax*	giant reed	graminoid	x	x	x		
Poaceae	*Bothriochloa ischaemum var. songarica*	king ranch bluestem	graminoid	x	x	x	x	
Poaceae	*Bothriochloa laguroides ssp. torreyana*	silver bluestem	graminoid		x	x		
Poaceae	*Bouteloua curtipendula*	sideoats grama	graminoid			x		
Poaceae	*Bouteloua dactyloides*	buffalograss	graminoid		x			
Poaceae	*Bromus catharticus*	rescuegrass	graminoid	x			x	
Poaceae	*Bromus diandrus*	ripgut brome	graminoid	x			x	
Poaceae	*Bromus pubescens*	hairy brome	graminoid				x	
Poaceae	*Chasmanthium latifolium*	wood oats	graminoid		x	x		
Poaceae	*Cynodon dactylon*	Bermuda grass	graminoid	x	x	x		
Poaceae	*Dichanthelium annulatum*	Kleberg bluestem	graminoid	x	x			
Poaceae	*Elymus virginicus*	Virginia Wildrye	graminoid		x	x	x	
Poaceae	*Nassella leucotricha*	Texas wintergrass	graminoid		x	x	x	
Poaceae	*Panicum virgatum*	switchgrass	graminoid		x	x	x	
Poaceae	*Paspalum setaceum*	thin paspalm	graminoid		x			
Poaceae	*Paspalum urvillei*	vaseygrass	graminoid	x	x			
Poaceae	*Phyllostachys aurea*	bamboo	graminoid	x	x	x	x	

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Poaceae	*Setaria leucopila*	plains bristlegrass	graminoid		x			
Poaceae	*Setaria scheelei*	southwestern bristlegrass	graminoid			x		
Poaceae	*Sorghum halepense*	johnsongrass	graminoid	x	x	x	x	
Poaceae	*Tripsacum dactyloides*	eastern gamagrass	graminoid		x	x	x	
Polygonaceae	*Rumex crispus*	curly dock	forb	x	x		x	
Portulacaceae	*Portulaca pilosa*	chisme	forb		x			
Pteridaceae	*Cheilanthes alabamensis*	Alabama lipfern	fern				x	
Punicaceae	*Punica granatum*	pomegranate	shrub	x			x	
Ranunculaceae	*Clematis drummondii*	oldman's beard	vine		x			
Ranunculaceae	*Clematis pitcheri*	purple leatherflower	vine			x		
Rhamnaceae	*Zizyphus obtusifolia*	lotebush	shrub		x		x	
Rosaceae	*Crataegus marshallii*	parsley hawthorn	shrub/tree					x
Rosaceae	*Prunus mexicana*	Mexican Plum	tree			x	x	x
Rosaceae	*Prunus serotina var. exima*	escarpment black cherry	tree					x
Rosaceae	*Eriobotrya japonica*	loquat	shrub	x	x	x	x	
Rosaceae	*Photinia serratifolia*	Chinese photinia	shrub	x	x	x	x	
Rosaceae	*Photinia X Fraseri*	redtip photinia	shrub	x	x	x		
Rosaceae	*Prunus caroliniana*	cherry laurel	shrub/tree			x	x	
Rosaceae	*Pyrus calleryana*	bradford pear	tree	x		x		
Rosaceae	*Rubus trivialis*	dewberry	vine		x	x	x	
Rubiaceae	*Cephalanthus occidentalis*	buttonbush	shrub			x		
Rutaceae	*Poncirus trifoliata*	trifoliate orange	tree	x	x			
Rutaceae	*Ptelea trifoliata*	hop tree	tree		x	x	x	

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Salicaceae	*Populus deltoides*	cottonwood	tree		x	x	x	
Salicaceae	*Salix nigra*	black willow	tree		x	x	x	
Sapindaceae	*Ungnadia speciosa*	Mexican buckeye	shrub		x	x	x	x
Sapindaceae	*Sapindus saponaria L. var. drummondii*	western soapberry	tree		x	x		
Sapotaceae	*Sideroxylon lanuginosum*	gum bumelia	tree		x	x	x	
Scrophulariaceae	*Leucophyllum frutescens*	cenizo	shrub		x	x		
Simaroubaceae	*Ailanthus altissima*	tree of heaven	tree	x		x	x	
Simaroubaceae	*Ailanthus altissima*	tree of heaven	tree	x		x		
Smilacaceae	*Smilax bona-nox*	greenbrier	vine		x	x	x	
Solanaceae	*Capsicum annuum*	chile pequin	forb		x	x		
Solanaceae	*Datura sp.*	datura	forb		x			
Solanaceae	*Solanum elaeagnifolium*	silverleaf nightshade	forb		x	x	x	
Solanaceae	*Solanum triquetrum*	Texas nightshade	forb				x	
Sterculliaceae	*Firmiana platnifolia*	Chinese parasol tree	tree	x		x	x	
Thelypteridaceae	*Thelypteris ovata var. lindheimeri*	river fern	fern				x	
Tiliaceae	*Tilia americana var. caroliniana*	Carolina basswood	tree			x		
Typhaceae	*Typha domingensis*	southern cattail	forb		x	x		
Ulmaceae	*Ulmus americana*	American elm	tree		x	x	x	x
Ulmaceae	*Ulmus crassifolia*	cedar elm	tree		x	x	x	x
Ulmaceae	*Celtis laevigata var. laevigata*	sugar hackberry	tree		x	x	x	
Ulmaceae	*Ulmus parvifolia sempervirens*	Chinese lacebark elm	tree	x	x	x	x	

Family	Botanical name	Common Name	Growth habit	Non-native or out of range	LBJWFC	Siglo	Carr	PPC
Urticaceae	*Parietaria pensylvanica*	rock pellitory	forb		x	x	x	
Verbenaceae	*Callicarpa americana*	American beautyberry	shrub		x		x	
Verbenaceae	*Lantana horrida*	lantana	forb			x	x	
Verbenaceae	*Lantana montifidensis*	purple lantana	shrub	x	x			
Verbenaceae	*Phyla nodiflora*	frogfruit	forb			x		
Verbenaceae	*Vitex agnus-castus*	chaste tree	shrub	x	x	x		
Violaceae	*Viola missouriensis*	Missouri violet	forb		x			
Viscaceae	*Phoradendron tomentosum*	hairy mistletoe	shrub		x	x		
Vitaceae	*Ampelopsis arborea*	peppervine	vine		x	x	x	
Vitaceae	*Cissus trifoliata*	cow-itch vine	vine		x	x		
Vitaceae	*Parthenocissus quinquefolia*	Virginia creeper	vine			x	x	
Vitaceae	*Vitis mustangensis*	mustang grape	vine		x	x	x	

Mammals

List compiled from inaturalist.org.

