ZILKER PARK

Natural Resource Inventory & Management Guidelines

May 7, 2021

SIGLO GROUP

2021

BARTON SPRINGS CONSERVANCY

Barton Springs is a natural treasure that is the heart and soul of Austin. The Barton Springs Conservancy honors, preserves, and enhances the experience of Barton Springs through education and facility improvements.

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MAY 7, 2021

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PART 1
INTRODUCTION

Zilker Metropolitan Park (Zilker Park) is central to the history, culture, and ecology of Austin, Texas. Ecologically, the site includes a diversity of plant communities influenced by topographic changes, variation in soils, hill country geology, impacts from a long history of site use, and periodic flooding that have shaped the landscape. These communities range from riparian habitat by the water's edge to woodlands on steep slopes. Zilker Park plays an indispensable role as a refuge for residents and wildlife. Lying along the eastern boundary of the Edwards Plateau ecoregion, Zilker Park contains four major springs and shoreline for three waterbodies; is home to two endangered salamander species; offers habitat for 33 bird Species of Greatest Conservation Need; and supports over 600 species of native flora and fauna.

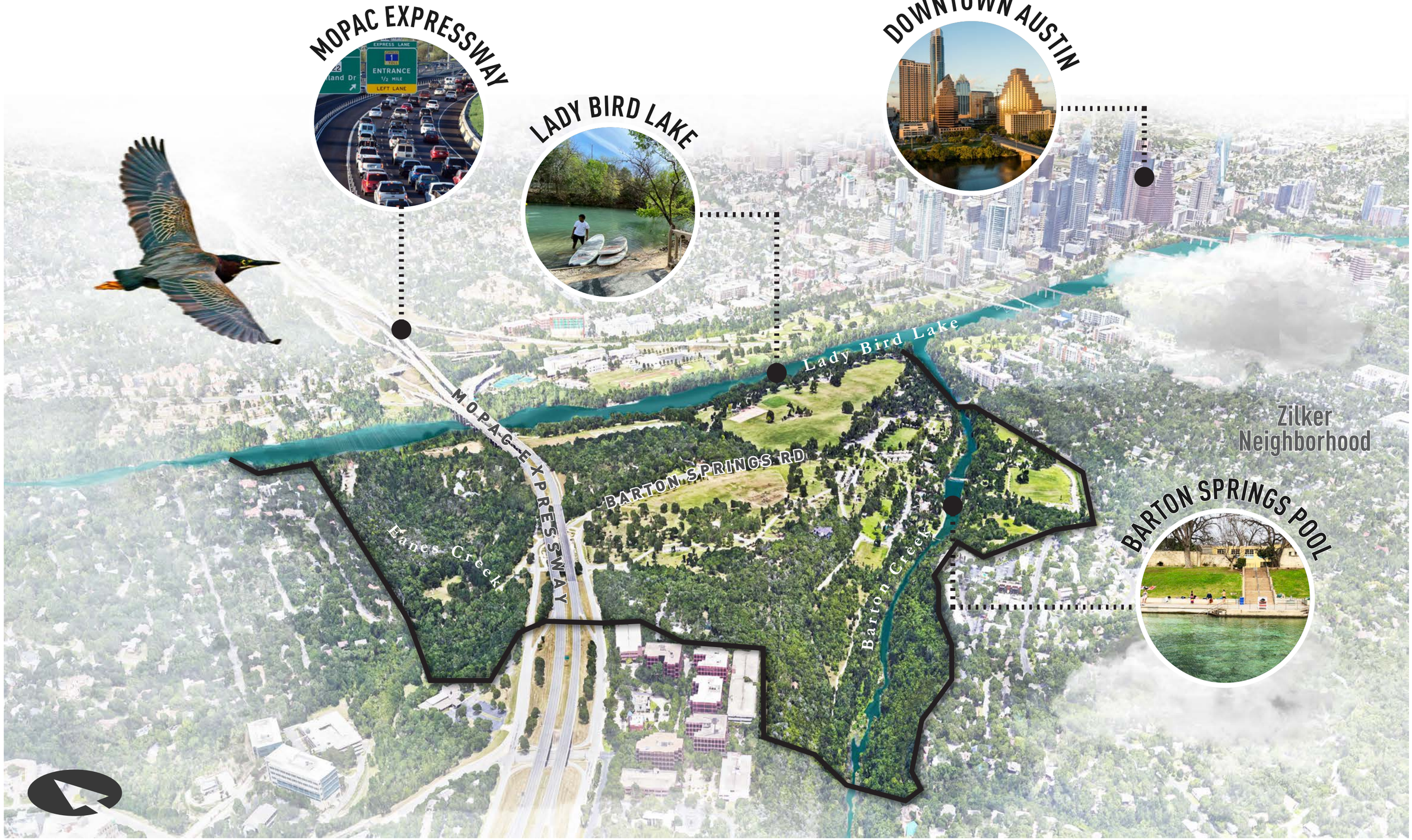

Figure 1. 1. *Zilker Urban Context*

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The Barton Springs Conservancy commissioned this report to proactively look at opportunities and issues to improve the natural areas of Zilker Park over the next four years—as park usage is increasing—and to ensure the Zilker Vision Plan process has the needed information to embed ecological health into the planning process. The recommendations provided in this report highlight the beauty and desirability of Zilker Park's natural areas. They acknowledge the degradation caused by millions of annual visitors who are loving the park to death and outline management practices that would improve the site, by enhancing existing natural areas and expanding them where appropriate.

The guidelines work towards the following goals:

NATURAL RESOURCE GOALS

- **Protect and maintain endangered species habitat and water quality:** Protect the habitat of the endangered Barton Springs and Austin Blind Salamanders and maintain the water quality of all waterbodies adjacent to and within the study area.
- **Repair environmental degradation:** Address threats to the site's ecological health including invasive species, erosion issues, and past or former detrimental land uses.
- **Restore and enhance plant communities:** Manage and expand native meadows, savannas, and woodlands to create diverse, resilient plant communities.
- **Repair and improve wildlife habitat:** Enhance habitat quality for wildlife by managing the site for ecological health, creating connectivity between habitat patches, and providing refuge in an urban environment.
- **Enhance the user experience:** Provide aesthetically pleasing, compelling, and comfortable natural surroundings.
- **Facilitate stewardship:** Catalyze opportunities to appreciate, observe, and care for the natural environment as an ongoing part of people's lives.

As a multifaceted open space, Zilker Park not only supports a wide variety of wildlife but can also increase the health and well-being of the surrounding community and improve the user experience through direct benefits and ecosystem services. Zilker Park's waters, urban forest, and natural areas perform critical tasks including increasing happiness,[1] bolstering mental well-being,[1–3] supporting physical health,[4,5] fostering social cohesion,[6] cleaning the air,[7] reducing noise pollution,[8] enhancing water quality,[9] sequestering carbon,[10] intercepting rainfall,[11] mitigating flooding,[12] reducing erosion,[13] decreasing urban temperatures,[14] shading recreation areas,[15] building soil,[16] providing wildlife habitat,[17] reducing infrastructure costs,[18] and supporting lower maintenance costs.[19]

Like its ecological importance, the cultural importance of Zilker Park cannot be overstated. The natural areas of Zilker Park have a history that stretches back millennia. Indigenous Peoples were the original inhabitants of the site, tied to the riparian environment, and relying upon it for food, resources, and shelter. Early accounts of Indigenous Peoples living in the riparian environment recorded their consumption of prickly pear, venison, and other plants.[20] The woodlands were likely more expansive and dense and the waters of Barton Springs were regarded with even spiritual significance, supporting countless individuals over thousands of years of habitation. While so much has changed since Indigenous Peoples' earliest use of the springs and the park's later purchase in 1917, Zilker Park and its surrounding areas are still essential to Austin's appeal as a place to visit and live. With over 3 million visitors every year,[21] Zilker Park is one of the city's most popular attractions.

Today, Zilker Park is the front porch of the Austin experience. Situated in the heart of Austin, it lies adjacent to Mopac Expressway, Lady Bird Lake, and in close proximity to one of the most dynamic and fastest growing residential and business centers in the U.S., downtown Austin (Figure 1.1). The popular Barton Springs Pool lies on site and the Barton Creek Greenbelt is connected via the Violet Crown Trail to the south. No matter what the activity, Zilker Park offers the opportunity to enjoy numerous outdoor events in a natural setting.

This 351-acre park has over two dozen named areas. These areas range from maintenance facilities and historic features to ball fields and natural areas. The Map of Zilker Park calls out these major areas with names that are commonly used by the City of Austin or the public (Figure 1.2). Visitors can swim in the spring-fed waters of Barton Springs Pool or hike to beautiful views in the Zilker Nature Preserve. Formalized educational experiences are offered at the Austin Nature & Science Center, the Beverly S. Sheffield Education Center and Splash! Exhibit at Barton Springs, and Zilker Botanical Garden; summer plays are offered at the Hillside Theater; and active recreation takes place in the park's Disc Golf Course, Rugby Field, ball fields, Polo Field, volleyball courts; and

the iconic Great Lawn. Throughout this report, official area names are capitalized and this map can serve as a reference for where they are in the park.

This report emphasizes the present and future pressures of Austin's tightly clustered downtown population on Zilker Park's 350+ acres and recommends management strategies to preemptively address the increasing demands on this park, so that it may be protected, enhanced, and enjoyed for generations to come. It acknowledges the ecological and cultural significance of the site and recommends ways to sustain and improve the user experience and ecological function of the urban forest and natural areas around Zilker Park. Investments to the area are not only necessary ecologically but make sense financially. Investments in the urban forest in Austin are estimated to have a nearly 1 to 10 return.[22] This document provides a road map for land management practices with a focus on land use and management of areas outside of formal landscapes, as well as the intersection of areas with ecological and cultural resources. This project identifies areas appropriate for ecological restoration, as well as erosion mitigation and invasive species management, canopy enhancement, and green stormwater infrastructure placement.

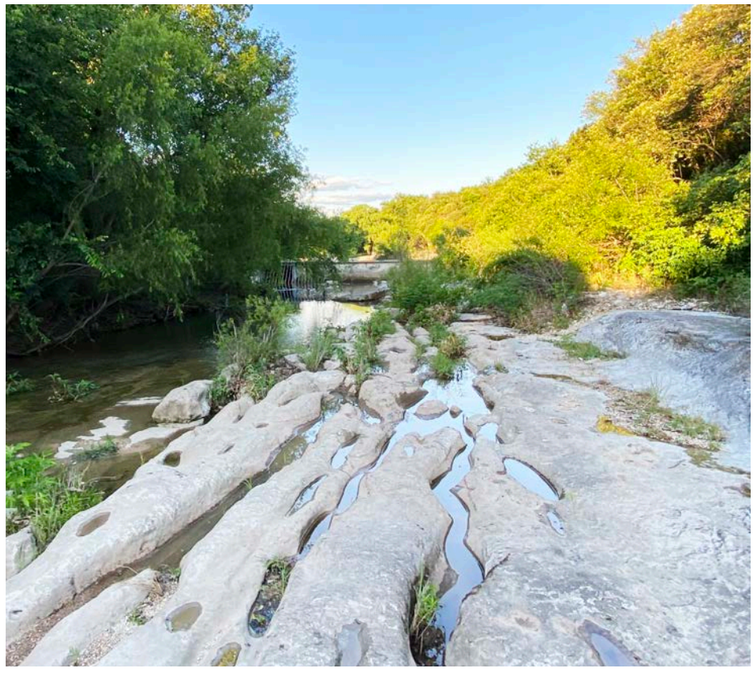
While major improvements will be seen within the first several years, the full results will unfold over decades—a forest takes time to grow. The result will be a more enriching, interesting, and ecologically functional natural system that continues to make Zilker Park a place for people to visit and enjoy into the future.

General Zones

Figure 1. 2. *General zones of Zilker Park*

ALIGNED WITH THE CITY'S VISION, POLICIES, AND PRACTICES

This project is closely aligned with the goals and objectives of Imagine Austin, the Urban Forest Master Plan, Watershed Protection Master Plan, Our Parks Our Future Austin Parks and Recreation Long Range Plan, Urban Trails Master Plan, and Invasive Species Management Plan. In addition, the analysis and report were put together with input from numerous departments including Parks and Recreation, Watershed Protection, and Urban Forestry. The restoration of open spaces and the conservation of natural resources increase environmental resilience and adaptability. The current natural area management work at Zilker Park and the recommendations provided in this report align with City of Austin's plans, as detailed to the right.



This report aligns with the following 2012 Imagine Austin Comprehensive Plan priority programs::

- Sustainably manage water resources
- Use green infrastructure to protect environmentally sensitive areas and integrate nature into the city

This report aligns with the following guiding principles put forth in the 2013 Austin's Urban Forest Master Plan:

- Greatest Good Philosophy
- Wise Use of Resources
- Sustainability
- Science-Based Decision Making
- Industry-Recognized Best Management Practices
- This report aligns with the following 2015/2016 Watershed Protection Master Plan goals:
- Protect channel integrity and prevent property damage resulting from erosion.
- Protect and improve Austin's waterways and aquifers for citizen use and support of aquatic life.
- Improve the urban environment by fostering additional beneficial uses of waterways and drainage facilities.
- Optimize City resources by integrating flood, erosion, and water quality control measures.

This report aligns to the following 2019 Our Parks Our Future Austin Parks and Recreation Long Range Plan recommendations:

- Ensure Parks Act as a Relief from Urban Life
- Expand and Improve Park Access for All
- Activate and Enhance Urban Public Space

This report aligns with the following 2014 Urban Trails Master Plan objectives:

- Minimize impacts to water quality of creeks, lakes, and aquifers through the use of appropriate Urban Trail design and green infrastructure.
- Avoid placement within Erosion Hazard Zones and Critical Water Quality Zones.
- Preserve vegetation, trees, and wildlife habitat.

This report aligns with the following 2012 Invasive Species Management Plan 5-year goals:

- Standardized, centralized digital record-keeping system for invasive species management and control used for all City managed lands
- Each department will have implemented invasive species removal actions on at least 25% of their total acreage
- Determine baseline data for invasive species distribution
- Each department will have implemented treatment plans for a reduction in distribution from the baseline.
- By Jan 2013, COA will no longer purchase or recommend known invasive species

In the following chapters, the Zilker Park Natural Resource Inventory and Management Guidelines provides a detailed overview of Zilker Park's natural features and threats including heritage trees, plant communities, wildlife, water quality considerations, erosion, and land use. This survey is then used to make recommendations that aim to enhance the park for users, improve habitat for wildlife, and increase the ecosystem services for Austin residents.

PART 2
HISTORIC & CULTURAL USE

Zilker aerial, 1938 (from The Austin History Center via UNT Texas History Portal)

A historic understanding of modern-day Zilker Park will inform land management and planning. Human interactions with these lands stretch back thousands of years and include a unique history of Native American settlement, homesteading, industry, agriculture, and recreation unearthed through archeological exploration and over 450 years of documentation. The human impact on the landscape in the last century has led to contamination in several areas, which will impact management and infrastructure decisions into the future.

ZILKER TIMELINE

FOREST, SAVANNA, AND SPRINGS

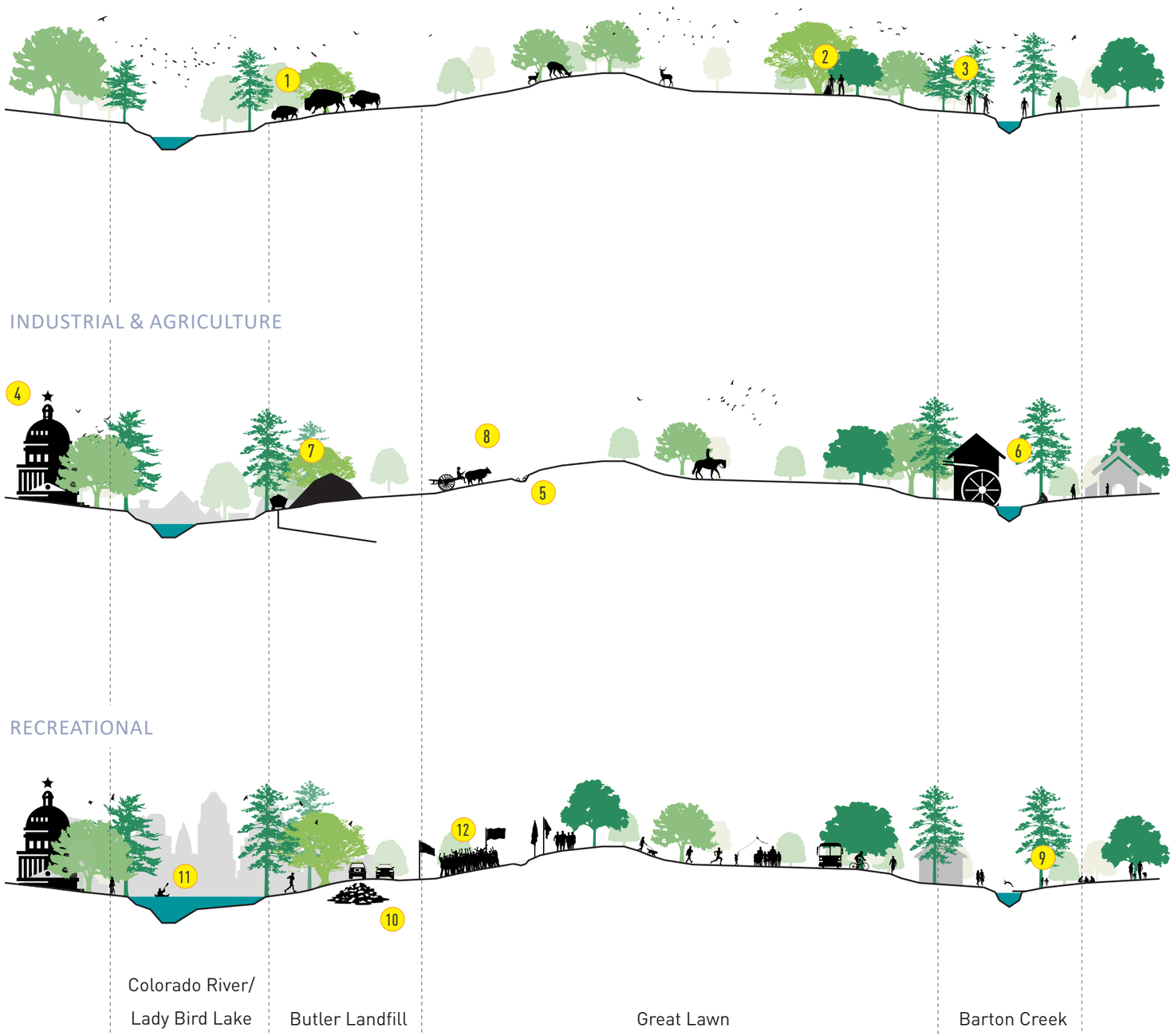


Figure 2.1 *Zilker Timeline, Early indigenous settlement to current day. (Drawings not to scale)*

FOREST, SAVANNA, & SPRINGS

7000 B.C.E. - 17th Century
Wildlife is abundant, bison and deer roam the landscape and are a major food source for indigenous peoples hunting in the area.

Indigenous peoples' encampments are near Barton Creek. Numerous tribes frequented the area—of these, the Tonkawa, Comanche, and Lipan Apache were among those documented in written records.

People fish along Barton Creek.

INDUSTRIAL & AGRICULTURE

1839
Austin named the capital of the Texas Republic in part because of its abundant wildlife and forage for livestock.

1860
Early settlers already report lack of game, lack of forage, and erosion issues.

1870
Colonists start industry. Mills are built along Barton Creek, which is also used for swimming.

1900
Mining takes place along the Colorado River and includes a conveyor to the north side of the Colorado River.

1910
Great Lawn is cleared and used for agriculture.

RECREATIONAL

1920s - 1940s
Barton Springs Pool & Bathhouse are formalized. Charles Page park plan developed; New Deal programs begin in the park.

1948 - 1967
Butler Landfill is used to dispose of trash.