Scientific name	Common name	Quality Grade
Canis latrans	Coyote	Possible
Castor canadensis	American Beaver	Possible
Dasypus novemcinctus	Nine-banded Armadillo	Possible
Didelphis virginiana	Virginia Opossum	Confirmed
Erethizon dorsatum	Common Porcupine	Possible
Mephistes mephistes	Striped Skunk	Possible
Mus musculus	House Mouse	Probable
Odocoileus virginianus	White-tailed Deer	Possible
Peromyscus	Deer Mice	Possible
Procyon lotor	Common Raccoon	Confirmed
Sciurus niger	Fox Squirrel	Confirmed
Sigmodon hispidus	Hispid Cotton Rat	Possible
Sylvilagus floridanus	Eastern Cottontail	Probable
Tadarida brasiliensis	Mexican Free-tailed Bat	Confirmed
Urocyon cinereoargenteus	Common Gray Fox	Probable
Vulpes vulpes	Red Fox	Possible

Amphibians

List compiled from inaturalist.org.

Scientific name	Common name	Quality grade
Acris blanchardi	Blanchard's Cricket Frog	possible
Eleutherodactylus marnockii	Cliff Chirping Frog	Confirmed
Hyla cinerea	Green Tree Frog	possible
Hyla versicolor	Gray Tree Frog	possible
Incilius nebulifer	Gulf Coast Toad	Probable
Lithobates catesbeianus	American Bullfrog	possible
Plethodon albagula	Western Slimy Salamander	possible
Lithobates berlandieri	Rio Grande Leopard Frog	Probable

Reptiles

List compiled from inaturalist.org.

Scientific name	Common name	Quality Grade
Agkistrodon piscivorus ssp. leucostoma	Western Cottonmouth	Possible
Anolis carolinensis	Green Anole	Confirmed
Apalone spinifera	Eastern Spiny Softshell	Confirmed
Aspidoscelis gularis	Common Spotted Whiptail	Possible
Chelydra serpentina	Snapping Turtle	Probable
Gerrhonotus infernalis	Texas Alligator Lizard	Possible
Hemidactylus turcicus	Mediterranean House Gecko	Confirmed
Kinosternon flavescens	Yellow Mud Turtle	Possible
Micrurus tener	Texas Coral Snake	Possible
Nerodia erythrogaster flavigaster	Yellowbelly Water Snake	Possible
Nerodia erythrogaster transversa	Blotched Water Snake	Confirmed
Nerodia rhombifer	Diamondback Watersnake	Possible
Opheodrys aestivus	Rough Green Snake	Possible
Pantherophis obsoletus	Texas Rat Snake	Confirmed
Plestiodon fasciatus	Common Five-lined Skink	Possible
Pseudemys texana	Texas Cooter	Confirmed
Rena dulcis	Texas Blind Snake	Confirmed
Sceloporus olivaceus	Texas Spiny Lizard	Confirmed
Scincella lateralis	Little Brown Skink	Probable
Storeria dekayi texana	Texas Brown Snake	Possible
Tantilla gracilis	Flat-headed Snake	Possible
Terrapene carolina triunguis	Three-toed Box Turtle	Confirmed
Thamnophis cyrtopsis	Black-necked Gartersnake	Confirmed
Thamnophis marcianus	Checkered Garter Snake	Possible
Thamnophis proximus rubrilineatus	Redstripe Ribbon Snake	Confirmed
Trachemys scripta elegans	Red-eared Slider	Confirmed
Virginia striatula	Rough Earthsnake	Possible

Bird list

List from www.ebird.org.

Scientific Name	Common Name	Taxonomic Order	Seasonality *
Aix sponsa	Wood Duck	357	Resident
Pelecanus erythrorhynchos	American White Pelican	2069	Migrant
Ardea herodias	Great Blue Heron	2118	Resident
Egretta caerulea	Little Blue Heron	2173	Resident
Butorides virescens	Green Heron	2196	Summer
Nyctanassa violacea	Yellow-crowned Night-Heron	2244	Summer
Coragyps atratus	Black Vulture	2358	Resident
Cathartes aura	Turkey Vulture	2362	Resident
Pandion haliaetus	Osprey	2376	Winter
Ictinia mississippiensis	Mississippi Kite	2634	Migrant
Accipiter striatus	Sharp-shinned Hawk	2807	Winter
Accipiter cooperii	Cooper's Hawk	2821	Resident
Buteo lineatus	Red-shouldered Hawk	2959	Resident
Buteo platypterus	Broad-winged Hawk	2966	Migrant
Buteo swainsoni	Swainson's Hawk	2984	Migrant
Buteo jamaicensis	Red-tailed Hawk	2989	Resident
Leucophaeus pipixcan	Franklin's Gull	4299	Migrant
Larus delawarensis	Ring-billed Gull	4319	Winter
Columba livia	Feral Pigeon	4686.5	Resident
Zenaida asiatica	White-winged Dove	4992	Resident
Zenaida macroura	Mourning Dove	5015	Resident
Columbina inca	Inca Dove	5024	Resident

Coccyzus americanus	Yellow-billed Cuckoo	6907	Summer
Coccyzus erythropthalmus	Black-billed Cuckoo	6911	Migrant
Megascops asio	Eastern Screech-Owl	7160	Resident
Chordeiles minor	Common Nighthawk	7775	Summer
Chaetura pelagica	Chimney Swift	8096	Summer
Archilochus colubris	Ruby-throated Hummingbird	8896	Summer
Archilochus alexandri	Black-chinned Hummingbird	8898	Summer
Melanerpes carolinus	Red-bellied Woodpecker	10925	Resident
Sphyrapicus varius	Yellow-bellied Sapsucker	10936	Winter
Picoides scalaris	Ladder-backed Woodpecker	11137	Resident
Picoides pubescens	Downy Woodpecker	11148	Resident
Colaptes auratus	Northern Flicker	11308	Winter
Caracara cheriway	Crested Caracara	11581.24	Resident
Myiopsitta monachus	Monk Parakeet	11589.36	Resident
Contopus cooperi	Olive-sided Flycatcher	14516	Migrant
Contopus virens	Eastern Wood-Pewee	14534	Migrant
Empidonax flaviventris	Yellow-bellied Flycatcher	14573	Migrant
Empidonax virescens	Acadian Flycatcher	14574	Migrant
Empidonax traillii	Willow Flycatcher	14576	Migrant
Empidonax minimus	Least Flycatcher	14588	Migrant
Sayornis phoebe	Eastern Phoebe	14632	Resident
Myiarchus crinitus	Great Crested Flycatcher	14928	Summer
Tyrannus verticalis	Western Kingbird	15051	Summer
Tyrannus tyrannus	Eastern Kingbird	15055	Summer
Vireo griseus	White-eyed Vireo	17750	Summer
Vireo bellii	Bell's Vireo	17778	Migrant

Vireo solitarius	Blue-headed Vireo	17801	Winter
Vireo gilvus	Warbling Vireo	17828	Migrant
Vireo philadelphicus	Philadelphia Vireo	17849	Migrant
Vireo olivaceus	Red-eyed Vireo	17850	Migrant
Cyanocitta cristata	Blue Jay	18831	Resident
Corvus brachyrhynchos	American Crow	19073	Resident
Corvus corax	Common Raven	19134	Resident
Progne subis	Purple Martin	19953	Summer
Hirundo rustica	Barn Swallow	20037	Summer
Petrochelidon pyrrhonota	Cliff Swallow	20122	Migrant
Petrochelidon fulva	Cave Swallow	20128	Summer
Poecile carolinensis	Carolina Chickadee	20240	Resident
Baeolophus atricristatus	Black-crested Titmouse	20486	Resident
Certhia americana	Brown Creeper	20846	Winter
Troglodytes aedon	House Wren	21138	Winter
Troglodytes hiemalis	Winter Wren	21245	Winter
Thryothorus ludovicianus	Carolina Wren	21319	Resident
Thryomanes bewickii	Bewick's Wren	21330	Resident
Polioptila caerulea	Blue-gray Gnatcatcher	21403	Resident
Regulus calendula	Ruby-crowned Kinglet	21939	Winter
Catharus ustulatus	Swainson's Thrush	24602	Migrant
Dumetella carolinensis	Gray Catbird	26358	Migrant
Toxostoma rufum	Brown Thrasher	26393	Winter
Mimus polyglottos	Northern Mockingbird	26464	Resident
Sturnus vulgaris	European Starling	26621	Resident
Bombycilla cedrorum	Cedar Waxwing	27738	Winter

Seiurus aurocapilla	Ovenbird	27769	Migrant
Parkesia motacilla	Louisiana Waterthrush	27773	Migrant
Parkesia noveboracensis	Northern Waterthrush	27774	Migrant
Vermivora chrysoptera	Golden-winged Warbler	27781	Migrant
Mniotilta varia	Black-and-white Warbler	27782	Winter
Oreothlypis peregrina	Tennessee Warbler	27792	Migrant
Oreothlypis celata	Orange-crowned Warbler	27793	Winter
Oreothlypis ruficapilla	Nashville Warbler	27801	Migrant
Geothlypis philadelphia	Mourning Warbler	27824	Migrant
Geothlypis trichas	Common Yellowthroat	27838	Migrant
Setophaga ruticilla	American Redstart	27861	Migrant
Setophaga cerulea	Cerulean Warbler	27864	Migrant
Setophaga americana	Northern Parula	27865	Migrant
Setophaga magnolia	Magnolia Warbler	27882	Migrant
Setophaga petechia	Yellow Warbler	27885	Migrant
Setophaga pensylvanica	Chestnut-sided Warbler	27923	Migrant
Setophaga palmarum	Palm Warbler	27929	Migrant
Setophaga pinus	Pine Warbler	27933	Winter
Setophaga coronata	Yellow-rumped Warbler	27938	Winter
Setophaga virens	Black-throated Green Warbler	27977	Migrant
Cardellina pusilla	Wilson's Warbler	28091	Migrant
Icteria virens	Yellow-breasted Chat	28138	Migrant
Pipilo maculatus	Spotted Towhee	29580	Winter
Spizella passerina	Chipping Sparrow	29712	Winter
Spizella pallida	Clay-colored Sparrow	29719	Migrant
Spizella pusilla	Field Sparrow	29726	Winter

Chondestes grammacus	Lark Sparrow	29740	Resident
Ammodramus savannarum	Grasshopper Sparrow	29788	Migrant
Melospiza lincolnii	Lincoln's Sparrow	29904	Winter
Zonotrichia albicollis	White-throated Sparrow	29941	Winter
Zonotrichia leucophrys	White-crowned Sparrow	29946	Migrant
Piranga rubra	Summer Tanager	30160	Summer
Cardinalis cardinalis	Northern Cardinal	30233	Resident
Pheucticus ludovicianus	Rose-breasted Grosbeak	30273	Migrant
Passerina caerulea	Blue Grosbeak	30312	Migrant
Passerina cyanea	Indigo Bunting	30322	Migrant
Passerina ciris	Painted Bunting	30333	Migrant
Agelaius phoeniceus	Red-winged Blackbird	30339	Resident
Quiscalus quiscula	Common Grackle	30421	Resident
Quiscalus mexicanus	Great-tailed Grackle	30432	Resident
Molothrus aeneus	Bronzed Cowbird	30515	Summer
Icterus spurius	Orchard Oriole	30546	Migrant
Icterus galbula	Baltimore Oriole	30632	Migrant
Haemorhous mexicanus	House Finch	30866	Resident
Spinus psaltria	Lesser Goldfinch	31032	Resident
Spinus tristis	American Goldfinch	31039	Winter
Passer domesticus	House Sparrow	31345	Resident