1960
Lady Bird Lake is formed through the construction of the Longhorn Dam on the Colorado River.

2000
Major events take place in the Big Field, including ACL and the Zilker Kite Festival

Produced by Siglo Group

INDIGENOUS TRIBES

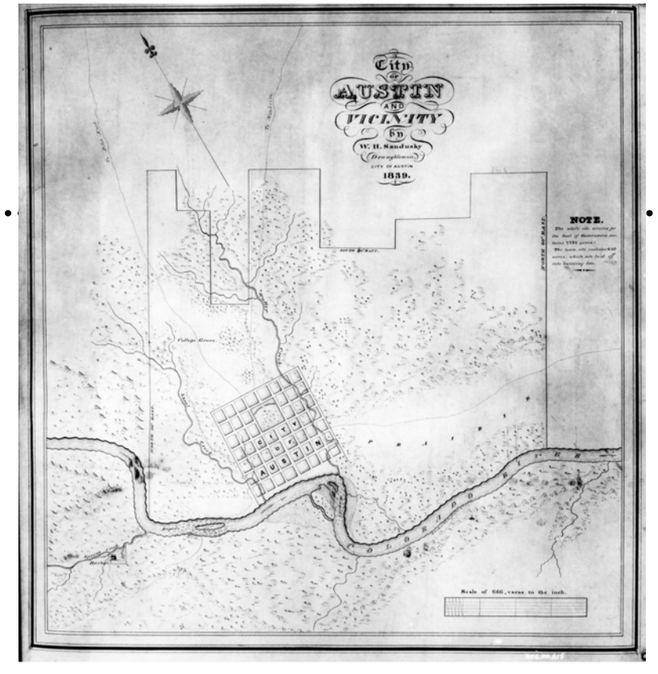
EUROPEAN SETTLEMENT

HISTORIC LAND USE

For the purposes of this report, Zilker Park's landscape history can be roughly divided into three periods—Forest, Savanna, & Springs; Industrial & Agriculture; and Recreational (Figure 2.1). The Forest, Savanna, & Springs period (7000 BCE–17th century) shows the landscape before widespread colonial settlements and represents thousands of years of Indigenous habitation. It highlights some of the tribes who frequented at the springs—including the Tonkawa, Lipan Apache, and Comanche. This landscape was characterized by a naturally dense forested landscape, a low and wide undammed Colorado River, plentiful wildlife, and naturally flowing spring water in Barton Creek. The Industrial & Agriculture period covers the 18th–19th centuries and ends approximately 300 years after colonists first arrived. This time period in Zilker Park was characterized by highly extractive activities, such as mining, farming, and milling along Barton Creek's banks. These intensive land use changes removed tree canopy, decreased wildlife, and increased erosion. The final Recreational period (20th–21st century) shows land use up to today, which shows Zilker Park as a city-owned public space. The modern landscape in Zilker Park is characterized by a higher and more consistent water level on the north side of the park, created by the damming of the Colorado River and formation of Lady Bird Lake. Additionally, heavy public use, soil compaction, trampling, and contamination is also present throughout the park.

These sections highlight not only Zilker Park's accelerating landscape changes, but also how land uses have changed and why. Themes that have emerged from these three historic periods include:

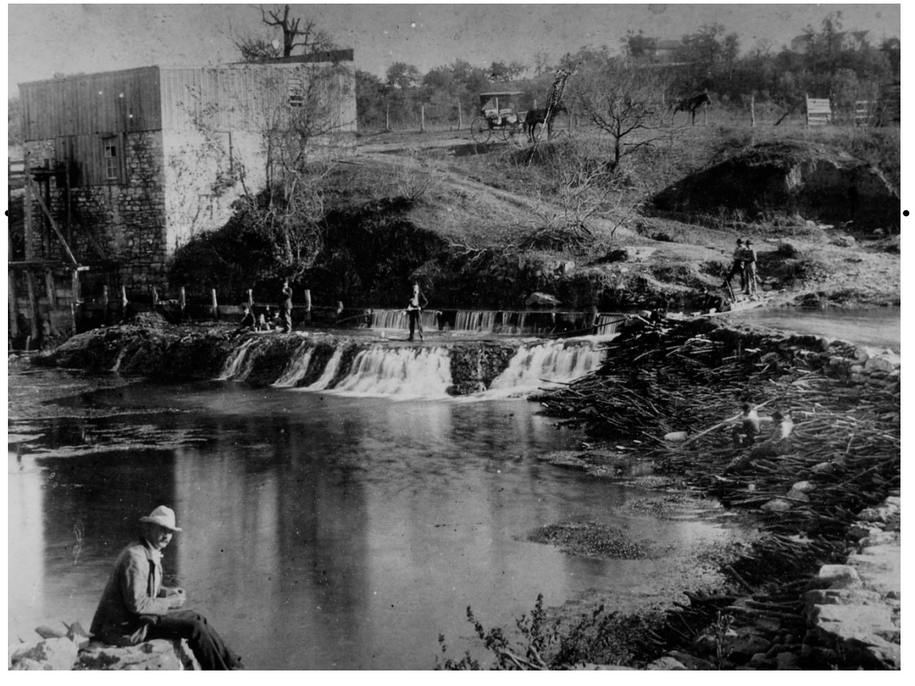
- A transition in land uses from a natural landscape to industrial and finally to recreational;
- A landscape where the proportion of wild lands decreases steadily over time;
- A decrease in wildlife abundance and diversity over time, especially a decrease in megafauna; and
- A transition from tribes camping along Barton Creek, to a few independent mill owners and homesteaders, to a modern landscape visited by hundreds of people daily.



City of Austin and Vicinity map, 1839 (from The Austin History Center via UNT Texas History Portal)

Indigenous Peoples

The earliest inhabitants of the area were nomadic hunter gatherers who frequented the confluence of Barton Creek and the Colorado River since 7000 BCE. By the Late-Prehistoric phase (approximately 700–1530 CE), a more localized population, known for their pottery, bead making, and tool fashioning, was present in the area. The earliest written account of Indigenous Peoples living within the riparian environment of this area was recorded by Cabeza de Vaca, a Spanish explorer in the mid-1500s.[20] These Indigenous Peoples may have been the Tonkawa, Comanche, or Lipan Apache, all of whom camped and hunted along what is now known as Barton Creek.[23,24] The Tonkawa in particular recognized the springs as a sacred place.[25,26] They often made temporary villages along riverbanks as they followed the buffalo—their main food source—across Central Texas.[27]



Grist Mill at Barton Springs, 1860 (from The Austin History Center via UNT Texas History Portal)

C00079, Austin History Center, Austin Public Library

Barton Springs Mill, built in 1871, is where the first ice in Austin was manufactered (from The Austin History Center via UNT Texas History Portal)

Like so many places throughout the United States, the full story of Indigenous Peoples and their relationship to Zilker Park and Barton Springs is not fully known or recorded due to a history of colonization, conquering, and extirpation. The remnants of evidence remaining suggest that this site has been a vital location of even spiritual significance for thousands of years by many groups.

1700s During this century, Tonkawa and Comanche were common throughout Central Texas, even though Spain claimed the state as a colony. The Comanche Trail—which followed reliable water sources between hunting grounds—included a stop at Barton Springs.[24,28] As the Spanish continued to colonize Texas, they established several missions in or near modern-day Zilker Park. One, established in 1716, has a marker in the park; for others, their exact location is unknown.[20]

1800s During the early 1800s, modern-day Zilker Park changed hands many times, with William Barton also moving onto the land during this time. Surveyors called Barton Springs "perhaps the greatest and most convenient water power…in the Republic,"[24] and new mills were constructed. One mill owner built Barton Creek's first recreational infrastructure: a small bathhouse and dam for swimmers. While this increased use led to quarrels with the native peoples over water access, development continued and a stone bridge was built to facilitate these businesses. Though documentation is conflicting, it is thought that a stone bridge just upstream of modern-day Barton Springs Pool was built in the late 1800s, and is thought to have washed out in 1900.[20] Part of the bridge abutment on the southern bank of Barton Creek is still visible today.

1900s Between 1901-1913, Andrew Jackson Zilker purchased approximately 350 acres of land around Barton Springs. He used the floodplain for row cropping and its waters for industry.[20] Clays and sand were mined from the banks of the Colorado River—which include portions of the modern-day Great Lawn and Butler Landfill—for use in a brick factory on the north side of the river.[20,29,30] Zilker also constructed the Elks Pit at Eliza Springs—possibly in 1903, though its construction date is estimated between 1903-1918—to facilitate outdoor meetings, by allowing seated congregants to be naturally cooled by air near the water's surface.[20]

Present day "Great Lawn" with Capitol in Background, 1910 (from The Austin History Center via UNT Texas History Portal)

Eliza Springs/Zilker Amphitheatre, Date Unknown (from The Austin History Center via UNT Texas History Portal)

Barton Springs Bathhouse, 1922 (from The Austin History Center via UNT Texas History Portal)

1910s Following two severe droughts that left the City of Austin in dire need of water supplies, Zilker bequeathed the Barton Springs tract of his land to the city in 1917. He charged $100,000, which was to go to the local Austin High School. Once the parkland was acquired, new park improvements began like construction of a new grandstand, removal of old mills, cleaning of Barton Creek's banks, and the deconstruction of an old dam. Between 1917–1918, the invasive species, elephant ear was first recorded along Barton Creek's banks.[20]

1920s Through the 1920s, the springs and the park received an increase in visitation and a new bathhouse was constructed in 1923. A Park Board was established and improvements to the areas around Barton Springs Pool began. These included a new concrete dam, an expanded pool, and burying the stream from Eliza Springs to Barton Springs in a concrete pipe.[20] The latter is believed to have reduced valuable habitat for the Barton Springs Salamander, which would not be named for another 70 years.[31,32] By 1928, a city-

Jordan Company. Barton Springs Pool with elephant ear, photograph, 1925 (from The Austin History Center via UNT Texas History Portal)

wide masterplan was created, which highlighted the preservation of natural areas and created Austin Recreation Department.[20] It should also be noted that the master plan explicitly recommended strategies for racially segregated public facilities, which has had lasting effects on the city and park.[33] In 1929, Zilker Park's first kite festival was held.[34]

1930s In 1932, Zilker sold an additional 250-300 acres to the city, with funds again going to Austin schools. In response to the Great Depression, New Deal Era programs—which included the Civilian Conservation Corps (CCC), Works Progress Administration (WPA), and National Youth Administration (NYA)—completed several construction projects building picnic tables, cooking areas, roadways, walking trails, bridle paths, a shooting range, scout cabins, Sunken Gardens, and the Rock Gardens.[20] The 1934 Charles Page park plan was developed to help drive CCC and WPA work. It also shows an arboretum, rock quarry, stables, and reptile farm.[35] These features supported activities like horseback riding, camping, tennis, skating, nature study, shooting, hiking, fishing, and boating.[20] The Zilker Nature Preserve was also established during this decade, the first of Austin's preserve system.[36] In 1935 and again in 1936, heavy rains caused substantial flooding in Austin.[37,38] The Pool was closed twelve times in 1935 and five times in 1936 due to flooding. The largest flood of 1935 was thought to be the worst since 1869.[39] It resulted in the waters of Barton Creek rising to 5 feet 8 inches inside the Caretaker's Cottage and took six days of intensive cleaning by 65 laborers and the entire Recreation Department staff of life guards and playground leaders to clean the site.[39,40]

Steam shovel at Barton Springs, 1926 (from The Austin History Center via UNT Texas History Portal)

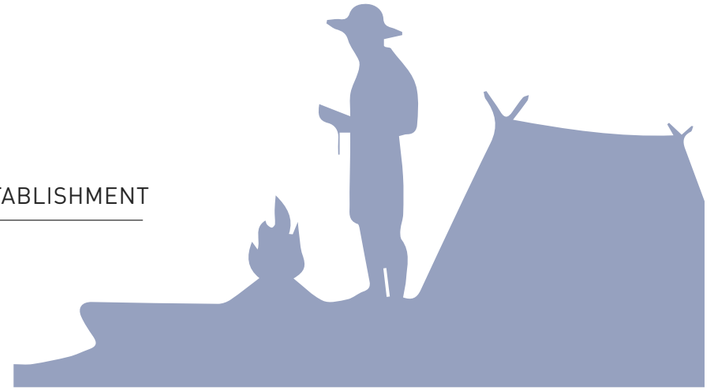
1940s-1950s

In the 1940s, the mostly forested park was surrounded by undeveloped natural areas, particularly to the west (Figure 2.2). At this time within the park, the landscape just upstream of Barton Springs Pool lacked tree canopy and a dense network of trails snaked throughout the park. In the Great Lawn and Polo Field areas, few trees were present. In 1944, the Austin City Council first proposed using the Missouri-Pacific (MoPac) Railroad right-of-way as a boulevard, but it would not be until 1950 when they adopted a Thoroughfare Plan.[41,42] In 1946, the Barton Springs Salamander was first collected, but it would not be formally described for another 47 years.[32] During this same year, Beverly Sheffield began his 27 year position as director of the Austin Parks and Recreation Department (PARD).[43] At the pool, a new bathhouse was built and the upstream waters were diverted to prevent contamination of its spring-fed waters.[20] Along the Colorado River, existing clay and rock quarries were repurposed as the Butler Landfill, which opened in 1948.[44] Additionally, a homestead tract was purchased by the city in 1953, adding approximately 4,000 feet of creek and bluff over Barton Springs to the park.[20] It was during this decade that Roberta Crenshaw—who would become one of Austin's most prolific environmental advocates—was appointed to the parks board by the Austin City Council.[45]

1960s

During the 1960s, the Longhorn Dam was constructed, damming the Colorado River and forming Lady Bird Lake (then known as Town Lake). Notable new construction projects included the Zilker Botanical Garden, the Zilker Christmas Tree, and the Zilker Eagle (more recently known as the Zilker Zephyr).[20] Additionally, Isamu Taniguchi's built the Japanese "Oriental" Garden at Zilker Botanical Garden as a gift to the City of Austin. In 1967, the City of Austin closed the Butler Landfill, after 19 years of use.[44] In part due to Roberta Crenshaw's activism, the city also created the Town Lake Beautification Committee.[45] In 1966, after years of negotiating and planning, the Texas Highway Department agreed to finance and

PARK EXPANSION & PRESERVE ESTABLISHMENT



Boy Scout hut / Zilker Clubhouse construction, circa 1934 (from The Austin History Center via UNT Texas History Portal)

Barton Springs Bathhouse flooded by the waters of Barton Creek. c.1935 (from The Austin History Center via UNT Texas History Portal)

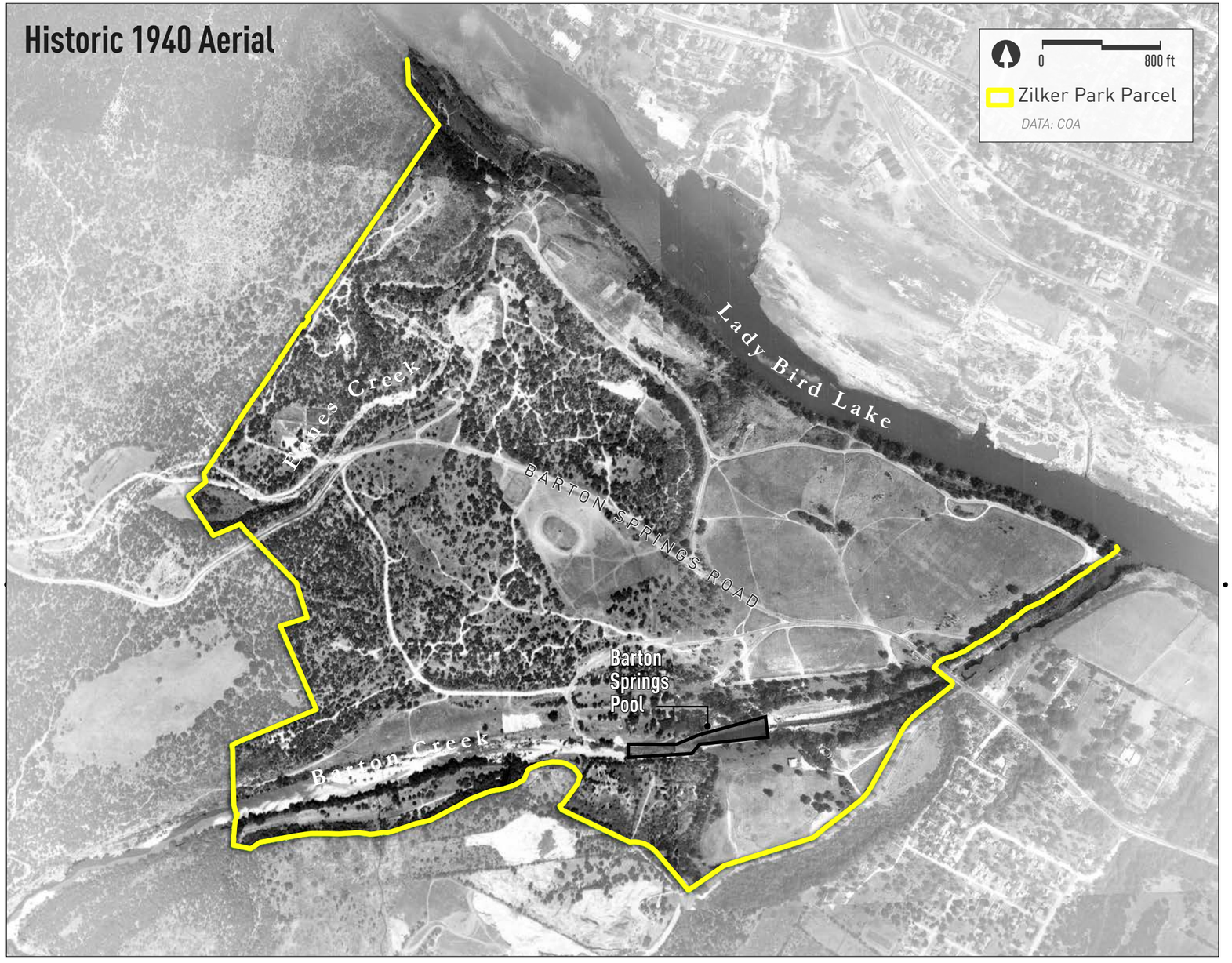


Figure 2.2 *Historic 1940 Aerial*

Barton Springs Bathhouse exterior, 1948 (from The Austin History Center via UNT Texas History Portal)

Bathers at Barton Springs Pool, 1940-1969 (from The Austin History Center via UNT Texas History Portal)

Zilker Zephyr with Capitol in background, 1960-1980 (from The Austin History Center via UNT Texas History Portal)

plan the construction of MoPac Boulevard.[41,46] Throughout 1967 and 1968, there were several public hearings to gain feedback on the proposal for MoPac Boulevard's route. After the final public meetings were held early in 1968, the route was solidified, and MoPac Boulevard would run through the western portion of Zilker Park. Construction began in 1969.[41,46]

1970s During this decade, connectivity was a major focus of the city, both within and around the park.[20] In 1971, trees in Zilker Park were cleared in preparation for the MoPac Boulevard construction, splitting the park in half with the preserve to the west and the remainder of the park to the east; phase one of the bridge construction would begin in 1974.[41,47,48] Upon seeing the devastation left behind in Zilker Park after the tree clearing, the superintendent of PARD, Jack Robinson, stated, "It looks like a tornado hit us. All we can do now is shed a tear and accept it."[41,48] Additionally, the Town Lake Beautification Committee—spearheaded by Lady Bird Johnson with Lou Neff—established the Ann and Roy Butler Hike-and-Bike Trail, which runs through Zilker Park's northern boundary.[49,50] Lady Bird Johnson often gets the credit for the popular Butler Trail, but when praised, Mrs. Johnson would often say that all she did was get aboard a moving train.[45] Roberta Crenshaw greatly contributed to this accomplishment. In fact, the Butler Trail's pedestrian bridge that crosses Lady Bird Lake would later be named after her—the Roberta Crenshaw Pedestrian Walkway.[51] In recognition of Lou Neff's work, Lou Neff Point was dedicated.[52] Today, the Trail Foundation continues the Town Lake Beautification Committee's work by overseeing the Butler Trail. In 1973, Beverly Sheffield left his position as director of PARD with a slew of accomplishments including establishing the Butler Trail, Zilker Botanical Garden, and the Zilker Hillside Theater (renamed the Beverly S. Sheffield Zilker Hillside Theater in 1997).[43]

This decade also saw community actions from groups like the Zilker Park Posse—which was formed in the late 1970s in reaction to