** Seasonality describes the time of year when the species is most likely to be in the park. Residents can be found year round. Migrants can be seen in fall and spring. Summer and winter birds will more likely be seen during their respective season but could also be seen during migration in fall and spring. Some summer birds may breed in the area.*

Fish

This list is based on records in the Fishes of Texas Database. All species were collected in the early 1950s from where Shoal Creek meets what is now called Lady Bird Lake, except for Western Mosquitofish which has been collected more recently from up stream.

Scientific Name	Common Name
Campostoma anomalum	Central Stoneroller
Cichlasoma cyanoguttatum	Rio Grande Cichlid
Cyprinella venusta	Blacktail Shiner
Etheostoma spectabile	Orangethroat Darter
Gambusia affinis	Western Mosquitofish
Hybopsis amnis	Pallid Shiner
Lepomis auritus	Redbreast Sunfish
Lepomis miniatus	Redspotted Sunfish
Lythrurus fumeus	Ribbon Shiner
Macrhybopsis aestivalis	Speckled Chub
Notemigonus crysoleucas	Golden Shiner
Opsopoeodus emiliae	Pugnose Minnow
Percina carbonaria	Texas Logperch
Percina sciera	Dusky Darter
Phenacobius mirabilis	Suckermouth Minnow
Pimephales vigilax	Bullhead Minnow
Pylodictis olivaris	Flathead Catfish

APPENDIX A11

MACROINVERTEBRATES AND DIATOMS DATA

EII Site # 116: Shoal Creek at 24th Street, Macroinvertebrate Data

Date	FLOW	PARAMETER	RESULT	UNIT	METHOD
19Nov1996	U	AGABUS	3	Count	SURBER
18Nov1994	U	ARGIA	6	Occurrence/Unit Time	KICK NET
26Jun1995	U	ARGIA	2	Occurrence/Unit Time	KICK NET
19Nov1996	U	ARGIA	70	Count	SURBER
10Mar2003	B	ARGIA	1	Count	SURBER
07Jul2006	B	ARGIA	10	Count	SURBER
28May2009	B	ARGIA	3	Count	SURBER
08Jun2011	B	ARGIA	5	Count	SURBER
07May2013	B	ARGIA	28	Count	SURBER
12Feb2001	B	BEROSUS	1	Count	SURBER
08Jun2011	B	BEROSUS	1	Count	SURBER
08Jun2011	B	BEZZIA / PALPOMYIA	3	Count	SURBER
07Jul2006	B	BRECHMORHOGA MENDAX	2	Count	SURBER
08Jun2011	B	BRECHMORHOGA MENDAX	1	Count	SURBER
26Jun1995	U	CAENIS	2	Occurrence/Unit Time	KICK NET
19Nov1996	U	CAENIS	1	Count	SURBER
07Jul2006	B	CAENIS	4	Count	SURBER
28May2009	B	CAENIS	10	Count	SURBER
28May2009	B	CAENIS	3	Count	SURBER
08Jun2011	B	CAENIS	69	Count	SURBER
07May2013	B	CAENIS	129	Count	SURBER
19Nov1996	U	CALOPARYPHUS	8	Count	SURBER
07May2013	B	CAMBARIDAE	1	Count	SURBER
26Jun1995	U	CAMELOBAETIDIUS	3	Occurrence/Unit Time	KICK NET
19Nov1996	U	CAMELOBAETIDIUS	3	Count	SURBER
07Jul2006	B	CAMELOBAETIDIUS	7	Count	SURBER
28May2009	B	CAMELOBAETIDIUS	1	Count	SURBER
08Jun2011	B	CAMELOBAETIDIUS	2	Count	SURBER
07May2013	B	CAMELOBAETIDIUS	8	Count	SURBER
19Nov1996	U	CHEUMATOPSYCHE	1	Count	SURBER
07Jul2006	B	CHEUMATOPSYCHE	18	Count	SURBER
28May2009	B	CHEUMATOPSYCHE	51	Count	SURBER
28May2009	B	CHEUMATOPSYCHE	16	Count	SURBER
08Jun2011	B	CHEUMATOPSYCHE	1	Count	SURBER
07May2013	B	CHEUMATOPSYCHE	3	Count	SURBER
07Jul2006	B	CHIMARRA	4	Count	SURBER
28May2009	B	CHIMARRA	6	Count	SURBER
18Nov1994	U	CHIRONOMIDAE	21	Occurrence/Unit Time	KICK NET
26Jun1995	U	CHIRONOMIDAE	263	Occurrence/Unit Time	KICK NET
19Nov1996	U	CHIRONOMIDAE	224	Count	SURBER
07Jul2006	B	CHIRONOMIDAE	225	Count	SURBER
28May2009	B	CHIRONOMIDAE	14	Count	SURBER
28May2009	B	CHIRONOMIDAE	1	Count	SURBER
28May2009	B	CHIRONOMIDAE	12	Count	SURBER
08Jun2011	B	CHIRONOMIDAE	194	Count	SURBER
07May2013	B	CHIRONOMIDAE	81	Count	SURBER
12Feb2001	B	CHIRONOMINAE	122	Count	SURBER
19Nov1996	U	COLLEMBOLA	9	Count	SURBER
07May2013	B	COPEPODA	8	Count	SURBER
28May2009	B	CORBICULA FLUMINEA	2	Count	SURBER
18Nov1994	U	CULICIDAE	4	Occurrence/Unit Time	KICK NET
26Jun1995	U	CULICIDAE	15	Occurrence/Unit Time	KICK NET
08Jun2011	B	DAPHNIIDAE	1	Count	SURBER
19Nov1996	U	DECAPODA	3	Count	SURBER
26Jun1995	U	DEROVATELLUS	2	Occurrence/Unit Time	KICK NET
28May2009	B	DUGESIA	2	Count	SURBER

07May2013	B	DUGESIA	2	Count	SURBER
26Jun1995	U	DUGESIA TIGRINA	3	Occurrence/Unit Time	KICK NET
19Nov1996	U	DUGESIA TIGRINA	4	Count	SURBER
12Feb2001	B	DUGESIA TIGRINA	10	Count	SURBER
10Mar2003	B	DUGESIA TIGRINA	4	Count	SURBER
08Jun2011	B	DUGESIA TIGRINA	12	Count	SURBER
07May2013	B	ENALLAGMA	4	Count	SURBER
07Jul2006	B	ENOCHRUS	2	Count	SURBER
08Jun2011	B	ENOCHRUS	2	Count	SURBER
19Nov1996	U	ERPOBDELLIDAE	2	Count	SURBER
19Nov1996	U	EUPARYPHUS	1	Count	SURBER
07Jul2006	B	EUPARYPHUS	1	Count	SURBER
28May2009	B	EUPARYPHUS	1	Count	SURBER
12Feb2001	B	FALLCEON	1	Count	SURBER
10Mar2003	B	FALLCEON	1	Count	SURBER
07Jul2006	B	FALLCEON	116	Count	SURBER
28May2009	B	FALLCEON	23	Count	SURBER
28May2009	B	FALLCEON	3	Count	SURBER
08Jun2011	B	FALLCEON	18	Count	SURBER
07May2013	B	FALLCEON	169	Count	SURBER
19Nov1996	U	GLOSSIPHONIIDAE	164	Count	SURBER
19Nov1996	U	Ancylidae	5	Count	SURBER
07Jul2006	B	HELISOMA	1	Count	SURBER
19Nov1996	U	HETAERINA	3	Count	SURBER
26Jun1995	U	HIRUDINEA	1	Occurrence/Unit Time	KICK NET
12Feb2001	B	HIRUDINEA	1	Count	SURBER
10Mar2003	B	HIRUDINEA	1	Count	SURBER
07Jul2006	B	HIRUDINEA	2	Count	SURBER
07May2013	B	HIRUDINEA	3	Count	SURBER
28May2009	B	HYALELLA	1	Count	SURBER
08Jun2011	B	HYALELLA	12	Count	SURBER
07May2013	B	HYALELLA	265	Count	SURBER
26Jun1995	U	HYDRACARINA	6	Occurrence/Unit Time	KICK NET
19Nov1996	U	HYDRACARINA	6	Count	SURBER
07Jul2006	B	HYDRACARINA	5	Count	SURBER
08Jun2011	B	HYDRACARINA	13	Count	SURBER
07May2013	B	HYDRACARINA	1	Count	SURBER
19Nov1996	U	HYDROPTILA	4	Count	SURBER
07May2013	B	HYDROPTILA	1	Count	SURBER
19Nov1996	U	LEPIDOPTERA: probably Petrophila sp.	1	Count	SURBER
19Nov1996	U	LIBELLULIDAE	2	Count	SURBER
07Jul2006	B	LIMONIA	1	Count	SURBER
26Jun1995	U	MICROVELIA	1	Occurrence/Unit Time	KICK NET
08Jun2011	B	MICROVELIA	5	Count	SURBER
07Jul2006	B	MUSCIDAE	1	Count	SURBER
19Nov1996	U	OLIGOCHAETA	24	Count	SURBER
12Feb2001	B	OLIGOCHAETA	2	Count	SURBER
07Jul2006	B	OLIGOCHAETA	10	Count	SURBER
28May2009	B	OLIGOCHAETA	5	Count	SURBER
08Jun2011	B	OLIGOCHAETA	2	Count	SURBER
07May2013	B	OLIGOCHAETA	3	Count	SURBER
10Mar2003	B	ORTHOCLADIINAE	243	Count	SURBER
26Jun1995	U	OSTRACODA	2	Occurrence/Unit Time	KICK NET
19Nov1996	U	OSTRACODA	28	Count	SURBER
07Jul2006	B	OSTRACODA	3	Count	SURBER
08Jun2011	B	OSTRACODA	8	Count	SURBER
07May2013	B	OSTRACODA	3	Count	SURBER
19Nov1996	U	PARACYMUS	1	Count	SURBER
12Feb2001	B	PHYSELLA	15	Count	SURBER
10Mar2003	B	PHYSELLA	5	Count	SURBER

07Jul2006	B	PHYSELLA	102	Count	SURBER
28May2009	B	PHYSELLA	2	Count	SURBER
08Jun2011	B	PHYSELLA	20	Count	SURBER
07May2013	B	PHYSELLA	11	Count	SURBER
19Nov1996	U	PHYSIDAE	85	Count	SURBER
19Nov1996	U	PLANORBIDAE: Probably Helisoma sp.	5	Count	SURBER
10Mar2003	B	PLANORBIDAE: Probably Helisoma sp.	5	Count	SURBER
19Nov1996	U	PROTONEURIDAE	2	Count	SURBER
07Jul2006	B	RHAGOVELIA	1	Count	SURBER
19Nov1996	U	SIMULIUM	2	Count	SURBER
10Mar2003	B	SIMULIUM	2	Count	SURBER
07Jul2006	B	STENELMIS	6	Count	SURBER
28May2009	B	STENELMIS	2	Count	SURBER
28May2009	B	STENELMIS	2	Count	SURBER
28May2009	B	STENELMIS	1	Count	SURBER
07May2013	B	STENELMIS	1	Count	SURBER
26Jun1995	U	STENONEMA femoratum	1	Occurrence/Unit Time	KICK NET
19Nov1996	U	STRATIOMYS	6	Count	SURBER
12Feb2001	B	TANYPODINAE	4	Count	SURBER
07Jul2006	B	TANYPODINAE	80	Count	SURBER
28May2009	B	TANYPODINAE	2	Count	SURBER
28May2009	B	TANYPODINAE	2	Count	SURBER
08Jun2011	B	TANYPODINAE	11	Count	SURBER
07Jul2006	B	TIPULA	1	Count	SURBER
19Nov1996	U	TROPISTERNUS	2	Count	SURBER

Source: City of Austin, Watershed Protection Dept.