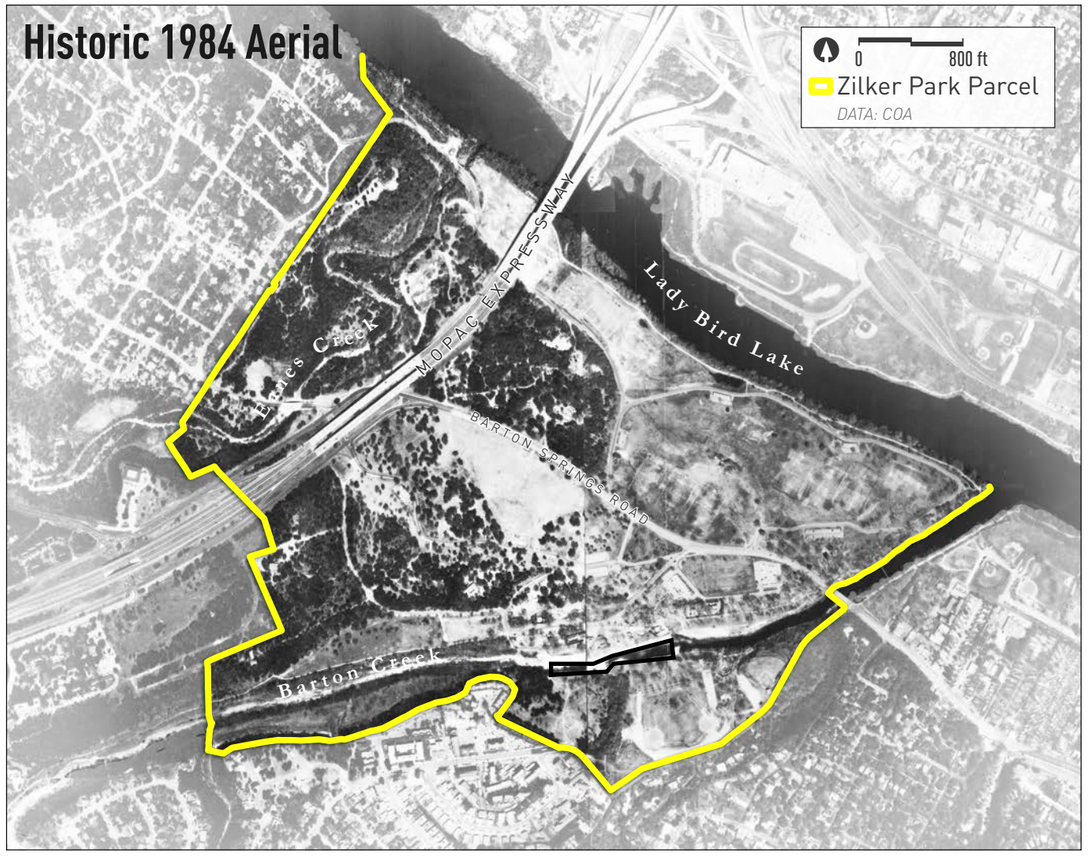


Figure 2.3 *Historic 1984 Aerial*

Isamu Tanguchi (left) at the Taniguchi Japanese "Oriental" Garden at Zilker Botanical Gardens, 1969 (from The Austin History Center via UNT Texas

the accelerated plans for urban development in the Barton Creek Watershed—and the Save Barton Creek Association—which was formed in 1979 in response to community concerns about the impact of urbanization on Barton Creek and Barton Springs.[53,54]

1980s By the 1980s, Austin's landscape was highly urbanized, with the bounds of Zilker Park lying adjacent to dense neighborhoods and office campuses (Figure 2.3). At this point within the park, cleared areas were present throughout the park's interior, including the present-day Bone Yard, Butler Landfill, Polo Field, and areas surrounding Barton Springs Pool. In the forested areas, the canopy was noticeably denser, especially in the present-day Zilker Botanical Garden and Zilker Nature Preserve. Within the park, playfields, parking lots, and cultural resources occupied much of the park's footprint. Few structural improvements were made in Zilker Park during this decade, but park use as a music venue accelerated, with the Beach Boys playing to 50,000 fans in 1987.[55]

1990s Both the Barton Creek Greenbelt and the Save Our Springs Alliance were established during this decade. In the early 1990s, the Trust for Public Land acquired more than 800 acres of environmentally sensitive land that created the Barton Creek Greenbelt as it exists today.[56] The latter successfully halted a 4,000-acre Barton Creek development and strengthened the 1986 Comprehensive Watersheds Ordinance to protect the Barton Springs watershed.[57] This work proved crucial when, in 1993, the Barton Springs Salamander was first formally described and just 4 years later, was listed as federally endangered.[58] In 1998, the first Barton Springs Pool Habitat Conservation Plan and incidental take permit was issued.[59] This same year, water quality protection lands were established that now conserve over 28,673 acres in the Barton Springs Segment of the Edwards Aquifer to protect the quantity and quality of water flowing into Barton Springs. This decade also saw an estimated 15,000 people drawn to Willie Nelson's 4th of July Picnic[55] and the construction of Austin's first Art in Public Places project, the pavilion at Lou Neff Point.[52]

2000s In 2001, the Austin Blind Salamander was first formally described.[32] In 2002, the first Austin City Limits Music Festival was held at Zilker Park.[60] Over the first few years of the festival, park stewards noticed environmental degradation beginning to take place. In response to this, the Austin City Limits Music Festival producers funded a $2.5 million renovation of the park in 2008.[61] During this decade, expanded trails, landscaping, and stone terracing at Lou Neff Point were also set in place with public and private funding.[52]

MAJOR OUTDOOR EVENTS WITHIN PARK

Clear water flows through the upper section of Barton Springs Pool today and remains deeply rooted within the Austin community, 2021.

2010s The popularity of the City of Austin and Zilker Park continued to grow throughout this decade. Austin City Limits Music Festival became a two-weekend event and drew an estimated 450,000 attendees.[60,62] Additionally, Barton Springs Pool attendance grew steadily, with a record being set of nearly one million visitors in a single year.[63] The Hill Country Conservancy also began construction of the Barton Creek Greenbelt Trailhead (now known as the Violet Crown Trail).[64] In terms of ecology, the Austin Blind Salamander was federally listed as an endangered species in 2013.[32] The following year, habitat conservation and management plans were created.[32,65] The Austin Blind Salamander was added to the Barton Springs Pool Habitat Conservation Plan in an amendment in 2013.[59] In 2017, the City of Austin restored habitat for the salamanders when they daylit the Eliza Springs stream, restoring it to a more natural state.[31] The Zilker Zephyr shut down in May 2019, after heavy rains caused erosion near the track.[66]

The 2019 aerial of Zilker Park (Figure 2.4) shows the distinction between natural and formal areas that were developed throughout the park's modern history. Forested areas remain dense along the western boundary of the park, while more central areas of the park and areas adjacent to waterways noticeably lack the same density of canopy trees. Compared to the 1984 aerial, various areas of the park are much more distinct with more groundcover in open areas.

PRESENT DAY

2020 In 2020, the Zilker Zephyr train tracks were removed, but plans to relaunch the Zilker Zephyr system are in place for August 2021.[66,67] Due to the COVID-19 pandemic, Barton Springs Pool was either closed or open to a limited number of swimmers in 2020.[68] Looking forward in planning for increasing usage of this popular metropolitan park, the Zilker Park Vision Plan should continue to consider past land uses as it attempts to uphold the park's history as a naturalistic refuge in the heart of the Texas capital.

2019 Aerial

Figure 2.4 *Present day aerial image of Zilker Park*

CULTURAL LANDSCAPE FEATURES

A cultural landscape is a geographic area, including its built, natural, and wildlife components, that has been uniquely affected and shaped by a culture.[69] Zilker Park's numerous natural and manmade historic landscape features have been incorporated into its design, contributing to its cultural landscape. Zilker Park is listed in the National Register of Historic Places. Its nomination includes a full list of its historic features (Table 2.1).[41,70] This list includes contributing features that were at least 50 years old at the time of the nomination and non-contributing features that were newer than 50 years old.[70] The City of Austin's PARD is currently updating the 1997 Zilker Park National Register Historic District listing. In this report, features that relate to the natural spaces and ecological health of Zilker Park are given primary focus and are highlighted in the table, mapped, and described below (Figure 2.5):

1 **Barton Springs Site** Barton Springs is the state's fifth largest natural springs.[70] The land around this spring has been in use for thousands of years. It is critical habitat for two federally endangered salamander species and home to Barton Springs Pool, a popular swimming destination that has received upwards of 900,000 visitors per year.[63]

2 **Zilker Amphitheater (Eliza Springs)** A stepped pit surrounds the Eliza Springs pool, which was built by landowner and Zilker Park's namesake, Andrew Jackson Zilker. Inscriptions with dates are located on its walls, include insignia of the Elks Lodge, Andrew Zilker's name, and "WM Barton's Springs". The area is now off limits to park visitors and is prime Barton Springs Salamander habitat.

5 **Pecan Grove Picnic Area** A large picnic area, established in 1958, contains several tables with concrete benches.

8 **Rock Garden** A rock garden was built into a natural limestone outcropping north of Barton Springs Pool in 1934.

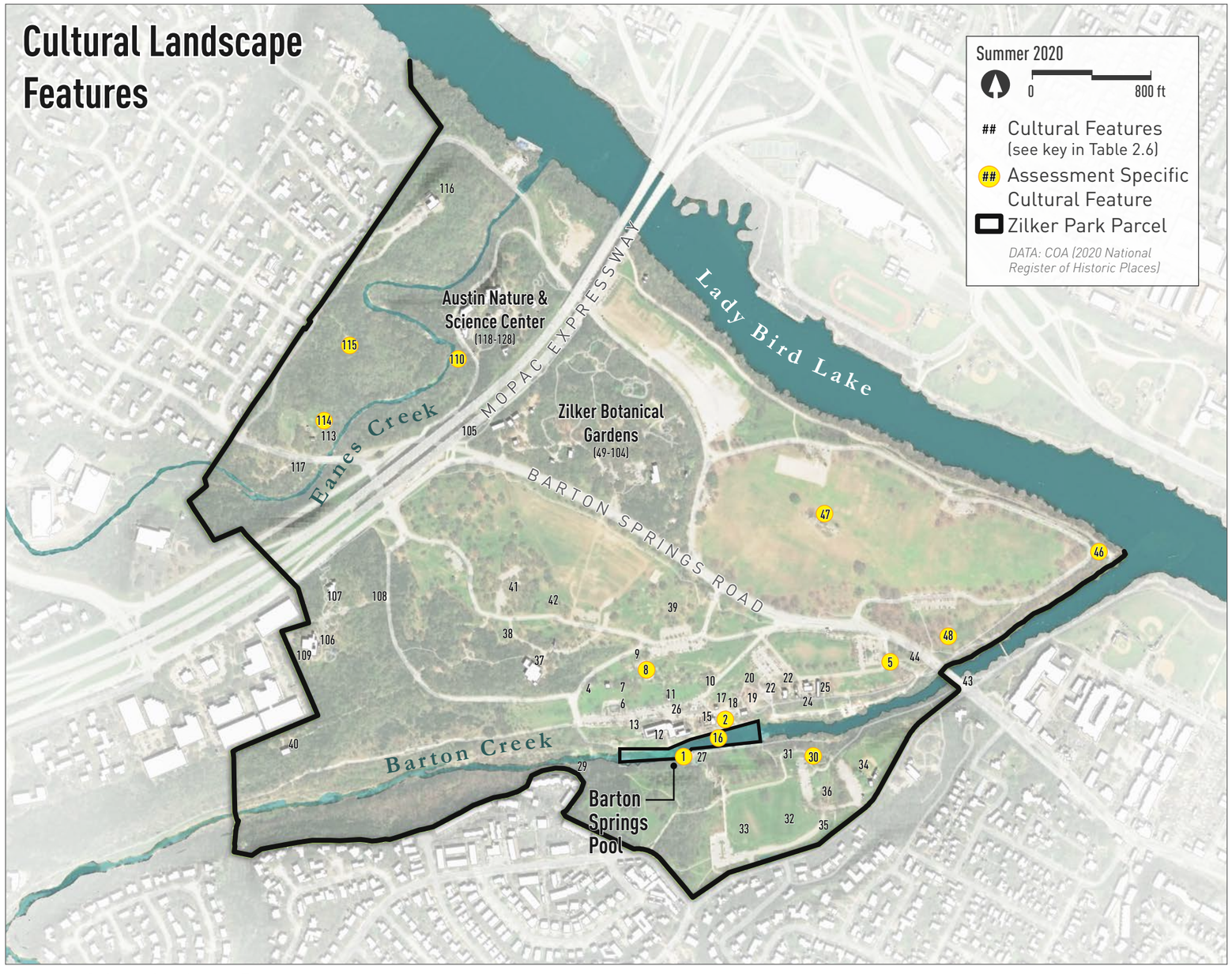


Figure 2.5 *Cultural Landscape Features*

It was designed with terraced footpaths, stone stairs, and two separate ponds—one containing lilies, the other containing turtles and goldfish. These ponds are now inoperative. The terraced stonework complements the natural outcroppings and often looks natural. "Zilker Ponds" is inscribed in cursive on a concrete wall on the south bank of the westernmost pond.

16 **Barton Springs Pool/Dam** The dams that create Barton Springs Pool were built between 1928–1929. Approximately 100 x 1000 feet in size, Barton Springs Pool—situated within Barton Creek—ranges from a few inches to over 16 feet deep. Although spring water enters the pool through multiple outlets, the main spring is located near the diving board. The upper and lower concrete dams, the gravel trap dam, and the southside sidewalk were constructed simultaneously. The aggregate northside sidewalk is modern.

30 **Sunken Gardens** Built between 1937–1939, a system of concentric stone terraces rises from Old Mill (or Zenobia) Spring to a pecan grove above. Today, mature pecans, some growing into the walls, shade the multilevel terraces. Near the bottom of the spring-fed pool is a small, elevated stage for performances. Stone picnic tables seating 250–300 people once occupied these terraces. Today, the stone picnic tables are gone, and the pool is dry most of the year. The area is now off limits to park visitors and is a protected Barton Springs Salamander habitat.

46 **Lou Neff Point** Originally the site of an overlook constructed via a New Deal program, Lou Neff Point was updated in the 1990s. New improvements included a pergola with benches named for Barbara Louise Neff (1930-1974), who was a prominent organizer and civic leader. The point was dedicated after her death in 1974 and in honor of her work on the Town Lake Beautification committee.

47 **Rock Island** This natural limestone outcropping generally runs NW/SE and is located near the center of the Great Lawn. Trees grow near its base and from the top. This area was designated as an arboretum in the 1934 Charles Page park plan.

48 **Pecan Grove Picnic Area** Established in 1955, a picnic area contains several large concrete picnic tables that appear to be from the same mold as the Pecan Grove and Polo Fields picnic tables.

110 **Mirror Pond** Two rock dams were constructed across Eanes Creek between the years of 1934–1935. After heavy rainfall and when full, these dams form a pool.

114 **Pistol Range** This open field was once the site of a rectangular pistol practice range. A stone wall separates the firing range from the Skeet Field Concession building to the south. The wall is in deteriorating condition. On the west, against a taller stone wall, is an open-air gabled roof shed in poor condition.

115 **Lookout Point** Built in 1934, a low stone wall defines a semi-circular arc and is placed at the edge of a cliff with a panoramic view of the Colorado River and downtown Austin. Stone piers rise at intervals above the curving line of the wall.

129 **Footpath System** A historic system of trails, originating in the 1930s, is present throughout the park. These include footpaths in the southwest portion of the park (near the Sunshine Camp), northwest (Austin Nature & Science Center), and north central (Zilker Botanical Garden). The modern trails that exist there today follow, to a certain extent, this historic 1934 trail system of largely unpaved footpaths.

Zilker Amphitheater (Eliza Springs) at Zilker Park now closed off to public

The Sunken Gardens (Old Mill Spring) at Zilker Park

Rock Gardens at Zilker Park

Table 2.1 *Cultural resources at Zilker Park*

Natural Area Cultural Resources

No. on Figure 2.5	Resource	Type	Year	Assessment Specific
1	The Barton Springs Site	Site	Various Periods	x
2	Zilker Amphitheater (Eliza Springs)	Site	1903	x
3	Water Fountains	Object	c. 1934	
4	Picnic Unit	Object	1935	
5	Pecan Grove Picnic Area	Object	c. 1958	x
6	Hillside Theatre	Site	1958	
7	Projection Booth	Building	c. 1980	
8	Rock Garden	Site	1934	x
9	Rock Garden Picnic Area	Object	1958	
10	Lamp Posts	Object	1928-29	
11	Bandstand	Structure	1936	
12	Barton Springs Bathhouse	Building	1947	
13	Sand Pit	Site	1928-29	
14	Rock wall system	Structure	Various Periods	
15	Concession Stand (Zilker Café)	Building	1959	
16	Barton Springs Pool/Dam	Structure	1928-29	x
17	Zilker Zephyr Tunnel	Structure	1961	
18	Zilker Zephyr Ticket Booth	Building	1961	
19	Zilker Zephyr Railroad	Structure	1961	
20	Modern Playscape	Structure	1969/1993/Various periods	
21	Fire Truck	Object	1928, 1969	
22	Caretaker's Lodge	Building	1929	
23	Fallout Shelter	Structure	1960	
24	Maintenance Shop	Building	1946	
25	Restroom	Building	1974	
26	Philosopher's Rock Statue	Object	1994	
27	Centennial Marker	Object	1937-38	
28	Rabb House Site*	Site		
29	Bridge Abutment*	Structure		
30	Sunken Gardens	Site	1937-39	x
31	Modern lift station	Building	c. late 1970s	
32	Ballfield with Dugouts	Site	1938	
33	Ballfield with Dugouts	Site	1938	
34	Wright Field	Site	1979	
35	Replica Log House	Building	1920s?	
36	Restrooms	Building	1970	
37	Sunshine Camp	Building	2015	
38	Sunshine Camp Amphitheater	Site	1935	
39	Moonlight Tower	Structure	1890/1990	
40	Zilker Cabin (Girl Scout Hut)	Building	1935	
41	Polo Fields Picnic Area	Object	c. 1938/1954	
42	Polo Fields Restrooms	Building	1974	
43	Barton Springs Road Bridge	Structure	1926/46	
44	Main Entrance Piers	Structure	1934	
45	Footbridge	Structure	1984	
46	Lou Neff Point	Site	1975	x
47	Rock Island	Site	1934	x
48	Peace Grove Picnic Area	Object	c. 1955	x
49	Zilker Botanical Garden System	Site	1965	
50	Austin Area Garden Center	Building	1965	
51	Rose Gate	Object	1996	
52	Main Gate	Object	1995	
53	Entrance Sign	Object	1964	
54	Ticket booth	Structure	Unknown	
55	Willie Birge Memorial Pond	Object	1966	
56	Parking Area Islands	Object	1964	
57	Pioneer Village	Site	1964	
58	Swedish Log Cabin	Building	1840/1965	
59	The Wishing Well	Object	1975	
60	Esperanza School House	Building	1866/1976	
61	Blacksmith Shop	Building	c. 1978	
62	Taniguchi Japanese (Oriental) Gardens	Site	1967-69	
63	Moon Bridge	Structure	1969	
64	Tea House	Structure	1969	
65	Austin Pond	Structure	1969	
66	Ship Pond	Structure	1969	
67	Stone Entry Gates	Object	1998	
68	Restrooms	Building	1978	
69	Bickler Cupola	Object	1894/1970	

** Locations omitted on map to protect archaeological sites*

Natural Area Cultural Resources (continued)

No. on Figure 2.5	Resource	Type	Year	Assessment Specific
70	Hamilton Parr Memorial Azalea Garden	Site	1964	
71	Hamilton Fountain/Japanese Garden Pond	Object	1966	
72	Water Stream System	Structure	1966/69/73	
73	Summer House	Structure	1968	
74	Green Garden	Site	1965	
75	Von Osthoff Bird Aviary	Object	1967	
76	Biblical/Green Garden Gates	Object	1965	
77	Biblical/Green Garden Rear Gates	Object	1965	
78	Grotto walls in Biblical/Green Garden	Structure	1967	
79	Cactus and Succulent Garden	Site	1966	
80	Mabel Davis Rose Garden	Site	1969	
81	Congress Avenue Footbridge	Structure	1870/1969	
82	Butler Window	Object	1887/1971	
83	Hartman Prehistoric Garden	Site	2002	
84	Hartman Pavilion	Structure	2002	
85	Ornithomimus Sculpture, 2002, Noncontributing Object	2002	Object	
86	Escarpment	Site	1964	
87	Greenhouse	Structure		
88	Greenhouse	Structure	1968	
89	Greenhouse	Structure		
90	Greenhouse	Structure		
91	Storage	Building		
92	Storage	Building		
93	Storage	Building		
94	Storage	Building		
95	Fragrance Garden	Site	1970	
96	"Rosemary, Goddess of Herbs" Sculpture	Object	2000	
97	Doug Blachly Butterfly Garden and Trail	Site	1990	
98	Animal/Children's garden	Site	c. 2010	
99	Daylily Garden	Site	1934/1965	
100	Oak Grove	Site	1964	
101	Posey Perennial Garden	Site	1975	
102	J. Curtis Harper Fountain	Object	1975	
103	Historic Light Standards	Structure	1926/1975	
104	CCC-era Picnic Unit	Object	c. 1935	
105	MoPac Boulevard	Structure	1978	
106	Danny G. McBeth Recreation Center	Building	1958	
107	Danny B. McBeth Recreation Center Annex	Building	1960	
108	McBeth Piers	Structure	1960	
109	Knights of Columbus Barbecue Pit	Object	1960	
110	Mirror Pond	Site	1934/35	x
111	Stratford Drive bridge	Structure		
112	MoPac footbridge	Structure	1978	
113	Skeet Field Concession/Comfort Station	Building	1934	
114	Pistol Range	Site	1935	x
115	Lookout Point (Lover's Peak, Observation Point)	Site	1934	x
116	Zilker Park Clubhouse (Boyscout Cabin)	Building	1934	
117	Picnic Unit (Tables, Benches, Oven)	Object	1935	
118	Nature Labs	Building	1987	
119	Wildlife Exhibit Building	Building	1988	
120	Austin Nature and Science Center Headquarters	Building	1981	
121	Visitor's Pavilion	Building	1988	
122	Pond System	Site	1988	
123	Dino Pit	Site	2000s	
124	Greenhouse	Structure		
125	Trail House (Ashford-McGill House)	Building	1870/1934	
126	Salamander Conservation Center	Building	2008	
127	Birds of Prey aviary	Site	2000s	
128	Human Sundial Installation	Object	2017	
129	Footpath System	Structure	1934	x
130	Parking Lot System	Structure	Various Periods	
131	Road Network	Structure	Various Periods	
132	Concrete Picnic Units	Object	c. 1955	

Eliza Springs when it was open to the public in the 1940's (from The Austin History Center via UNT Texas History Portal)

ENVIRONMENTAL CONTAMINATION FROM HISTORIC LAND USE

Zilker Park has three main areas of environmental concern—the Butler Landfill, the Pistol and Skeet Range, and the Bone Yard (Figure 2.6). In anticipation of future renovations planned for various areas on site, a Phase I Environmental Site Assessment was completed for Zilker Park in 2019 by TRC Environmental Corporation.[44] The following sections detail the type of contamination present in each of these three areas. This information can be used to plan future mitigation and restoration actions.