EII Site # 116: Shoal Creek at 24th Street, Diatom Data

Date	FLOW	PARAMETER	RESULT	UNIT
19Nov1996	U	ACHNANTHES EXIGUA	3	Count
28May2009	B	ACHNANTHES EXIGUA	1	Count
28May2009	B	ACHNANTHES LANCEOLATA	8	Count
12Feb2001	B	ACHNANTHIDIUM BIASOLETTIANUM	4	Count
07May2013	B	ACHNANTHIDIUM GRACILLIMUM	5	Count
18Nov1994	U	ACHNANTHIDIUM MINUTISSIMUM	2	Count
26Jun1995	U	ACHNANTHIDIUM MINUTISSIMUM	120	Count
19Nov1996	U	ACHNANTHIDIUM MINUTISSIMUM	82	Count
12Feb2001	B	ACHNANTHIDIUM MINUTISSIMUM	15	Count
10Mar2003	B	ACHNANTHIDIUM MINUTISSIMUM	34	Count
07Jul2006	B	ACHNANTHIDIUM MINUTISSIMUM	85	Count
28May2009	B	ACHNANTHIDIUM MINUTISSIMUM	18	Count
07May2013	B	ACHNANTHIDIUM MINUTISSIMUM	24	Count
18Nov1994	U	AMPHIPLEURA PELLUCIDA	2	Count
08Jun2011	B	AMPHORA LIBYCA	2	Count
26Jun1995	U	AMPHORA MONTANA	2	Count
12Feb2001	B	AMPHORA MONTANA	8	Count
10Mar2003	B	AMPHORA MONTANA	1	Count
07Jul2006	B	AMPHORA MONTANA	4	Count
12Feb2001	B	AMPHORA PEDICULUS	10	Count
10Mar2003	B	AMPHORA PEDICULUS	3	Count
28May2009	B	AMPHORA PEDICULUS	18	Count
07May2013	B	AMPHORA PEDICULUS	8	Count
12Feb2001	B	AMPHORA VENETA	1	Count
28May2009	B	AULACOSEIRA GRANULATA	2	Count
18Nov1994	U	CALONEIS BACILLUM	2	Count
19Nov1996	U	CALONEIS BACILLUM	4	Count
12Feb2001	B	CALONEIS BACILLUM	3	Count
10Mar2003	B	CALONEIS BACILLUM	3	Count
07Jul2006	B	CALONEIS BACILLUM	4	Count
08Jun2011	B	CALONEIS BACILLUM	3	Count
12Feb2001	B	CALONEIS SCHUMANNIANA	2	Count
28May2009	B	CALONEIS SCHUMANNIANA	2	Count
07Jul2006	B	COCCONEIS PLACENTULA	2	Count
07May2013	B	COCCONEIS PLACENTULA V LINEATA	1	Count
10Mar2003	B	CRATICULA HALOPHILA	1	Count
26Jun1995	U	CYCLOTELLA MENEGHINIANA	14	Count
19Nov1996	U	CYCLOTELLA MENEGHINIANA	13	Count
07Jul2006	B	CYCLOTELLA MENEGHINIANA	30	Count
28May2009	B	CYCLOTELLA MENEGHINIANA	6	Count
07May2013	B	CYCLOTELLA MENEGHINIANA	3	Count
18Nov1994	U	CYMBELLA AFFINIS	4	Count
18Nov1994	U	CYMBELLA AFFINIS	34	Count
26Jun1995	U	CYMBELLA AFFINIS	82	Count
19Nov1996	U	CYMBELLA AFFINIS	10	Count
19Nov1996	U	CYMBELLA AFFINIS	2	Count
07Jul2006	B	CYMBELLA AFFINIS	24	Count
28May2009	B	CYMBELLA AFFINIS	228	Count
08Jun2011	B	CYMBELLA AFFINIS	177	Count
07May2013	B	CYMBELLA AFFINIS	37	Count
07Jul2006	B	CYMBELLA HUSDTEDTII V STIGMATA	124	Count
08Jun2011	B	CYMBELLA HUSTEDTII	16	Count
07May2013	B	CYMBELLA HUSTEDTII	4	Count
07May2013	B	CYMBELLA NEOCISTULA	2	Count
26Jun1995	U	CYMBELLA TUMIDULA	4	Count
19Nov1996	U	DENTICULA KUETZINGII	19	Count
12Feb2001	B	DENTICULA KUETZINGII	8	Count

10Mar2003	B	DENTICULA KUETZINGII	20	Count
07Jul2006	B	DENTICULA KUETZINGII	6	Count
28May2009	B	DENTICULA KUETZINGII	30	Count
08Jun2011	B	DENTICULA KUETZINGII	32	Count
07May2013	B	DENTICULA KUETZINGII	345	Count
28May2009	B	DENTICULA SUBTILIS	4	Count
28May2009	B	DIADESMIS CONFERVACEA	2	Count
10Mar2003	B	ENCYONEMA DELICATULA	2	Count
28May2009	B	ENCYONEMA ELGINENSE	1	Count
18Nov1994	U	ENCYONEMA MINUTUM	44	Count
26Jun1995	U	ENCYONEMA MINUTUM	6	Count
07May2013	B	ENCYONEMA MINUTUM	4	Count
18Nov1994	U	ENCYONEMA SILESIACUM	42	Count
26Jun1995	U	ENCYONEMA SILESIACUM	94	Count
19Nov1996	U	ENCYONEMA SILESIACUM	58	Count
10Mar2003	B	ENCYONEMA SILESIACUM	33	Count
07Jul2006	B	ENCYONEMA SILESIACUM	36	Count
28May2009	B	ENCYONEMA SILESIACUM	6	Count
07May2013	B	ENCYONEMA SILESIACUM	24	Count
12Feb2001	B	ENCYONEMOPSIS SILESIACUM	89	Count
19Nov1996	U	EPITHEMIA SOREX	2	Count
08Jun2011	B	EPITHEMIA TURGIDA	1	Count
18Nov1994	U	FALLACIA MONOCULATA	36	Count
12Feb2001	B	FALLACIA MONOCULATA	1	Count
12Feb2001	B	FRAGILARIA ACUS	46	Count
18Nov1994	U	FRAGILARIA CAPUCINA	13	Count
19Nov1996	U	FRAGILARIA CAPUCINA	2	Count
12Feb2001	B	FRAGILARIA CAPUCINA	4	Count
12Feb2001	B	FRAGILARIA FASCICULATA	3	Count
10Mar2003	B	FRAGILARIA FASCICULATA	32	Count
26Jun1995	U	FRAGILARIA ULNA	8	Count
12Feb2001	B	FRAGILARIA ULNA	7	Count
10Mar2003	B	FRAGILARIA ULNA	29	Count
07May2013	B	GOMPHONEMA ACUMINATUM	3	Count
10Mar2003	B	GOMPHONEMA AFFINE	4	Count
28May2009	B	GOMPHONEMA AFFINE	4	Count
08Jun2011	B	GOMPHONEMA AFFINE	17	Count
07May2013	B	GOMPHONEMA AFFINE	4	Count
10Mar2003	B	GOMPHONEMA ANGUSTATUM	36	Count
08Jun2011	B	GOMPHONEMA ANGUSTUM	2	Count
19Nov1996	U	GOMPHONEMA GRACILE	47	Count
12Feb2001	B	GOMPHONEMA INSIGNE	2	Count
18Nov1994	U	GOMPHONEMA PARVULUM	14	Count
26Jun1995	U	GOMPHONEMA PARVULUM	66	Count
19Nov1996	U	GOMPHONEMA PARVULUM	98	Count
12Feb2001	B	GOMPHONEMA PARVULUM	65	Count
10Mar2003	B	GOMPHONEMA PARVULUM	28	Count
07Jul2006	B	GOMPHONEMA PARVULUM	35	Count
28May2009	B	GOMPHONEMA PARVULUM	18	Count
08Jun2011	B	GOMPHONEMA PARVULUM	7	Count
07May2013	B	GOMPHONEMA PARVULUM	2	Count
26Jun1995	U	GOMPHONEMA PSEUDOAUGUR	4	Count
19Nov1996	U	GOMPHONEMA TRUNCATUM	2	Count
12Feb2001	B	GOMPHONEMA TRUNCATUM	4	Count
10Mar2003	B	GOMPHONEMA TRUNCATUM	7	Count
07May2013	B	GOMPHONEMA TRUNCATUM	8	Count
19Nov1996	U	LUTICOLA MUTICA	2	Count
26Jun1995	U	MASTOGLOIA SMITHII	2	Count
18Nov1994	U	MELOSIRA LINEATA	8	Count
10Mar2003	B	MELOSIRA VARIANS	3	Count
10Mar2003	B	MERIDION CIRCULARE	2	Count

18Nov1994	U	NAVICULA ABSOLUTA	2	Count
07May2013	B	NAVICULA ANTONII	1	Count
18Nov1994	U	NAVICULA CINCTA	8	Count
18Nov1994	U	NAVICULA CRYPTOCEPHALA	42	Count
26Jun1995	U	NAVICULA CRYPTOCEPHALA	2	Count
19Nov1996	U	NAVICULA CRYPTOCEPHALA	4	Count
28May2009	B	NAVICULA CRYPTOCEPHALA	2	Count
19Nov1996	U	NAVICULA CRYPTOTENELLA	3	Count
12Feb2001	B	NAVICULA CRYPTOTENELLA	1	Count
07Jul2006	B	NAVICULA CRYPTOTENELLA	5	Count
19Nov1996	U	NAVICULA ERIFUGA	5	Count
07Jul2006	B	NAVICULA KOTSCHYI	1	Count
07May2013	B	NAVICULA KOTSCHYI	4	Count
07Jul2006	B	NAVICULA LEPTOSTRIATA	1	Count
12Feb2001	B	NAVICULA LIBONENSIS	9	Count
10Mar2003	B	NAVICULA LIBONENSIS	1	Count
19Nov1996	U	NAVICULA MENISCULUS	2	Count
12Feb2001	B	NAVICULA MENISCULUS	62	Count
10Mar2003	B	NAVICULA MENISCULUS	36	Count
19Nov1996	U	NAVICULA MINIMA	1	Count
12Feb2001	B	NAVICULA MINIMA	3	Count
10Mar2003	B	NAVICULA MINIMA	4	Count
07Jul2006	B	NAVICULA MINIMA	32	Count
28May2009	B	NAVICULA MINIMA	4	Count
18Nov1994	U	NAVICULA MINUSCULA	4	Count
10Mar2003	B	NAVICULA RADIOSA	16	Count
28May2009	B	NAVICULA RECENS	5	Count
10Mar2003	B	NAVICULA RHYNCHOCEPHALA	3	Count
28May2009	B	NAVICULA ROSTELLATA	7	Count
18Nov1994	U	NAVICULA SCHROETERII	10	Count
12Feb2001	B	NAVICULA SCHROETERII	1	Count
07Jul2006	B	NAVICULA SCHROETERII	3	Count
18Nov1994	U	NAVICULA SUBMINISCULA	6	Count
19Nov1996	U	NAVICULA SUBMINISCULA	2	Count
12Feb2001	B	NAVICULA TRIVIALIS	3	Count
07Jul2006	B	NAVICULA TRIVIALIS	7	Count
19Nov1996	U	NAVICULA VENETA	4	Count
12Feb2001	B	NAVICULA VENETA	6	Count
10Mar2003	B	NAVICULA VENETA	6	Count
07Jul2006	B	NAVICULA VENETA	2	Count
28May2009	B	NAVICULA VENETA	4	Count
18Nov1994	U	NAVICULA VIRIDULA	2	Count
19Nov1996	U	NAVICULA VIRIDULA	3	Count
07Jul2006	B	NAVICULA VIRIDULA	5	Count
26Jun1995	U	NITZSCHIA AMPHIBIA	6	Count
19Nov1996	U	NITZSCHIA AMPHIBIA	32	Count
12Feb2001	B	NITZSCHIA AMPHIBIA	28	Count
10Mar2003	B	NITZSCHIA AMPHIBIA	1	Count
07Jul2006	B	NITZSCHIA AMPHIBIA	22	Count
28May2009	B	NITZSCHIA AMPHIBIA	50	Count
08Jun2011	B	NITZSCHIA AMPHIBIA	80	Count
07May2013	B	NITZSCHIA AMPHIBIA	17	Count
26Jun1995	U	NITZSCHIA AMPHIBIOIDES	14	Count
28May2009	B	NITZSCHIA AMPHIBIOIDES	44	Count
10Mar2003	B	NITZSCHIA ANGUSTATA	2	Count
18Nov1994	U	NITZSCHIA CLAUSII	46	Count
19Nov1996	U	NITZSCHIA CLAUSII	3	Count
12Feb2001	B	NITZSCHIA CLAUSII	4	Count
10Mar2003	B	NITZSCHIA COMMUNIS	1	Count
12Feb2001	B	NITZSCHIA DISSIPATA	6	Count
10Mar2003	B	NITZSCHIA DISSIPATA	151	Count