Contaminated Areas

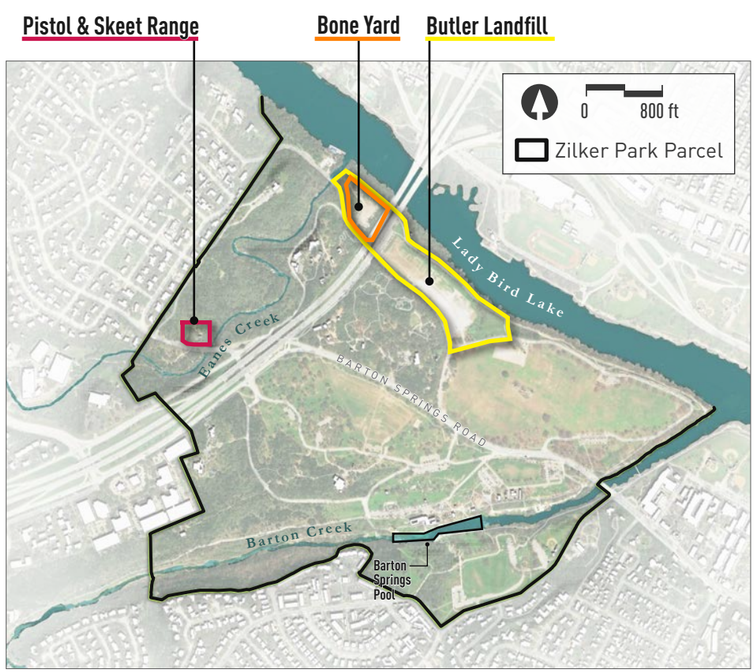


Figure 2.6 *Contaminated Areas*

Austin's skyline is the backdrop at the historic Butler Landfill.

Butler Landfill

The 25-acre Butler Landfill has a maximum depth of 30 feet. It is bounded on the north by Lady Bird Lake, on the west by Eanes Creek, on the south by Stratford Drive, and on the east by Lou Neff Road. It is located within the Edwards Aquifer Recharge Zone and underlies the Bone Yard on its far western corner. This location originally served as a clay quarry for the Butler Brick Factory through the early 1900s, but after termination of quarry operations, the location was operated as a municipal landfill by the City of Austin from 1948 to 1967.[44]

Due to its proximity to waterbodies, several investigations and groundwater monitoring events have been conducted. While the earlier events described in this paragraph did not find constituents of concern (COCs), later monitoring events did detect them, as described in the following paragraph. In 1984, a monitoring well was installed near the southeast end of the landfill and assessors estimated that the landfill held approximately 100,000 cubic yards of refuse. They identified it as a medium risk for hazardous material content due to the date of its closure. During drilling, old rags, paper, plastic, and a light bulb were observed. Sand and gravel were encountered from 19 ft below grade to a total measured depth of 26 ft, which is where the monitoring well ends. Hazardous materials were not present in the landfill's leachate and there was no indication that these materials would severely contaminate ground or surface water.

Subsequent groundwater reports have identified COCs at levels above their respective Protective Concentration Levels (PCLs). These include the 1997–1998 findings that waste materials were exposed in several areas throughout the landfill and that—with the building of Longhorn Dam in 1960 and the creation of Town Lake—the groundwater elevations were raised which saturated the lower portion of material within the landfill. A range of contaminants exceeded recommended maximum levels including arsenic, barium, cadmium, chromium, magnesium, lead, iron, and manganese. Due to this, the 2019 Environmental Assessment classified Butler Landfill as a recognized environmental condition (REC) due to the COC PCL exceedances and the potential for comingling of groundwater from Lady Bird Lake.[44] According to the ASTM E 1527-13, which sets the industry standard for Phase I Environmental Site Assessments, a REC is defined as the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: (1) due to any release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a

The Bone Yard is bordered by Mopac to the east and Eanes Creek to the west.

Dense woodland habitat surrounds the Pistol and Skeet Range.

material threat of a future release to the environment.[44]

As an aside, a small wetland borders the capped Butler Landfill on the east side. The Watershed Protection Department (WPD) typically advises that ponded areas should not exist over closed landfills. However, it is unclear why this area has never been proposed for corrective action. What is known is that, based on the 1998 Task 5 Report, the boundary of the fill extends eastward towards the Zilker Zephyr tracks and under the eastern ponded area. As of 2019, when the Zilker Park Working Group completed their report on the park, WPD and PARD were planning to assess this area and consult with the Texas Commission on Environmental Quality to determine if additional action is necessary relative to this pond.[71]

Pistol and Skeet Range

The 2.5-acre Pistol and Skeet Range was originally developed in the 1930s. Based on aerial photographs and interviews with PARD staff, the western portion of the range was used for skeet shooting (Skeet Range), while the east side was used for pistol and rifle shooting (Pistol Range).[44] In the latter area, shooting stations were situated to the southeast with shooting targeted at soil berms to the north.

The range was likely heavily used on a daily basis by the Austin Police Department and citizens between the mid-30s and 70s. Based on historic reports and aerial photographs, the Pistol Range property was used by the Austin Nature & Science Center for archery, equipment storage, and supply storage in portable buildings after the mid-1980s.

Historic and recent soil investigations conducted at the Pistol Range have identified elevated concentrations of arsenic, antimony, and lead at concentrations above applicable PCLs. The Pistol and Skeet Range, including the wooded area to the north, is therefore a REC and until remediated, is not deemed suitable for recreation and/or ecological restoration.[44]

Bone Yard

This area lies atop the northwest corner of the Butler Landfill and is currently used for storage of equipment and landscaping materials such as soil, brush, and gravel. Due to the presence of asphalt, electric powered carts and small vehicles with lead-acid batteries, surplus lawn-maintenance equipment, and chemical containers without cover and/or impervious pavement, this area has a possibility of leaking hazardous substances and/or petroleum products to the environment.[44] This area is not considered a REC, but is an ongoing focus due to these hazardous substances.

Major take-aways that will impact future development include:[15]

- **The Butler Landfill is considered a recognized environmental condition due to the high levels of arsenic, barium, cadmium, chromium, magnesium, lead, iron, and manganese, along with the potential for comingling of groundwater within the landfill with Lady Bird Lake.**
- **The Pistol and Skeet Range, including the wooded area to the north, is considered a recognized environmental condition due to historic and recent soil investigations that have identified elevated concentrations of arsenic, antimony, and lead.**
- **The Bone Yard, while not a recognized environmental condition, has several hazardous materials that could threaten the surrounding environment.**

PART 3
ECOLOGY & SITE CHARACTERISTICS

Zilker Park is an ecological gem, providing habitat for over 600 plants and animals including the endangered Barton Springs and Austin Blind Salamanders. The 350-acre site is in the transition zone between the Edwards Plateau and Blackland Prairie ecoregions, blending aspects of the two. Hydrologically, Zilker Park sits atop the Edwards Aquifer and within the Colorado River corridor (Figure 3.1). The park includes sections of both Barton Creek and Eanes Creek and is home to the iconic Barton Springs. These factors combine to create a beloved, ecologically significant landscape in great need of planning and stewardship. This chapter describes the site's hydrology, topography, geology, soils, plant communities, and wildlife. This information is the foundation of this report's management guidelines and has been prepared to support the Zilker Vision Plan process beginning in 2021.

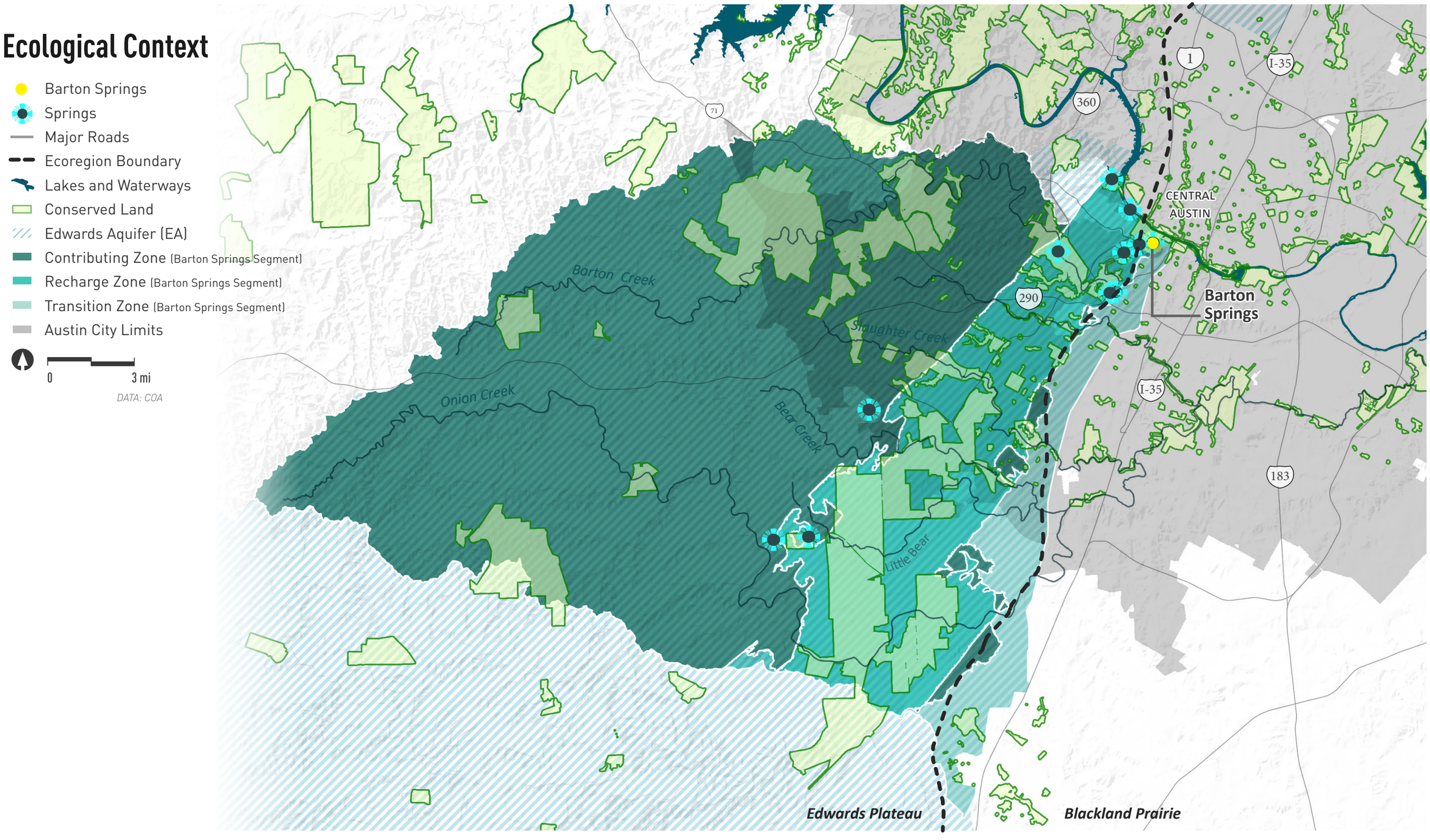


Figure 3.1. *Ecological context of Zilker Park*

WATER RESOURCES AND WATER QUALITY CONCERNS

The ecology of Zilker Park is defined by its waters. Good water quality is a top priority for Barton Springs Conservancy because that water supports the park's endangered salamanders and the park's overall ecological health. Zilker Park faces several critical water quality issues such as controlling and reducing stormwater runoff from impervious cover, reducing the impacts of users on waterways, and protecting the spring areas. These issues can be addressed by adjusting land management practices within the park.

In this section, we describe the water resources of the park including the Edwards Aquifer, major and minor springs, Barton Springs Pool, Barton Creek, Lady Bird Lake, Eanes Creek, the floodplain, and water quality buffers. In each subsection, we relate resources to the ecology of the site and show how water quality concerns can be addressed through land management.

EDWARDS AQUIFER

The Edwards Aquifer lies under the eastern and southern borders of the Hill Country and gives rise to the iconic springs of Central Texas. The Barton Springs segment of the Edwards Aquifer covers 250,000 acres and includes the Barton and Eanes Creek watersheds. The recharge zone is the critical area where water enters the aquifer through cracks and pores in the limestone. The recharge zone covers over 56,000 acres including 321 acres in Zilker Park (Figure 3.1). Water from the recharge zone flows out in the prolific Barton Springs system that feeds Barton Springs Pool and creates habitat for the endangered Austin Blind Salamander and Barton Springs Salamander. Because the limestone—through which water enters the aquifer—does not filter out contaminants, this critical, fast-moving water system is impacted by resource management decisions throughout the contributing and recharge zones. Activities in the park can also impact the recharge zone and areas immediately adjacent to the springs.

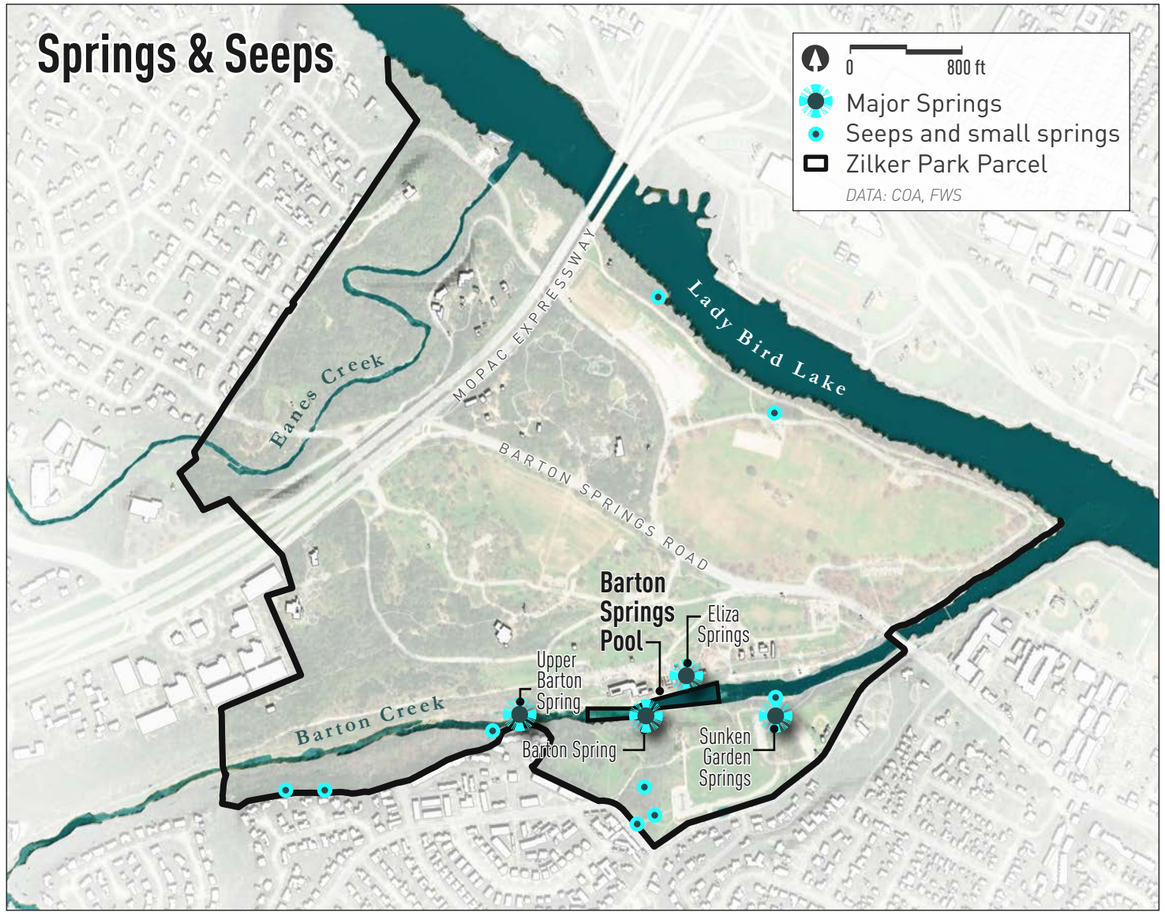


Figure 3.2. *The seeps and springs of Zilker Park with the 4 major springs highlighted*

SPRINGS & SEEPS

Zilker Park contains four major springs—Barton, Eliza, Sunken Gardens (Old Mill), and Upper Barton (Figure 3.2). Each of these major springs is home to endangered salamanders (discussed in detail in the Wildlife Section of this chapter). This 4-spring complex has an average combined discharge of 53 cubic ft per second.[72] Discharge varies substantially from year to year and season to season, ranging from as little as 10 cubic ft per second to as much as 166 cubic ft per second.[72] During the severe 2009 drought, discharge was only 13 cubic ft/second.[32]

Eliza and Old Mill Springs lie at a higher elevation than Barton Creek and are protected from all but the most severe floods, while Upper Barton Springs is in the creek bed. Barton Springs is protected in the pool by a bypass channel, but this channel is overrun during major flood events, allowing floodwaters to enter the pool and reduce water quality.

There are an additional nine seeps and small springs located throughout the park. Seeps are areas where just enough groundwater percolates to the surface to wet the soil, usually without creating flowing water. Many of these seeps and small

springs are clustered south of Barton Creek or near the major springs. Two are located along Lady Bird Lake, with one located within the wetland adjacent to the Butler Landfill. All springs and seeps are impacted by land use in the recharge and contributing zones because water flows through the aquifer quickly with no filtration to remove contaminants. The waters of Zilker Park's major springs are protected through the implementation of the Habitat Conservation Management Plan for the park's endangered salamander species, but issues associated with stormwater and visitor use still impact water quality.