18Nov1994	U	NITZSCHIA FILIFORMIS	6	Count
18Nov1994	U	NITZSCHIA FRUSTULUM	40	Count
26Jun1995	U	NITZSCHIA FRUSTULUM	18	Count
19Nov1996	U	NITZSCHIA FRUSTULUM	29	Count
12Feb2001	B	NITZSCHIA FRUSTULUM	3	Count
07Jul2006	B	NITZSCHIA FRUSTULUM	9	Count
26Jun1995	U	NITZSCHIA INCONSPICUA	6	Count
19Nov1996	U	NITZSCHIA INCONSPICUA	14	Count
12Feb2001	B	NITZSCHIA INCONSPICUA	65	Count
10Mar2003	B	NITZSCHIA INCONSPICUA	17	Count
07Jul2006	B	NITZSCHIA INCONSPICUA	44	Count
28May2009	B	NITZSCHIA INCONSPICUA	6	Count
18Nov1994	U	NITZSCHIA LINEARIS	7	Count
19Nov1996	U	NITZSCHIA LINEARIS	2	Count
12Feb2001	B	NITZSCHIA LINEARIS	6	Count
10Mar2003	B	NITZSCHIA LINEARIS	7	Count
18Nov1994	U	NITZSCHIA MICROCEPHALA	8	Count
26Jun1995	U	NITZSCHIA MICROCEPHALA	10	Count
18Nov1994	U	NITZSCHIA PALEA	74	Count
26Jun1995	U	NITZSCHIA PALEA	42	Count
19Nov1996	U	NITZSCHIA PALEA	33	Count
12Feb2001	B	NITZSCHIA PALEA	1	Count
10Mar2003	B	NITZSCHIA PALEA	4	Count
07Jul2006	B	NITZSCHIA PALEA	16	Count
08Jun2011	B	NITZSCHIA SINUATA V DELOGNEI	110	Count
19Nov1996	U	NITZSCHIA SOLITA	6	Count
28May2009	B	NITZSCHIA SOLITA	3	Count
28May2009	B	NUMBER OF DIATOM CELLS	500	Count
08Jun2011	B	NUMBER OF FIELDS COUNTED	500	Count
07May2013	B	NUMBER OF FIELDS COUNTED	500	Count
28May2009	B	UMBER OF SPECIES IN COMPOSITE SAMPLE	29	Count
08Jun2011	B	UMBER OF SPECIES IN COMPOSITE SAMPLE	15	Count
07May2013	B	PINNULARIA MICROSTAURON	1	Count
08Jun2011	B	PINNULARIA VIRIDIS	1	Count
28May2009	B	RHOICOSPHENIA CURVATA	8	Count
08Jun2011	B	RHOICOSPHENIA CURVATA	2	Count
07May2013	B	RHOICOSPHENIA CURVATA	1	Count
07Jul2006	B	RHOPALODIA GIBBA	2	Count
08Jun2011	B	RHOPALODIA GIBBA	2	Count
28May2009	B	SELLAPHORA PUPULA	4	Count
18Nov1994	U	STEPHANODISCUS PARVUS	24	Count
18Nov1994	U	SURIRELLA ANGUSTA	14	Count
19Nov1996	U	SURIRELLA ANGUSTA	6	Count
12Feb2001	B	SURIRELLA ANGUSTA	1	Count
10Mar2003	B	SURIRELLA ANGUSTA	3	Count
18Nov1994	U	SURIRELLA PATELLA	4	Count
07Jul2006	B	SYNEDRA ULNA	1	Count
28May2009	B	SYNEDRA ULNA	10	Count
08Jun2011	B	SYNEDRA ULNA	48	Count
10Mar2003	B	TOTAL COUNT	500	Count
18Nov1994	U	TRYBLIONELLA APICULATA	2	Count
19Nov1996	U	TRYBLIONELLA APICULATA	7	Count
12Feb2001	B	TRYBLIONELLA APICULATA	29	Count
10Mar2003	B	TRYBLIONELLA APICULATA	10	Count
07May2013	B	TRYBLIONELLA APICULATA	2	Count
28May2009	B	TRYBLIONELLA CALIDA	3	Count
28May2009	B	TRYBLIONELLA DEBILIS	2	Count

Source: City of Austin, Watershed Protection Dept.