BARTON SPRINGS POOL

Barton Springs Pool had nearly one million visitors in 2018, with rapid growth in attendance expected to continue.[63] The pool is fed by the main Barton Spring, which discharges from fissures in the rocky bottom of the pool, just west of the diving board.[39] Localized water quality concerns for the pool include contamination entering from off-site,[73] Barton Creek floodwaters causing pool contamination,[32,74] gasoline-powered pool cleaners causing contamination,[39] and stagnant water during drought conditions causing algal blooms.[39]

BARTON CREEK

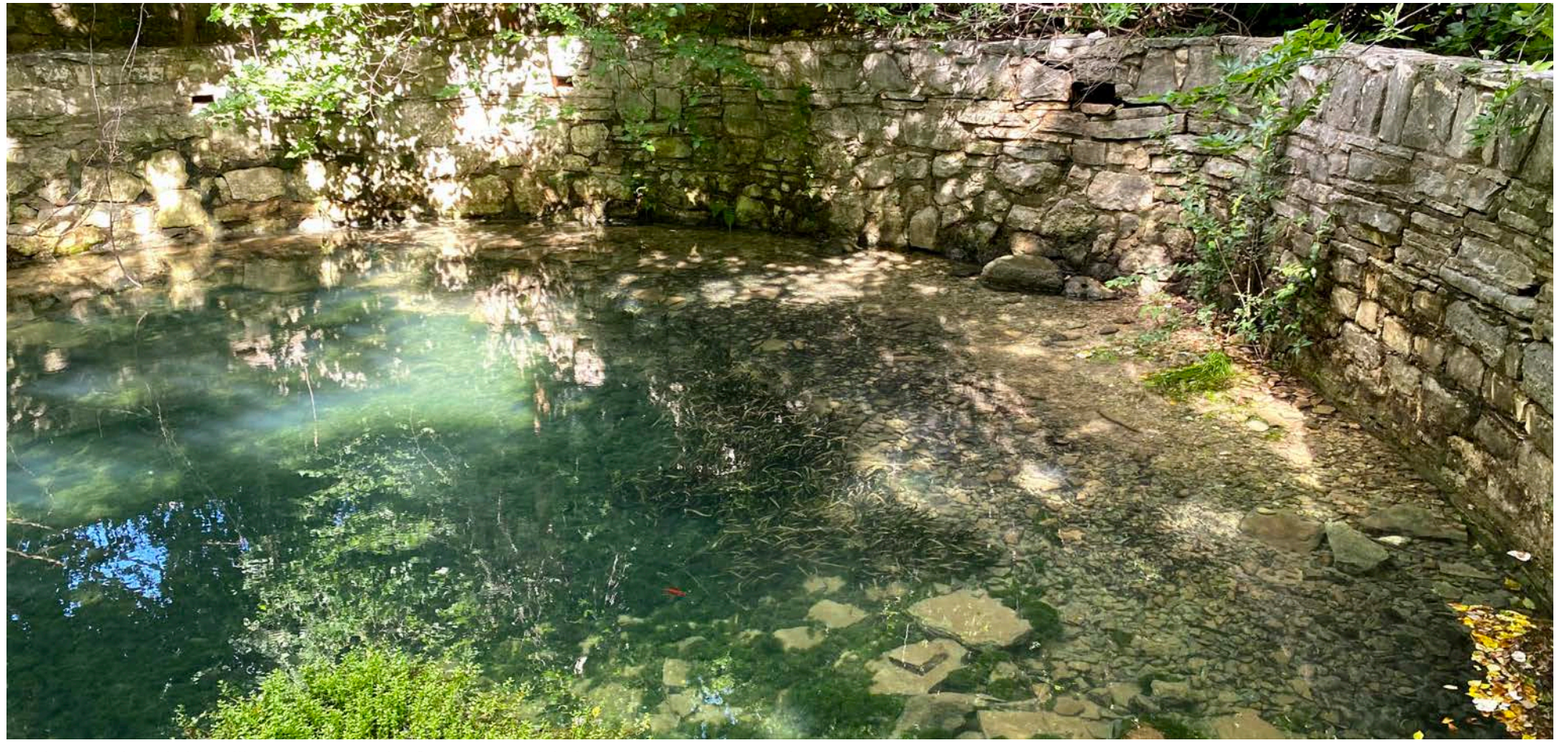
The last mile of the 50-mile-long Barton Creek flows through Zilker Park before it drains into Lady Bird Lake. The creek's watershed includes 118 acres of the study area (Figure 3.3). The creek above the pool (upper creek) has highly variable flows that have an impact on plant and animal habitat. The upper creek typically fills up after high rainfall periods in spring and is dry in the more drought-prone summer and winter months. Below the pool, the creek is fed by the springs, flows from the upper creek, and inundation from Lady Bird Lake, creating year-round flow. Water quality concerns for the creek include stormwater runoff and the resulting contaminants from park infrastructure, informal trails, trash (bottles, cans, wrappers, etc.) from people swimming and boating in the creek, and animal waste entering from the shoreline, and offsite infrastructure.

LADY BIRD LAKE

Zilker Park includes 6,000 linear ft of Lady Bird Lake shoreline. The shoreline's steep banks descend rapidly in some places from the upland Butler Trail to the wetland fringe below. This area has some of the largest trees in Austin. The Colorado River, of which Lady Bird Lake is a 400-acre impoundment, flows from New Mexico to the Gulf Coast and connects Zilker Park to a migratory flyway. There are 169 acres of the study area that drains into Lady Bird Lake (Figure 3.3). Water quality concerns here include substantial stormwater runoff around Mopac, bank erosion along all of the Butler Trail, and trampling and compaction along the water's edge.

EANES CREEK

Eanes Creek is a 6-mile-long creek that runs through the Zilker Nature Preserve for 4,500 linear ft before it empties into Lady Bird Lake. There are 115 acres of the study area that drain into it (Figure 3.3). The portion of Eanes Creek in Zilker Park is dry much of the year, giving it the nickname Dry Creek. Although the Zilker Nature Preserve and Austin Nature & Science Center are some of the least disturbed areas of Zilker Park, Eanes Creek is impacted by issues outside the park. Extensive new development just outside the park has created high flows that have channelized the creek, while runoff from Mopac degrades the quality and quantity of flow into the creek. Water quality concerns here include flows draining from the Disc Golf Course and bank erosion near Stratford Drive.



Sunken Gardens (Old Mill) Springs is south of Barton Creek below Barton Springs Pool.

FLOODPLAINS AND WATER QUALITY BUFFERS

A floodplain is an area along a waterway that is prone to flooding. According to the Interim Atlas 14 floodplain from the City of Austin, 75.5 acres (18%) of Zilker Park are included in the 25-year floodplain. An additional 31.1 acres (8%) are included in the 100-year floodplain (Figure 3.3). Since the lower Barton Creek 100-year floodplain has not been modeled under Atlas 14, likely additional floodplain is marked with a dotted line. The floodplain is highly regulated by City of Austin building code and any potential floodplain modifications should comply with these regulations.

Floodplains play an important role in regulating water quality, because they filter water through their soils. The extra moisture creates denser plant growth, providing important wildlife habitat. Floodplains can be harmed by trampling and high runoff during storms that erode soil and wash away plants. At Zilker Park, both problems are visible, especially along Barton Creek where visitors compact creekbank soils in search of water access.

Barton Creek is intermittent in areas of the park

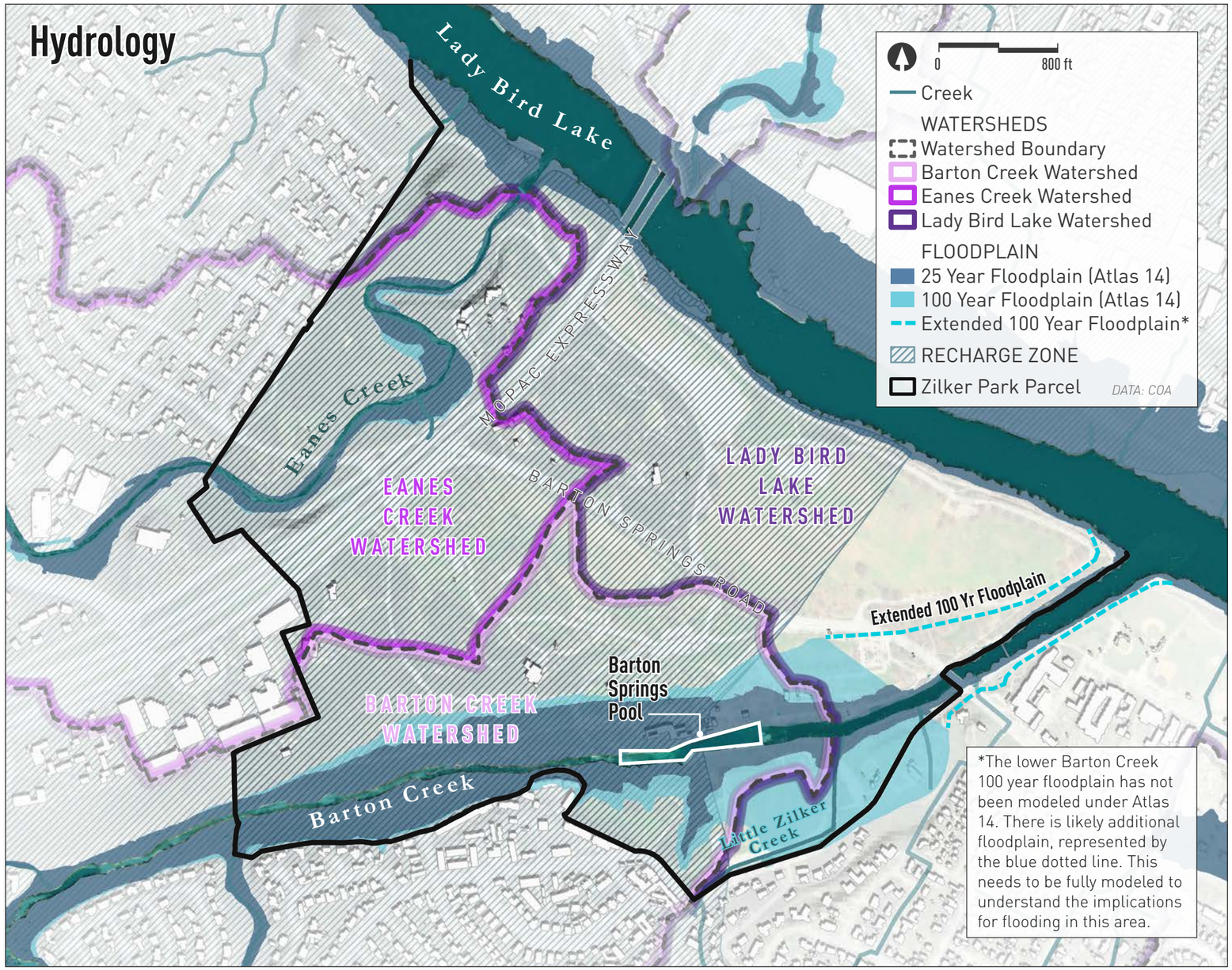


Figure 3.3. *Hydrology of Zilker Park*

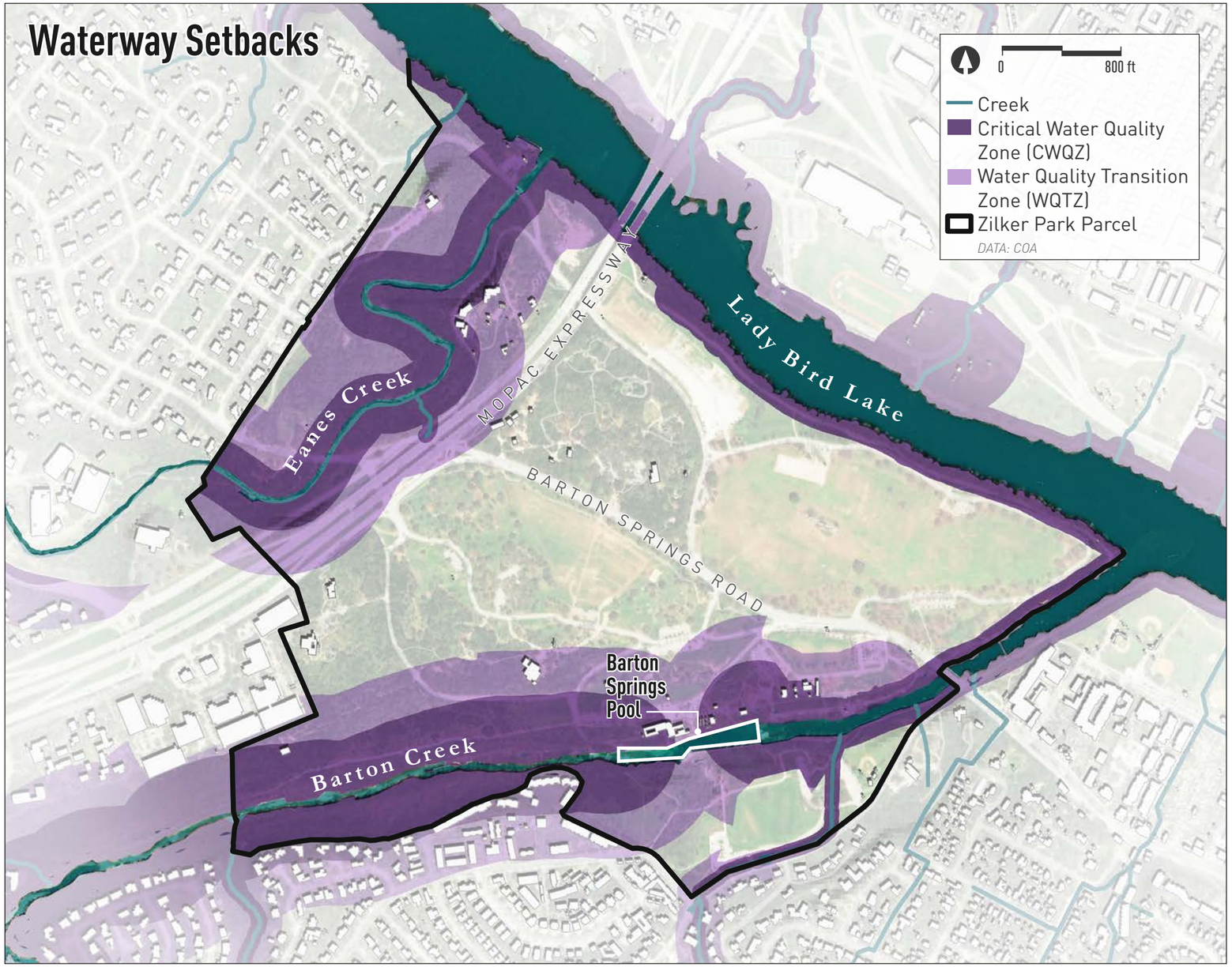


Figure 3.4. *Waterway setbacks of Zilker Park*

Critical Water Quality Zones and Water Quality Transition Zones restrict land use near waterways to protect healthy riparian corridors. Critical Water Quality Zones extend for 200, 400, and 100 ft from Eanes Creek, Barton Creek, and Lady Bird Lake, respectively. Water Quality Transition Zones extend an additional 300 ft from both Eanes Creek and Barton Creek (Figure 3.4). In Critical Water Quality Zones, City of Austin building code prohibits development, except for fencing, open space, docks, detention basins, trails, and wet ponds.[75] Most of the Water Quality Transition Zones in Zilker Park have the same restrictions because they are in the recharge zone. The Water Quality Transition Zones around the Rugby Fields are outside of the recharge zone. They are in the "Water Supply Suburban" watershed protection zone, which allows minor drainage facilities, water quality controls, and up to 18% impervious cover.[76] The Barton Creek Critical Water Quality Zone looks odd at the pool because the base flow from the creek flows through the bypass tunnel around the pool. Therefore, the creek is underground at that point and not subject to Critical Water Quality Zone restrictions.

Much of the existing park infrastructure would not be allowed to be built today based on current floodplain and water quality regulations. Reducing impervious cover in the floodplain and in water quality buffers is one of the best ways to increase water quality and the ecological health of Zilker Park.

TOPOGRAPHY

The topography of Zilker Park varies from low-lying lands near waterways to steep cliffs carved by creeks (Figure 3.5). The lowest elevations in the park are along the Lady Bird Lake shoreline which, due to damming, stay near 428 ft elevation. The highest points in the study area are over 550 ft, with the highest point at 562 ft elevation. These areas are located upslope of a major bend on the west side of Eanes Creek—with Lookout Point lying near the high point of 562 ft and the Zilker Park Clubhouse lying near 554 ft. On the other side of Mopac, the McBeth Recreation Center lies close to the 554 ft elevation point. Changes in topography (slope) are most substantial west of Mopac, along the lakeshore, and along Barton Creek. In contrast, the Great Lawn, Disc Golf Course, and Polo Fields are comparatively flat.

The topography of the site affects its current condition in numerous ways. Generally, within parks, steep slopes contain the most intact woodlands yet are more prone to erosion. Flat areas accessible to lawnmowers tend to be regularly mowed. While the elevation gain throughout the site is relatively small, high points do allow for a greater variety of views of Lady Bird Lake, the urban forest canopy, and the Austin skyline.

View of downtown Austin from the Zilker Park lookout point located just south of the Zilker Clubhouse.

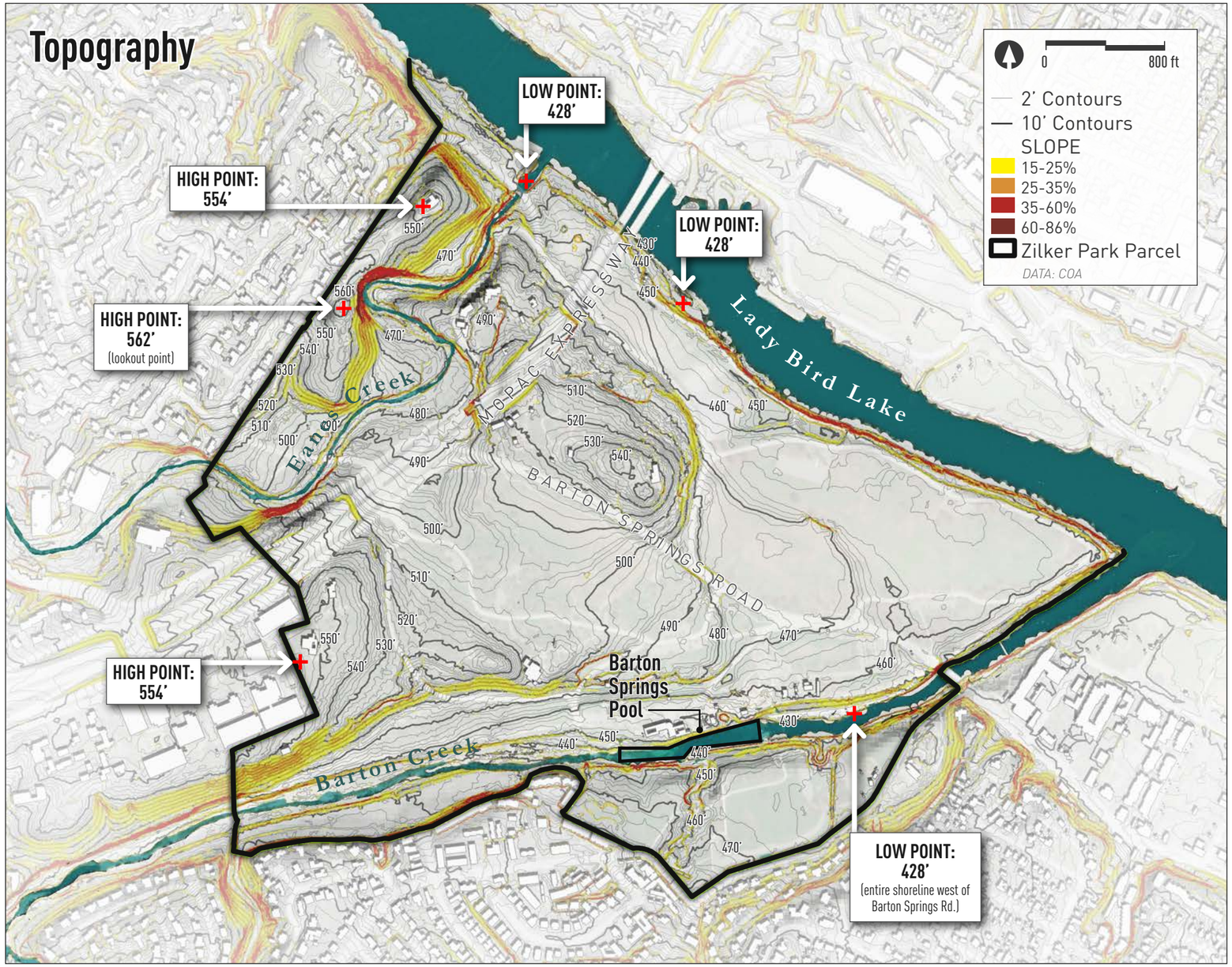


Figure 3.5. *Topography of Zilker Park*

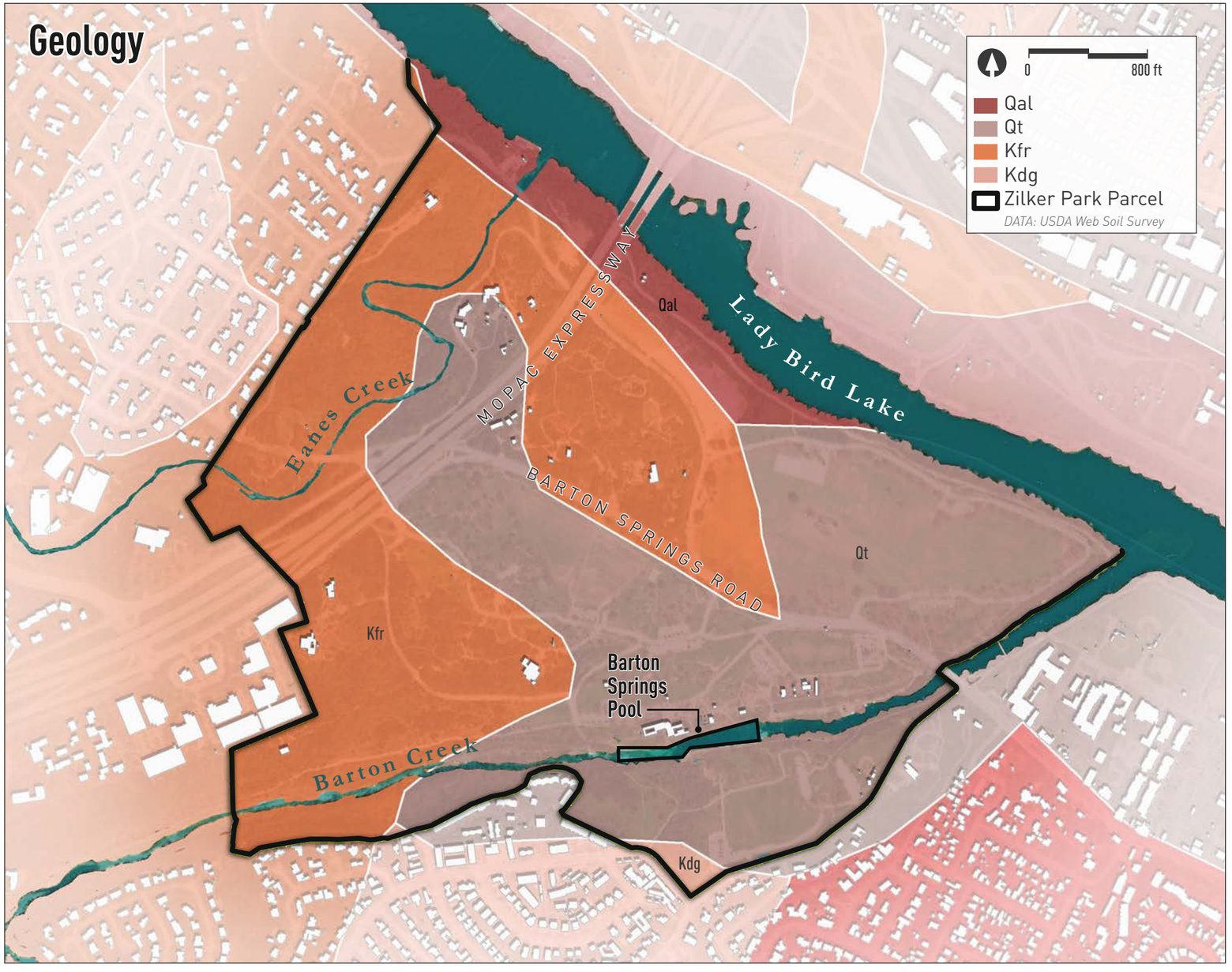


Figure 3.6. *Geology of Zilker Park*

GEOLOGY

The geology of Zilker Park is a combination of Hill Country limestone and influences from the Blackland Prairie, shaped by water that cuts through rock and sediment to expose different types of bedrock.

Four bedrock types underlie Zilker Park (Figure 3.6):

- Quaternary Alluvium (Qal)
- Fluviatile Terrace Deposits (Qt)
- Fredericksburg Group (Kfr)
- Del Rio Clay and Georgetown Limestone (Kdg)

The alluvium deposits of the Qal and Qt layers (6% and 48% of the park, respectively) underlie areas along Lady Bird Lake, much of Barton Creek, and the low-lying portions of the park. Alluvium deposits are materials brought by the Colorado River over millions of years. They are highly variable with some areas dominated by sand and others by loamy clay or gravel.

The Fredericksburg Group comprises the upland forested areas of Zilker Park, accounting for approximately 45% of the site. It is the underlying geologic layer that creates the “Balcones” rock formations described by Spanish settlers for its similarity to balconies and is made of Edwards Limestone, Bee Cave Marl, and Comanche Limestone. This group is known for its karst features (caves and sinkholes), although none have been found on the property. The limestone underlaying Zilker Park serves as the conduit by which aquifer water from the entire Barton Springs segment of the Edwards Aquifer reach the four major springs. In addition, it serves as the framework for both the surface and subterranean endangered species habitat.

Del Rio Clay and Georgetown Limestone cover less than 1% of the site and is comprised of clay and beds of limestone with marl. This bedrock type is characteristic of the Edwards Aquifer confined (or artesian) zone and contributes to the pressure in artesian springs.

SOILS

Soil is the living, breathing foundation of an ecosystem. Healthy soils provide ecological services like water absorption, filtration, and retention; decomposition of organic matter and nutrient cycling; and carbon sequestration and storage. The ability of a soil to provide these services is determined by the soil's physical characteristics, the community of microorganisms living in the soil (the "microbial" community), and the soil's history.

Soil particles are sorted by size from clay to silt to sand (smallest to largest). Different proportions of silt, clay and sand produce different soil characteristics, ranging from loose sands to hard clays. Soils also contain organic matter. Organic matter is added to soils as living organisms decompose and can be removed by erosion or plowing. Soils with more organic matter hold more carbon and absorb more water.

The microbial community includes all the microscopic species living in the soil (fungi, bacteria and even viruses). Soil microbes break down organic matter and make nutrients available to plants. Uncompacted soils with large spaces between the soil particles support an aerobic microbial community. Soils with low oxygen levels host anaerobic communities. Low oxygen can be caused by compaction but is most common in wet soils along rivers or in wetlands.

The final influence on soils is their history. Soils can be disturbed by natural forces like flooding that washes away soil or adds new soil. Erosion during rain or by human activities can remove soil from a site. High human use (trampling or driving) can compact soils, reducing pore space and making it more difficult for plants and microbes to live in the soil. Finally, humans can disturb soils by digging, plowing, or construction. Exposing soils to the air speeds up the decomposition of organic matter, reducing how much water and carbon they can hold.

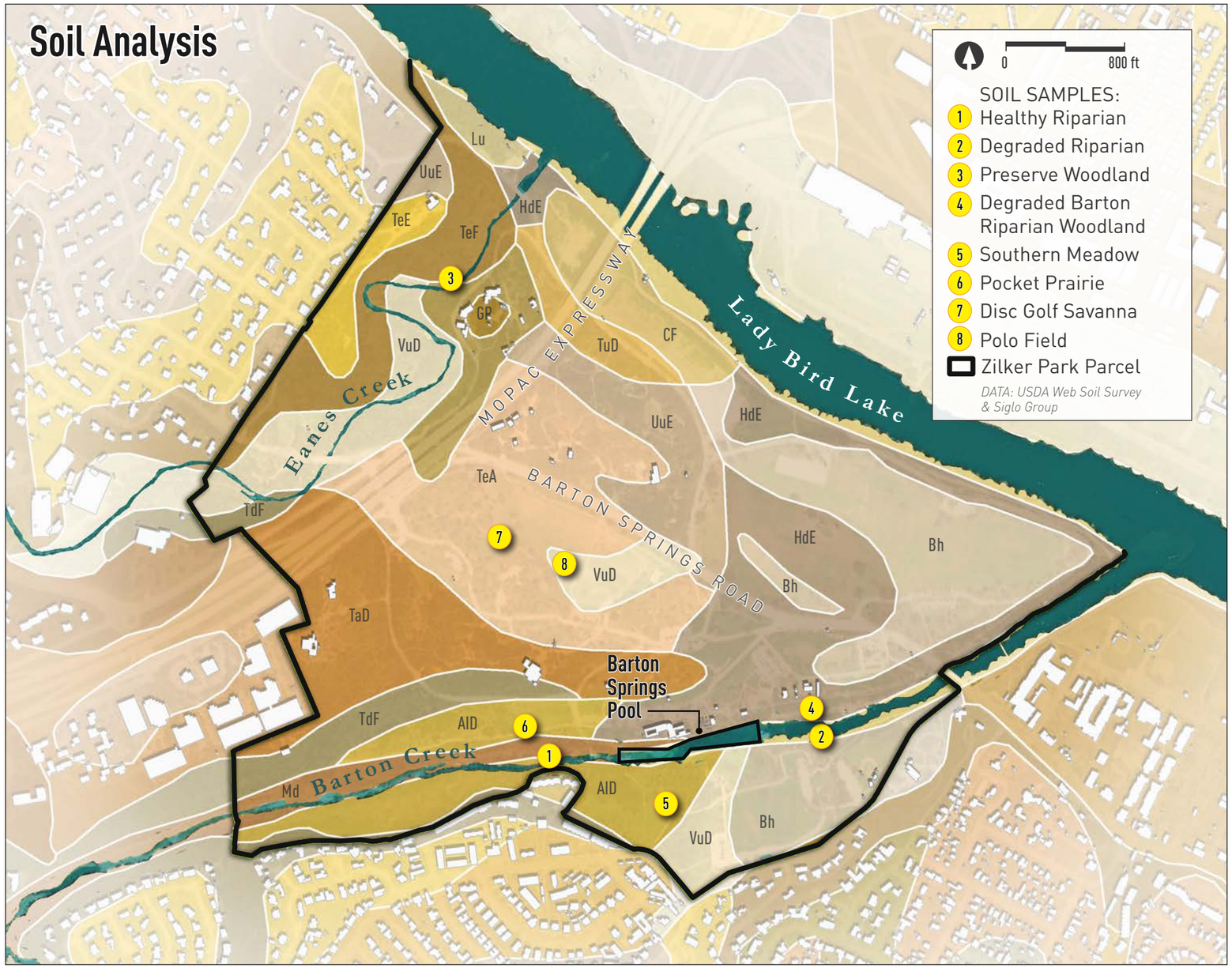


Figure 3.7. *Soil Analysis of Zilker Park*

SOIL TYPES

Zilker Park includes 13 soil types (Figure 3.7). These soils have been heavily impacted by agriculture and urbanization over the past 150 years as well as ecological changes in climate and topography. Their composition, nutrient levels, organic material, and health give direction on what may grow in areas, and what needs to occur to restore native plant communities. The 13 soil types include:

- Tarrant Series (TeE, TeF, TeA, TdF, TaD, and TuD; 27%) – These are shallow clay soils over limestone with rocks covering 25-85% of the surface. Tarrant soils developed under tallgrass savanna. They are found on the highest elevation points on the property.
- Bergstrom Soils and Urban Land (Bh, 14%) – These are very deep soils found in bottomlands and stream terraces. Bergstrom soils developed under riparian forest and tall grass. They underlie the Great Lawn and the land south of Barton Creek downstream from the pool.
- Altoga Soils and Urban Land (AlD, 7%) – These are very deep silty clays, found on risers between stream terraces. They border both sides of Barton Creek upstream of Barton Springs Pool. Altoga soils developed under tallgrass prairies with scattered trees but at Zilker these soils are currently occupied by riparian woodland.
- Volente Soils and Urban Land (VuD, 8%) – These are deep clay soils, found on stream terraces. At Zilker, they are found along low-lying areas adjacent to Barton and Eanes Creeks. Volente soils developed under tallgrass prairies with scattered trees but at Zilker these soils are currently under riparian woodland.
- Hardeman Soils and Urban land (HdE, 14%) – These are deep sandy loam soils, found on the sloped risers of stream terraces. This soil type underlies much of the park's infrastructure including Barton Springs Pool, the Zilker Zephyr, Zilker Caretaker Cottage and Park Ranger Headquarters, and Zilker Park Boat Rentals, as well as Rock Island. Hardeman soils developed under prairies.
- Lincoln Soils and Urban Land (Lu, 1%) – These are loamy fine sands, found along creeks. At Zilker, they are only found in the northernmost corner along Lady Bird Lake. Lincoln soils can support prairies, savanna, or riparian woodland. Because the soils are sandy, they drain quickly after flooding.
- Mixed Alluvial Land (Md, 2%) – These are gravelly sands found in floodplains. At Zilker, they are found in the creek bed and creek banks upstream of the pool. These soils can support grassland or riparian forest. Although they flood frequently, the soils drain quickly.
- Poorly Graded Gravel (GP, 0.3%) – These soils are defined by their lack of variability in particle size and underlie the Austin Nature & Science Center.
- Urban Land (UuE, 5%) – This soil underlies the Zilker Botanical Garden.
- Cut and Fill Land (CF, 3%) – This soil type consists of areas that have been altered by construction. Cut and fill generally refers to a type of construction where the amount of soil excavated for a project roughly equals the amount needed to form embankments near the site. These underlie the Butler Landfill and Bone Yard.

SOIL ANALYSIS

Soils were analyzed to understand their current condition. The analyses evaluated nutrient content, percent organic matter, texture, compaction, and microbial populations. Soil microbial communities were analyzed for biodiversity, variability, anaerobic activity, and average fungal diameter. Eight sites were selected for evaluation based on their current vegetation: two riparian sites, two meadow sites, two woodland sites, the Disc Golf Savanna, and the

Microorganisms in the soil serve as a metric for soil health and ability to support healthy plant communities.

Polo Field (Figure 7). It should be noted that there is a connection between anaerobic characteristics and compaction/land use. When heavy machinery or foot traffic occurs on a soil, it compresses the soil, leading to less pore space. This smaller pore space means less oxygen and water can infiltrate the soil, making for anaerobic conditions.

RIPARIAN

The Riparian site upstream from the pool (Healthy Riparian) had clay loam soil with 6.3% organic matter. No anaerobic activity was detected. The microbial populations were diverse but variable, suggesting variability in vegetation types and/or fluctuations in soil moisture. Fungal populations appeared to be largely beneficial. The soil had a compaction depth of 11 inches, meaning the soil is deeper and less compacted than all but one of the other sample sites.

The Riparian site downstream from the pool (Degraded Riparian) had a desirable loam texture and a healthy 6% organic matter content but had relatively low nutrient levels. Anaerobic activity was detected by the presence of ciliates and anaerobic bacteria and fewer beneficial fungi were found. The compaction depth was a shallow 2.9 inches. Foot traffic is one likely source contributing to compaction in this soil. With the loam texture and high organic matter, this soil has great potential to be restored and support healthy vegetation.

WOODLANDS

The Preserve Woodland site had loam soils with a high 15.9% organic matter. This high organic content was the highest measured in the sampling areas. The microbiome at this site was also quite diverse and consistent, and no anaerobic activity was detected. Fungal populations appeared to be beneficial and had low variability. Soils were uncompacted.

The Degraded Barton Riparian Woodland site was notably sandier than other areas sampled. The presence of ciliates indicates a tendency for this area to become anaerobic. The soil did not show signs of heavy compaction despite being close to a highly visited trail at the water's edge. This is likely due to the high sand content, as the sand grains are larger and maintain larger pore space. While the site is current dominated by Ligustrum, the soil analysis indicates a high potential for restoration.

MEADOWS

The large meadow south of the pool (Southern Meadow), as well as a pocket prairie along the Violet Crown Trail, were evaluated. Both had sandy clay loam texture and relatively low amounts of nitrogen, phosphorus, and potassium. Organic matter was low in both sites (4% in the southern meadow and 5% in the pocket prairie). This is low relative to the other sampled areas in Zilker Park, but higher than most urban soils. While there was no indication of anaerobic activity in either meadow site, the pocket prairie site had more beneficial microbial activity. The Southern Meadow had a shallow 3.8-inch average depth, while the pocket prairie had 6.2 inches and more fungi present, reflective of the plant diversity found there.

DISC GOLF SAVANNA

The Disc Golf Savanna has a good framework of structure, organic matter, and microbiology. The structure is a silty clay loam and has 4.2% organic matter. The levels of plant-available nutrients here and in the Polo Field are substantially higher than other sample sites, suggesting this area has been fertilized. There was no indication of anaerobic activity, and populations of fungi here were found to be beneficial and consistent, which may be due to the minimal mechanical disturbance of the root zone in this area. The areas that are less traveled between the mowed paths have great potential to contribute more to ecological services like carbon drawdown and water infiltration.

POLO FIELD

The Polo Field soils are silty clay loam with 5.4 % organic matter. As with the Disc Golf Savanna, high plant-available nutrients suggest the application of fertilizers. The presence of ciliates and anaerobic bacteria suggest a consistent anaerobic environment. Soil compaction depth is 5 inches, likely due to intense intermittent land use as a parking lot during large events.

Soil samples were collected as part of a soil analysis for the assessment.

URBAN FOREST AND PLANT COMMUNITIES

PLANT COMMUNITIES

Zilker Park's habitats were grouped in 16 plant communities (Figure 3.8). The plant communities are influenced by the soil and geology described above, as well as the history of human influence. These plant communities include over 380 plant species (Table 3.1) and are described in more detail below.

SPRING (0.3 ACRES, 0.1% OF PARK)

The spring plant community includes the waters and land immediately surrounding Upper Barton, Eliza, and Sunken Gardens (Old Mill) Springs. The areas immediately surrounding Eliza and Old Mill Springs have been heavily altered, with concrete retaining walls, rock walls, and planted species. The aquatic vegetation in the springs is often thinned to benefit the salamanders.

This plant community has 25 native plant species and 4 invasives. There are also 3 obligate wetland plant species present, along with 3 facultative wetland plants. The spring's waters are home to aquatic species like eelgrass, Bacopa, and macro algae, while numerous natives are present above water.

In Eliza Springs, non-aquatic species include Lindheimer's muhly, eastern gamagrass, swamp milkweed, and Maximillian sunflower. In Sunken Gardens (Old Mill), the area is mostly unmanaged with overgrown hackberry, mustang grape, and poison ivy.

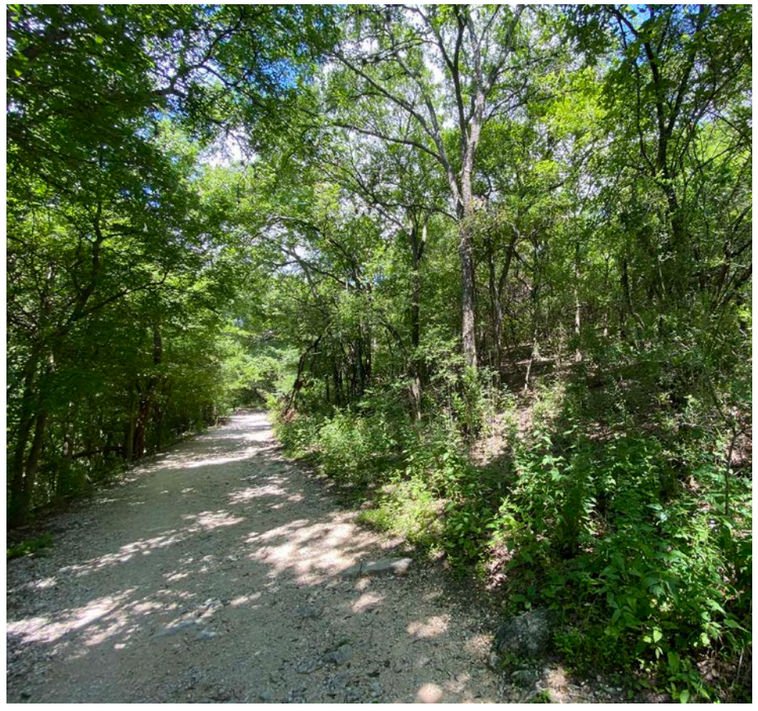
No invasive species were documented in the springs' waters. However, Bermudagrass, hedge parsley, Johnsongrass, and perennial ryegrass were found in the adjacent terrestrial areas.

Figure 3.8. *Plant communities*

OAK/JUNIPER/ELM WOODLAND (114.6 ACRES, 28.4% OF PARK)

Oak-juniper woodlands are characteristic of the Texas Hill Country. At Zilker Park, this plant community is found throughout most of the Zilker Nature Preserve, as well as in the Austin Nature & Science Center, informal areas of the Zilker Botanical Garden, surrounding the Violet Crown Trail and upper Barton Creek, and in the southwestern portions of the park. This plant community has 173 native plant species and 34 invasives and exotics. There are also 7 facultative wetland plants.

Overstory species include live oak, cedar elm, and Ashe juniper. The understory includes younger individuals of the overstory species along with hackberry and Durand oak. Shrub species include Texas hog plum, hop-tree, agarita, Brazilian bluewood, mouse's ear, Mexican buckeye, Texas Persimmon, red buckeye, mountain laurel, and elbowbush. Herbaceous plants in the understory include grasses (especially Canada wild-rye, Cherokee sedge, and inland seaoats) and forbs (especially white boneset, bush croton, and fall golden-eye). Vines like mustang grape, Virginia creeper, Carolina snailseed, and greenbriar are common along woodland edges, with oneseed bur cucumber vine found in the preserve.



Oak/Juniper/Elm Woodland in Zilker Park

The woodland varies in species diversity and in age structure based on former clearing, recent land use, and soil type. For example, clearing can be seen in the 1940 and 1984 aerials (Figures 2.2 and 2.3) in the area south of Columbus Drive and the road to the Girl Scout Hut; that area still has smaller plants and lower diversity today. Along the Violet Crown Trail and in the Zilker Nature Preserve, some areas include a diversity of tree sizes, age classes, and species. On southeastern facing slopes in both the Zilker Nature Preserve and along the Violet Crown Trail, groves of mountain laurel and Texas persimmon occur on pockets of shallow soils. Adding to the diversity of the community are small, scattered pockets of weedy open meadows. The noticeable ecological health of the Zilker Nature Preserve may be due in part to Louis René Barrera's work as caretaker of the City of Austin's 2,200 acres of nature preserves.

Non-native, invasive species include Ligustrum, Nandina, and Japanese honeysuckle. Chinese pistache is found in the Disc Golf Course and a Chinese parasol tree was noted in the Zilker Nature Preserve, near the entrance across from the boat dock. King Ranch bluestem and Johnsongrass are less common but found in open areas.

BARTON RIPARIAN WOODLAND (9 ACRES, 2.2% OF PARK)

Extending from Barton Springs Pool upstream along the creek, this woodland includes the floodplain and upper bank of Barton Creek. Its plants are inundated during floods and, in lower areas, they may stay underwater for months. The woodland has diverse canopy, understory, and herbaceous layers. This plant community has 78 native plant species and 15 invasive and exotic species. There are also 10 facultative wetland plants, but most plants on the slopes are in dry soils.

The overstory includes live oak, American elm, black willow, and pecan, with an understory of vines such as mustang grape, poison ivy, and Virginia creeper. Roughleaf dogwoods are often present in the understory, as are hop-tree, fragrant sumac, flame leaf sumac, silk tassel, and agarita along the upper edges. The herbaceous layer consists of a mixture of grasses, including Canada wild-rye, inland seaoats, and switchgrass in the more open areas. Common wildflowers include frostweed, fall golden-eye, fall aster, and American germander.

Non-native, invasive species are found throughout the area, with Chinese tallow and Arundo being especially common. Woody plants like Nandina and Ligustrum are found occasionally. Herbaceous invasives include Johnsongrass and King Ranch bluestem.

INTERMITTENT CREEKBED (3.2 ACRES, 0.8% OF PARK)

The Intermittent Creekbed upstream of Barton Spring Pool includes pools, channels, and low water areas where the water flows through vegetation. Diversity is generally low in this plant community, with only 35 native species and 7 invasives recorded during plant surveys. Additionally, 2 obligate and 6 facultative wetland plant species were found.

Many plants in this community are characteristic of wetlands. Common canopy species include American elm, sycamore, Texas ash, black willow, and cottonwood. Understory species include roughleaf dogwood and false indigo-bush. Herbaceous species include American water willow, baby jump up, water starwort, switchgrass, limewater brookweed, spike sedge, western umbrella-sedge, and bushy bluestem. Maidenhair fern occurs often on the shaded south bank.

Maindenhair fern in Eanes Creek

Non-native, invasive species include Arundo—found in dense stands—along with Ligustrum, Chinese tallow, and Johnsongrass.

EANES CREEK RIPARIAN WOODLAND (12.3 ACRES, 3.1% OF PARK)

This woodland lies on both sides of Eanes Creek. Variability in moisture within this mostly dry creek affects the diversity and abundance of plants. This plant community has 121 native plant species and 19 invasives. There are no obligate wetland plant species present, but the area is home to 10 facultative wetland species. This community has 65% more species than the Barton Creek Riparian Woodland, likely a result of less human impact and the work of Louis René Barrera.

Cottonwoods, juniper, pecans, and oaks dominate the overstory, with hackberry and Carolina cherry laurel found throughout. A diverse understory adjacent to the creek includes Mexican plum, Eve's necklace, mountain laurel, evergreen and fragrant sumac, mesquite, Texas hogwood, Brazilian bluewood, and mouse's ear. Of these, mouse's ear, Brazilian bluewood, Texas hogwood, and mesquite also occur farther upslope. The herbaceous layer is limited in the shade but abundant in open areas. Wildflowers include prairie coneflower, firewheel, wild petunia, and yellow passionflower. Grasses include inland seaoats, sideoats grama, Canada wild-rye, and Texas wintergrass. Greenbriar, mustang grape, Virginia creeper, and Carolina snailseed are the most common vines. Cherokee sedge, Alabama lip-fern, and large colonies of maidenhair fern are common along the bordering steep limestone cliffs.

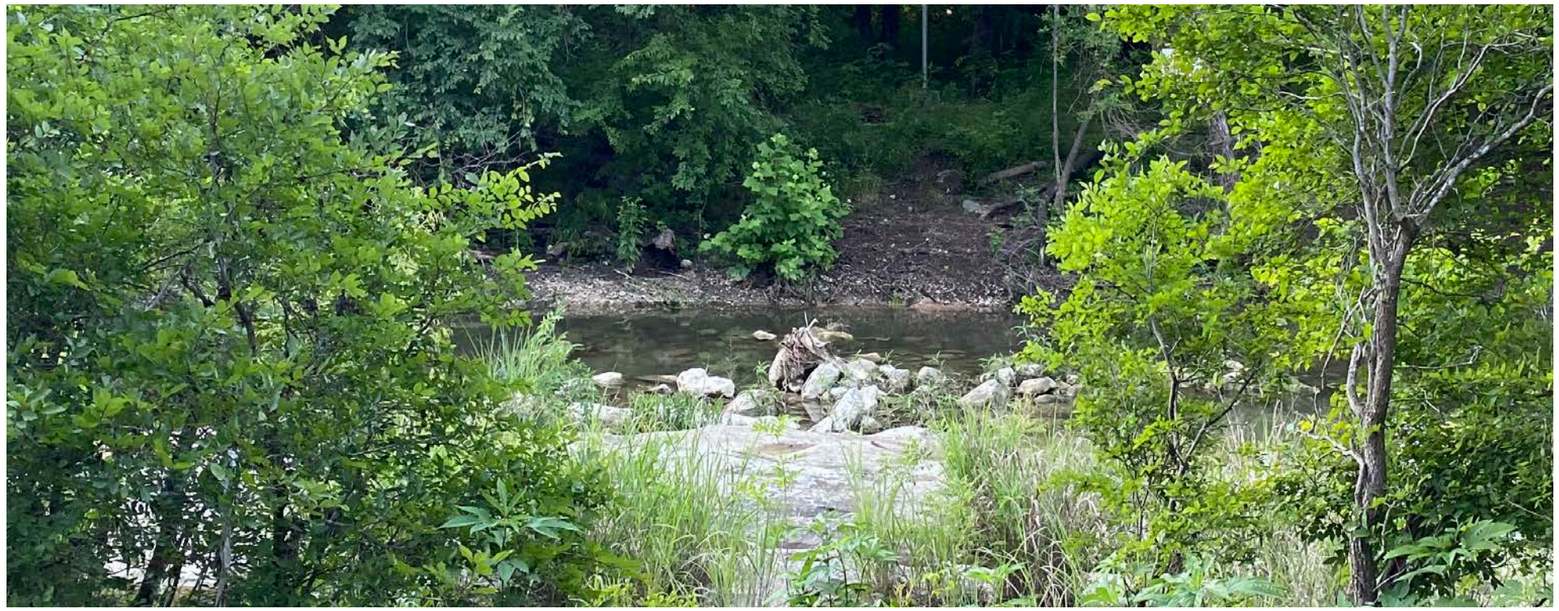
Non-native, invasive plants are found throughout this area, spread by the floods. Common invasives include Ligustrum, Nandina, Chinaberry, and Japanese honeysuckle.

DEGRADED BARTON RIPARIAN WOODLAND (5.6 ACRES, 1.4% OF PARK)

This woodland lies on the sloped hillsides around Barton Creek, downstream of the pool. This plant community has 64 native plant species and 20 invasive and exotic species. It also has 1 obligate wetland plant species, along with 2 facultative wetland species.

The overstory is dominated by American elm, hackberry, and large pecans. The understory on the northwestern slopes is dominated by hackberry and on the southeastern slopes by Ligustrum with occasional roughleaf dogwood, Carolina buckthorn, and red buckeye. Inland sea oats, Canada wild-rye, bedstraw, spiderworts, and Turk's cap are common in the herbaceous layer. Vines include mustang grape, Virginia creeper, poison ivy, and Carolina snailseed.

Non-native, invasive woody species include Ligustrum, Chinese tallow, and Nandina.



Barton Wooded Shoreline in Zilker Park

Aquatic systems in Zilker Park

DEGRADED BARTON CREEK SHORELINE (2.6 ACRES, 0.6% OF PARK)

The community is a thin strip of vegetation between the trail and the creek downstream of Barton Springs Pool. While this could be one of the most robust plant communities in the study area, overuse and upslope stormwater outfalls have degraded the vegetation. This plant community has 50 native plant species and 15 invasive and exotic species. It also has 3 obligate wetland plant species present, along with 6 facultative wetland plants.

Black willow, cottonwood, box elder, and bald cypress are common along the water's edge with the occasional horsetail reed and river fern along the bank. Non-native, invasive species including Ligustrum, Chinese tallow, Johnsongrass, and Nandina, along with substantial stands of Arundo.

AQUATIC – BARTON SPRINGS POOL AND PERMANENT WATER (5 ACRES, 1.3% OF PARK)

The permanent waters of Zilker Park include Barton Springs and extend from the Pool spillway through Barton Creek and into Lady Bird Lake. It does not include bank species. Only two plant species—Cabomba (*Cabomba caroliniana*) and Arrowroot (*Sagittaria platyphylla*)—were found within the pool itself. Both are obligate wetland species. Because this artificial pool is often cleaned and used heavily, it has very little native aquatic vegetation. In similar spring-fed limestone pools along perennial creeks, aquatic plants such as eelgrass, pondweed, hornwort, and floating primrose would likely be present.

The spillway waters contain a mixture of Cabomba, Arrowroot, and macro algae also. Much of the rest of the permanent water lacks aquatic vegetation, with only Cabomba being present.

LAKESHORE RIPARIAN WOODLAND (15.7 ACRES, 3.9% OF PARK)

This woodland extends from the water's edge of Lady Bird Lake to the top of the floodplain slope and ranges in width from 40 ft with very steep slopes to 250 ft with a more moderate slope. This community is one of the most used recreational areas in Austin because of its location along the Butler Trail and next to the Great Lawn. It also includes 4 of the largest 10 trees in Austin, because it is one of the few areas along Lady Bird Lake that appears not to have been cleared in the last 100 years. This plant community has 89 native plant species and 25 invasive and exotic species. It also has 2 obligate wetland plant species present, along with 6 facultative wetland species.

The canopy includes large bald cypress, pecans, sycamore, American elm, cottonwood, and green ash. The understory is less dense and lacks younger trees but includes hop-tree, gum bumelia,

false indigo-bush, and red buckeye, with Carolina cherry laurel dominant in some areas. The herbaceous layer includes Virginia and Canada wild-rye, inland seaoats, Turk's cap, and a variety of wildflowers. Vines growing along the edge of these woodlands include poison ivy, Virginia creeper, mustang grape, Carolina snailseed, and purple leather flower.

Non-native, invasive species are common throughout this area. Woody species include Ligustrum, Nandina, Chinaberry, and Chinese tallow. A single Chinese parasol tree was found near the boat dock. Vines include sweet autumn clematis, Japanese honeysuckle, catclaw vine (around Mopac). In open areas, herbaceous species include Johnsongrass, Bermudagrass, hedge parsley, and bastard cabbage.

WETLAND (1.9 ACRES, 0.5% OF PARK)

The wetland lies at the junction of the Butler Landfill, Butler Trail, and Lou Neff Road. This area was created to collect water from surrounding areas before it runs into the Lake. It includes a small spring/seep (Figure 3.2). This plant community has 38 native plant species and 10 invasive and exotic species. It has no obligate wetland species and 1 facultative wetland species.

Higher area is dominated by Bermudagrass. Whereas the slopes are vegetated with a variety of trees like desert willow, cedar elm, white mulberry, green ash, and live oak. Densely shrubby areas are home to mustang grape, Virginia creeper, marine ivy, and greenbriar. In sunny areas, grasses and wildflowers like Virginia wild-rye, paspalum, prairie coneflower, fall aster, pink evening primrose, and southern wood-sorrel are abundant.

Non-native, invasive species include rescue grass, prickly lettuce, Bermudagrass, Ligustrum, Chinaberry, white mulberry, Johnsongrass, hedge parsley, and Brazilian vervain.

OPEN MEADOW (7 ACRES, 1.7% OF PARK)

Open meadows are found at the Violet Crown Trailhead and near the southern entrances. This plant community has 46 native plant species and 12 invasive and exotic species. It also has 1 facultative wetland species.

These open meadows are home to a variety of wildflowers such as lemon beebalm, prairie coneflower, firewheel, and Engelmann's daisy. Native grasses are less abundant but include Canada wild-rye, Texas wintergrass, silver bluestem, and little bluestem.

Non-native, invasive grasses include the perennials Johnsongrass, King Ranch bluestem, and Bermudagrass, as well as annuals such as Japanese brome and rescue grass. The stands of invasive grasses are maintained by low and frequent mowing. This mowing regime reduces the opportunity for native grasses and forbs to flower and seed. The mowing has also created good growing conditions for Japanese brome, a cool-season annual that creates a thick thatch layer that smothers out natives.

FORMAL AREAS (225.7 ACRES, 56% OF PARK)

Formal areas of Zilker Park include the Disc Golf Course, Zilker Botanical Garden, Austin Nature & Science Center, Maintained Parkland and Infrastructure, and rights-of-way. These consist of large open areas and a variety of buildings, playground, and other park infrastructure used for recreation and upkeep. These plant communities collectively are home to 203 native plant species and 65 invasive and exotic species. They also have 3 obligate wetland species and 11 facultative wetland species.

These areas have abundant live oak, Texas oak, Texas persimmon, and Ashe Juniper canopy trees with shrub species like agarita, mountain laurel, and yaupon. The maintained parkland includes a variety of trees—primarily pecan, live oak, and other species of oak—and planted shrubs along margins and roadways. Native grasses have low cover, aside from carpet grass, which is maintained in the Maintained Parkland areas around Barton Springs Pool. Open, grassy lawn areas are often mowed to just a few inches high.

These areas lack diversity and are dominated by non-native, invasive grasses such as Bermudagrass, King Ranch bluestem, hedge parsley, prickly lettuce, and rescue grass.

Open Meadow in Zilker Park

Table 3.1 *Plant species documented at Zilker during botanical survey. N = Native, I = Invasive, E = Exotic, ? = Unknown. Wetland status: OBL=Obligate Wetland, Hydrophyte, Almost always occur in wetlands; FACW=Facultative Wetland, Hydrophyte, Usually occur in wetlands, but may occur in non-wetlands; FAC=Facultative; CULT=cultivated; CF = compare with, identification is probable but uncertain*

Botanical Survey

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Agalinis	*Agalinis sp.*		N		x										x				
Agarita	*Mahonia trifoliolata*		N		x	x		x					x			x	x	x	x
Agave	*Agave sp.*		N		x												x		x
Alabama lip-fern	*Cheilanthes alabamensis*		N		x			x										x	
Alamo vine	*Merremia dissecta*	*FAC*	N																x
Alligator juniper	*Juniperus deppeana*		N														x		
Amaranthus	*Amaranthus sp.*		N		x			x		x			x	x		x			x
American beautyberry	*Callicarpa americana*		N																x
American elm	*Ulmus americana*	*FAC*	N		x	x	x		x	x			x			x			x
American germander	*Teucrium canadense*	*FACW*	N			x	x	x		x									
American holly	*Ilex opaca*		N										x						
American water willow	*Justicia americana*	*OBL*	N				x												
Annual meadow grass	*Poa annua*		E										x				x		x
Annual paintbrush	*Castilleja indivisa*	*FAC*	N		x													x	
Arkansas lazy daisy	*Aphanostephus sp.*		N																x
Arrowroot	*Sagittaria platyphylla*	*OBL*	N								x								
Arundo	*Arundo donax*	*FAC*	I			x	x			x									
Ashe juniper	*Juniperus ashei*		N		x	x		x								x	x	x	x
Asthma weed	*Conyza bonariensis*		E														x		x
Autumn sage	*Salvia greggii*		N																x
Baby blue-eyes	*Nemophila phacelioides*		N		x			x											
Baby jump up	*Mecardonia procumbens*	*FACW*	N				x												
Bacopa	*Bacopa monnieri*	*OBL*	N	x															
Bald cypress	*Taxodium distichum*	*OBL*	N	x			x		x	x			x						x
Ball moss	*Tillandsia recurvata*		N		x	x		x	x				x	x		x	x	x	x
Bamboo	*Phyllostachys aurea*		I		x												x		x
Barbados cherry	*Malpighia glabrata*		N																x
Barometer bush	*Leucophyllum frutescens*		N																x

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Bastard cabbage	*Rapistrum rugosum*		I			x	x		x	x			x						x
Beaked yucca	*Yucca rostrata*		N																x
Bedstraw	*Galium aparine*		N						x										
Beebrush	*Aloysia gratissima*		N		x			x										x	
Bermudagrass	*Cynodon dactylon*		I	x	x			x	x	x			x	x	x	x	x	x	x
Bindweed	*Convolvulus equitans*		N		x	x									x				x
Bitterweed	*Helenium amarum*		N		x											x			
Black locust	*Robinia pseudoacacia*		N																x
Black medick	*Medicago lupulina*		E		x											x	x	x	x
Black willow	*Salix nigra*	*FACW*	N			x	x			x			x			x			
Blue bells	*Eustoma russellianum*		N							x									
Blue curls	*Phacelia congesta*		N		x	x									x			x	
Blue morning glory	*Ipomoea indica*	*FAC*	E														x		
Blue passionflower	*Passiflora caerulea*		E														x		
Bluebonnet	*Lupinus texensis*		N		x								x						x
Blue-eyed grass	*Sisyrinchium sp.*		N													x			
Bluets	*Hedyotis nigricans*		N		x														
Box elder	*Acer negundo*	*FAC*	N	x	x	x				x			x				x		x
Branched dicliptera	*Dicliptera brachiata*	*FACW*	N		x	x		x	x	x			x		x				
Brazilian bluewood	*Condalia hookeri*		N		x			x					x			x	x	x	
Brazilian vervain	*Verbena brasiliensis*		I					x						x			x		x
Bristle grass	*Setaria sp.*		?		x	x		x	x				x		x				x
Browne's savory	*Clinopodium brownei*	*OBL*	N				x												
Brown-eyed Susan	*Rudbeckia hirta*		N		x			x								x	x		x
Buffalo gourd	*Cucurbita foetidissima*		N		x														
Buffalo grass	*Bouteloua dactyloides*		N		x														x
Buffpetal	*Rhynchosida physocalyx*		N																x
Bull nettle	*Cnidoscolus texanus*		N		x	x													

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Bur oak	*Quercus macrocarpa*		N																x
Bush croton	*Croton fruticulosus*		N		x	x		x								x	x		x
Bushy bluestem	*Andropogon glomeratus*	*FACW*	N			x	x	x		x			x						x
Butterfly bush	*Buddleja racemosa*		N					x											
Butterfly bush CULT	*Buddleja sp.*		E																x
Buttonbush	*Cephalanthus occidentalis*	*OBL*	N																x
Cabomba	*Cabomba caroliniana*	*OBL*	N								x	x							
Camphorweed	*Heterotheca subaxillaris*		N		x	x		x	x	x			x		x				
Canada wild-rye	*Elymus canadensis*		N		x	x		x	x	x			x		x	x	x	x	x
Candelilla	*Euphorbia antisiphylitica*		N																x
Cardinal flower	*Lobelia cardinalis*	*FACW*	N				x												
Carolina buckthorn	*Rhamnus caroliniana*		N						x	x							x		
Carolina cherry laurel	*Prunus caroliniana*		N					x	x				x				x		x
Carolina geranium	*Geranium carolinianum*		N																x
Carolina ponyfoot	*Dichondra carolinensis*	*FAC*	N													x			x
Carolina snailseed	*Cocculus carolinus*		N	x	x	x		x	x				x	x	x	x		x	x
Carpet grass	*Axonopus fissifolius*	*FAC*	N														x		x
Castor bean	*Ricinus communis*		I			x													
Catclaw vine	*Macfadyena unguis-cati*		I										x				x		
Cattail	*Typha sp.*	*OBL*	N																x
Cedar elm	*Ulmus crassifolia*	*FAC*	N		x	x		x	x				x	x		x	x	x	x
Cedar sage	*Salvia roemeriana*		N			x													x
Cedar sedge	*Carex planostachys*		N		x														
Chenopodium	*Chenopodium berlandieri*		N										x	x					x
Cherokee sedge	*Carex cherokeensis*	*FACW*	N		x			x											
Chinaberry	*Melia azedarach*		I		x			x	x				x	x		x	x		x
Chinese elm, lacebark elm	*Ulmus parvifolia*		I						x										x
Chinese parasol tree	*Firmiana simplex*		I		x			x					x					x	x

Botanical Survey (continued...)

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Chinese pistache	*Pistacia chinensis*		I		x								x		x	x	x		x
Chinese tallow	*Triadica sebifera*	*FAC*	I		x	x	x		x	x			x			x			x
Chinese wisteria	*Wisteria sinensis*		I																x
Chinquapin oak	*Quercus muhlenbergia*	*FAC*	N																x
Clover	*Trifolium repens*		E													x			x
Coastal indigo	*Indigofera miniata*		N													x		x	x
Coffeeweed	*Sesbania herbacea*	*FACW*	N			x													
Common sunflower	*Helianthus annuus*		N		x			x						x					x
Copper canyon daisy CULT	*Tagetes lemonii*		E																x
Copper lily	*Habranthus tubispathus*	*FACW*	N													x			x
Cottonwood	*Populus deltoides*	*FAC*	N				x	x	x	x			x						x
Cowpen daisy	*Verbesina encelioides*	*FAC*	N														x		
Creeping cucumber	*Melothria pendula*	*FAC*	N		x														
Creeping woodsorrel	*Oxalis corniculata*		N															x	x
Crepe myrtle	*Lagerstroemia indica*		E												x	x			x
Cretin weed	*Hedypnois cretica*		E																x
Cross vine	*Bignonia capreolata*	*FAC*	N																x
Crow poison	*Nothoscordum bivalve*		N		x											x			
Cudweed	*Gamochaeta pensylvanica cf*		N											x					
CULT	*Caesalpinia pulcherrima*		E														x		x
CULT	*Erythrina sp.*		E																x
CULT	*Tradescantia pallida*		E																x
CULT	*Yucca aliofolia cf*		N																x
CULT	*Yucca flaccida cf*		N																x
Cultvated rose	*Rosa sp.*		E		x														
Curly dock	*Rumex crispus*	*FAC*	N	x			x						x	x	x				x
Cyperus	*Cyperus sp.*		?		x			x		x				x					x

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Dakota verbena	*Glandularia bipinnatifida*		N		x			x							x		x		
Dandelion	*Taraxacum sp.*		E										x						x
David's spurge	*Euphorbia davidii*		E						x								x		x
Day-flower	*Commelina erecta*		N		x			x	x	x			x			x	x		x
Desert willow	*Chilopsis linearis*		N											x					
Dewberry	*Rubus trivialis*		N	x	x	x		x	x	x			x	x	x	x		x	x
Dodder	*Cuscuta spp.*		N				x												
Dogweed	*Thymophylla pentachaeta*		N																x
Dove-weed	*Croton monanthogynus*		N		x					x						x	x		x
Drummond's wild petunia	*Ruellia drummondiana*		N										x						
Drummond's wood-sorrel	*Oxalis drummondii*		N														x		
Durand oak	*Quercus sinuata cf*		N		x			x											
Dwarf palmetto	*Sabal minor*	*FACW*	N	x									x						x
Easter Red Cedar	*Juniperus virginiana*		N																x
Eastern gamagrass	*Tripsacum dactyloides*	*FAC*	N	x															x
Eelgrass	*Vallisneria americana cf*	*OBL*	N	x															
Elbowbush	*Forestiera pubescens*		N		x			x							x	x	x	x	
Elderberry	*Sambucus canadensis*		N		x														
Elegant sneezeweed	*Helenium elegans*		N				x			x									
Elephant ear	*Colocasia esculenta*	*OBL*	I										x						
Engelmann's daisy	*Engelmannia peristenia*		N		x	x		x	x	x			x		x	x	x	x	x
English ivy	*Hedera helix*		I														x		
Erect spiderling	*Boerhavia erecta*		N																x
Evergreen sumac	*Rhus virens*		N		x	x		x								x	x	x	x
Eve's necklace	*Styphnolobium affine*		N		x			x											x
Fall aster	*Symphyotrichum drummondii*		N		x	x		x	x	x			x	x			x	x	x
Fall golden-eye	*Viguiera dentata*	*FACW*	N		x	x		x						x		x	x	x	

Botanical Survey (continued...)

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Fall witchgrass	*Digitaria cognata cf*		N		x			x	x				x	x			x		
False day-flower	*Tinantia anomala*		N		x			x	x	x			x				x		
False ground cherry	*Chamaesaracha spp.*		N		x												x		
False hawksbeard	*Youngia japonica*		E																x
False indigo-bush	*Amorpha fruticosa*	*FACW*	N			x	x			x			x						
False pennyroyal	*Hedeoma reverchonii cf*		N		x														x
False ragweed	*Parthenium confertum*		N		x	x		x		x			x	x		x	x	x	x
Field bindweed	*Convolvulus arvensis*		I		x											x			x
Firewheel	*Gaillardia pulchella*		N		x	x		x							x	x	x	x	x
Flame leaf sumac	*Rhus lanceolata*		N		x	x		x											x
Flax	*Linum rupestre cf*		N		x										x	x			x
Fleabane	*Erigeron modestus*	*FACW*	N		x			x											x
Four o'clock	*Mirablis jalapa*		E		x								x						x
Fragrant mimosa	*Mimosa borealis*		N		x											x			
Fragrant sumac	*Rhus trilobata*		N		x	x		x									x	x	
Frog-fruit	*Phyla nodiflora*	*FAC*	N				x										x		
Giant false yucca	*Hesperaloe funifera*		N																x
Giant ragweed	*Ambrosia trifida*	*FAC*	N	x	x	x	x	x	x	x			x	x	x	x	x	x	x
Giant spiderwort	*Tradescantia gigantea*		N		x								x						x
Globemallow	*Sphaeralcea angustifolia*		N												x				
Goathead	*Tribulus terrestris*		I																x
Goldenrod	*Solidago sp.*		N		x	x													
Gray vervain	*Verbena canescens*		N		x											x			x
Graybark grape	*Vitis cinerea*	*FAC*	N		x	x		x	x	x			x						x
Green ash	*Fraxinus pennsylvanica*	*FAC*	N						x	x			x	x					
Green poinsettia	*Euphorbia dentata*		N		x				x					x			x		x
Green sprangletop	*Leptochloa dubia*		N																
Greenbriar	*Smilax bona-nox*		N		x	x		x	x				x	x		x	x	x	x

Botanical Survey (continued...)

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Gregg's mistflower	*Conoclinum dissectum*		N					x										x	
Gum bumelia	*Sideroxylon lanuginosum*		N		x	x		x	x	x			x	x			x	x	x
Hackberry	*Celtis laevigata*	*FAC*	N	x	x	x	x	x	x	x			x	x	x		x	x	x
Hairy paspalum	*Paspalum pubiflorum*		N						x								x		x
Hairy tubetongue	*Justicia pilosella*		N		x			x								x	x		x
Heartleaf nettle	*Urtica chamaedryoides*		N		x			x											
Heartleaf skullcap	*Scutellaria ovata*		N																x
Heath aster	*Symphyotrichum ericoides*		N			x		x					x						
Hedge parsley	*Torilis arvensis*		I	x	x	x	x	x	x	x			x	x	x	x	x	x	x
Heller's plantago	*Plantago helleri cf*		N													x			x
Hophornbeam copperleaf	*Acalypha ostryifolia*		N														x		x
Hop-tree	*Ptelea trifoliata*	*FAC*	N		x	x		x	x	x			x			x	x	x	
Hordeum	*Hordeum pusillum*		N		x			x								x		x	
Horsetail reed	*Equisetum sp.*	*FACW*	N			x													
Huisache	*Vachellia farnesiana*		N		x	x		x		x			x	x					x
Hummingbird bush	*Anisacanthus quadrifidus wrightii*		N		x			x	x				x				x		x
Inland seaoats	*Chasmanthium latifolium*		N		x	x		x	x	x			x				x		x
Italian cypress	*Cupressus sempervirens*		E																x
Japanese brome	*Bromus japonica*		I		x			x							x	x		x	x
Japanese honeysuckle	*Lonicera japonica*		I		x	x		x	x				x						x
Japanese jasmine	*Jasminum mesnyi*		I				x												x
Johnsongrass	*Sorghum halepense*		I	x	x	x	x	x		x			x	x	x			x	x
Jump up flower	*Mimulus glabratus*	*OBL*	N							x									
Jungle rice	*Echinochloa colona*	*FACW*	E		x			x										x	
Juniper	*Juniperus sp.*		?																x
Kidneywood	*Eysenhardtia texana*		N		x			x					x				x	x	x
King Ranch bluestem	*Bothriochloa ishaemum*		I		x	x		x	x	x					x	x		x	x

Botanical Survey (continued...)

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Knotweed	*Polygonum aviculare*		E																x
Ladybird's century	*Zeltnera texensis*		N		x										x				
Late boneset	*Eupatorium serotinum*	*FAC*	N				x												
Lax hornpod	*Mitreola petiolata*	*FACW*	N																x
Leaf flower	*Phyllanthus polygonoides*		N		x														
Lemon beebalm	*Monarda citriodora*		N		x										x				
Ligustrum	*Ligustrum sinense*		I		x	x	x	x									x		
Ligustrum	*Ligustrum lucidum*		I		x	x		x	x	x			x	x			x	x	x
Limewater brookweed	*Samolus ebracteatus*	*FACW*	N				x												
Lindheimer's daisy	*Lindheimera texana*		N		x			x							x				
Lindheimer's globeberry	*Ibervillea lindheimeri*		N		x														
Lindheimer's milkwort	*Polygala lindheimeri*		N		x														
Lindheimer's morning glory	*Ipomoea lindheimeri*		N		x														
Lindheimer's muhly	*Muhlenbergia lindheimeri*	*FACW*	N	x													x		x
Lindheimer's senna	*Senna lindheimeriana*		N		x			x											x
Lindheimer's sida	*Sida lindheimeri*		N			x									x	x			x
Little bluestem	*Schizachyrium scoparium*		N		x	x		x							x			x	
Littleleaf walnut	*Juglans microcarpa cf*	*FAC*	N					x											
Live oak	*Quercus fusiformis*		N		x	x		x						x	x	x	x	x	x
Lizard's tail	*Gaura parviflora*		N		x	x			x				x		x				x
Lotebush	*Ziziphus obtusifolia*		N		x											x			
Maidenhair fern	*Adiantum capillus-veneris*	*FACW*	N	x		x	x	x											
Malta star thistle	*Centaurea melitensis*		I		x				x							x			x
Mare's tail	*Conyza canadensis*		N		x	x	x	x	x				x	x			x	x	x
Marine ivy	*Cissus incisa*		N		x	x		x	x	x			x	x			x		x
Maximillian sunflower	*Helianthus maximiliani*		N	x															x
Mesquite	*Prosopis glandulosa*		N		x	x		x					x		x	x			x

Botanical Survey (continued...)

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Mex. Turk's cap	*Malvaviscus arboreus var. mexicanus*		E		x				x				x						x
Mexican buckeye	*Ungnadia speciosa*		N		x	x		x					x				x	x	x
Mexican honeysuckle	*Justicia spicigera*		E										x						
Mexican palmetto	*Sabal mexicana*		N	x	x								x						
Mexican petunia	*Ruellia simplex*		E														x		x
Mexican plum	*Prunus mexicana*		N	x	x			x	x				x	x		x		x	x
Mexican white oak	*Quercus polymorpha*		N																x
Milkweed vine	*Cynanchum sp.*		N		x	x											x		x
Mist flower	*Conoclinium coelestinum*	*FACW*	N																x
Mountain laurel	*Dermatophyllum secundiflorum*		N		x			x		x			x		x		x	x	x
Mouse's ear	*Bernardia myricifolia*		N		x			x								x		x	
Mulberryweed	*Fatoua villosa*	*FAC*	E										x						
Mustang grape	*Vitis mustangensis*		N	x	x	x		x	x				x	x	x		x		x
Nandina	*Nandina domestica*		I		x	x		x	x	x			x				x		x
Neptinua	*Neptunia pubescens cf*	*FAC*	N												x				
Nightshade	*Solanum pycnanthum*		N										x				x		x
Nodding spurge	*Euphorbia nutans*		N						x							x	x		x
Noseburn	*Tragia ramosa*		N		x			x											
Old man's beard	*Clematis drummondii*		N			x									x				
Old plainsman	*Hymenopappus scabiosaeus*		N		x													x	
Oneflower flatsedge	*Cyperus retroflexus*		N																x
Oneseed bur cucumber	*Sicyos angulatus*	*FACW*	N		x			x											
Orchid tree	*Bauhinia congesta*		N													x	x		x
Orchid tree CULT	*Bauhinia sp.*		E																x
Palm	*Washingtonia sp.*		E																x
Palo verde	*Parkinsonia aculeata*	*FAC*	N										x		x				x

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Panic grass	*Dichanthelium oligosanthes*		N		x														
Panicled-leaf ticktrefoil	*Desmodium paniculatum*		N		x				x	x							x		
Panicum	*Panicum sp.*		?		x												x		
Paper mulberry	*Broussonetia papyrifera*		I						x									x	x
Paspalum	*Paspalum sp.*		?										x	x					x
Passionflower	*Passiflora incarnata*		N														x		
Pasture heliotrope	*Heliotropium tenellum*		N		x										x				x
Peach	*Prunus sp.*		E												x				
Pearl milkweed vine	*Matelea reticulata*		N		x			x	x				x	x			x	x	
Pecan	*Carya illinoinensis*	*FAC*	N			x		x	x	x			x			x		x	x
Pellitory	*Parietaria pensylvanica*	*FAC*	N		x	x		x		x			x				x	x	x
Pennywort	*Hydrocotyle umbellata*	*OBL*	N				x			x									
Peppervine	*Ampelopsis arborea*		N		x	x				x			x	x			x		
Pepperweed	*Lepidium virginiana cf*		N		x			x									x		x
Perennial ryegrass	*Lolium perenne*		I	x	x	x		x		x			x		x	x		x	x
Photinia	*Photinia sp.*		I					x	x										
Pigeon berry	*Rivina humilis*	*FAC*	N		x			x									x	x	x
Pink evening primrose	*Oenothera speciosa*		N		x	x		x						x		x			x
Plains coreopsis	*Coreopsis tinctoria*	*FAC*	N		x	x	x	x	x				x				x	x	x
Plantago	*Plantago patagonica cf*		N		x			x											x
Poison ivy	*Toxicodendron radicans*		N	x	x	x	x	x	x	x			x		x	x	x	x	x
Pokeweed	*Phytolacca americana*		N		x														
Pomegranite	*Punica granatum*		E		x														x
Possumhaw	*Ilex decidua*	*FAC*	N	x	x			x	x				x				x		x
Poverty weed	*Baccharis neglecta*	*FAC*	N		x											x			
Prairie brazosmint	*Warnockia scutellarioides*		N		x													x	
Prairie coneflower	*Ratibida columnifera*		N		x	x		x	x	x			x	x	x	x	x	x	x

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Prickly lettuce	*Lactuca serriola*	*FAC*	I		x	x		x					x	x	x	x	x	x	x
Prickly-pear	*Opuntia engelmannii*		N		x			x									x	x	
Purple leather flower	*Clematis pitcheri*		N			x							x						
Purple three-awn	*Aristida purpurea*		N		x										x				x
Rabbit tobacco	*Diaperia prolifera*		N		x												x		x
Ragweed	*Ambrosia psilostachya*		N		x	x	x	x	x					x	x	x	x	x	x
Rainlily	*Cooperia drummondii*	*FAC*	N		x			x								x	x		
Red buckeye	*Aesculus pavia*	*FAC*	N		x			x	x				x				x	x	
Red River scaleseed	*Spermolepis inermis*		N		x														x
Red yucca	*Hesperaloe parviflora*		N																x
Redbud	*Cercis canadensis texana*		N						x				x		x				x
Redseed plantago	*Plantago rhodosperma*		N													x			
redstem filaree	*Erodium cicutarium*		E													x			x
Rescue grass	*Bromus catharticus*		I		x	x		x	x	x				x	x	x	x	x	x
River fern	*Thelypteris ovata v lindheimeri cf*	*FACW*	N							x									
Rock cress	*Arabis petiolaris*		N		x														
Rock rose	*Pavonia lasiopetala*		N		x														x
Rough cocklebur	*Xanthium strumarium*	*FAC*	N																x
Roughleaf dogwood	*Cornus drummondii*	*FAC*	N		x	x	x	x	x	x			x					x	
Scarlet pimpernel	*Anagallis arvensis*		E			x		x							x			x	x
Scarlet spiderling	*Boerhavia coccinea*		N						x									x	x
Sedge	*Carex sp.*		?		x			x							x	x			x
Sedge	*Carex planostachys cf*		N	x															
Shrubby copperleaf	*Acalypha phleoides*		N		x			x								x		x	x
Sideoats grama	*Bouteloua curtipendula*		N		x			x							x			x	x
Silk tassel	*Garrya ovata lindheimeri*		N		x	x		x										x	
Silk tree	*albizia julibrissin*		I							x									

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Silver bluestem	*Bothriochloa laguroides*		N		x										x				x
Silver dwarf morning-glory	*Evolvulus sericeus*		N		x			x								x		x	x
Silver leaf nightshade	*Solanum elaegnifolium*		N		x	x		x	x	x			x	x	x	x	x	x	x
Smartweed	*Persicaria pensylvanica*	*FACW*	?				x												
Smoke tree CULT	*Cotinus sp.*		E																x
Snake herb	*Dyschoriste linearis*		N		x			x								x		x	
Snapdragon vine	*Maurandya antirrhiniflora*		N		x			x											
Snoutbean	*Rhynchosia texana*		N		x			x											
Soapberry	*Sapindus saponaria*		N		x														
Sotol	*Dasylirion texana*		N		x														
Southern live oak	*Quercus virginiana*		N																x
Southern magnolia	*Magnolia grandiflora*	*FAC*	N																x
southern wood-sorrel	*Oxalis dillenii*		N	x	x									x	x		x	x	x
sowthistle	*Sonchus oleraceus*		I		x														
Spanish moss	*Tillandsia usnoides*		N					x											
Spike sedge	*Eleocharis sp. lg*		N				x												
Spike sedge	*Eleocharis sp small*		N				x												
Spineless prickly pear	*Opuntia sp.*		E																x
Spiny aster	*Chloracantha spinosa*	*FACW*	N						x				x						
Spotted horsemint	*Monarda punctata*		N						x				x		x				
Sprawling signalgrass	*Urochloa reptans cf*		E														x		
Spurge	*Euphorbia sp. (Chamaesyce)*		?							x									x
Straggler daisy	*Calyptocarpus vialis*	*FAC*	N	x	x	x		x	x	x			x	x	x	x	x	x	x
Swamp milkweek cf	*Asclepias incarnata*		N	x															
Sweet autumn clematis	*Clematis terniflora*		I										x						
Sweet clover	*Meliotis alba*		E		x								x						x
Sweet mountain grape	*Vitis monticola cf*		N		x			x											

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Sweet pepper	*Capsicum annuum*		E		x				x				x						
Switchgrass	*Panicum virgatum*	*FAC*	N			x	x												
Sycamore	*Platanus occidentalis*	*FAC*	N	x		x	x		x	x			x						
Tasajillo	*Cylindropuntia leptocaulis*		N		x			x											
Texas ash	*Fraxinus albicans*		N			x	x	x											
Texas hog plum	*Colubrina texensis*		N		x			x											
Texas Indian mallow	*Abutilon fruticosum*		N		x										x			x	
Texas lantana	*Lantana urticoides*		N		x								x		x		x		x
Texas nightshade	*Solanum triquetrum*		N		x			x	x				x				x		
Texas oak	*Quercus buckleyi*		N		x			x								x	x	x	x
Texas persimmon	*Diospyros texana*		N		x			x	x				x	x	x	x	x	x	x
Texas thistle	*Cirsium texanum*		N		x	x		x					x			x	x	x	x
Texas vervain	*Verbena halei*		N		x			x					x			x	x	x	x
Texas wintergrass	*Nassella leucotricha*		N		x			x					x						
Thorn-crested century plan	*Agave univittata*		N		x														
Threelobe false mallow	*Malvastrum coromandelianum*	*FAC*	N		x				x				x	x		x	x	x	x
Tie-vine	*Ipomoea cordatotriloba*	*FAC*	N		x	x			x				x				x		x
Torrey's yucca	*Yucca torreyi*		N		x														
Trailing lantana	*Lantana montevidensis*		E		x												x		x
Trailing wild bean	*Strophostyles helvola*		N																x
Trans pecos spiderwort	*Tradescantia brevifolia cf*		N		x														
Tree of heaven	*Ailanthus altissima*		I		x				x										
Tropical sage	*Salvia coccinea*		N		x			x											
Trumpet creeper	*Campsis radicans*		N			x				x			x						x
Turk's cap	*Malvaviscus arboreus*		N		x	x		x	x	x			x						x
Twist-leaf yucca	*Yucca rupicola*		N		x			x	x				x				x		x
Velvet leaf mallow	*Allowissadula holosericea*		N		x		x		x										

Botanical Survey (continued...)

Common Name	Botanical Name	Wetland Status	Type	Spring	Oak/Juniper/Elm Woodland	Barton Riparian Woodland	Intermittent Creekbed	Eanes Creek Riparian Woodland	Degraded Barton Riparian Woodland	Degraded Barton Creek Shoreline	Barton Springs Pool	Permanent Water	Lakeshore Riparian Woodland	Wetland	Open Meadow	Disc Golf Course	Zilker Botanical Garden	Austin Nature & Science Center	Maintained Parkland & Infrastructure
Veronica	*Veronica sp.*		E		x				x	x									
Vinca	*Vinca sp.*		E														x		
Violet	*Viola missouriensis cf*	*FACW*	N		x			x									x		
Virginia creeper	*Parthenocissus quinquefolia*		N		x	x		x	x	x			x	x			x	x	x
Virginia frostweed	*Verbesina virginica*		N		x	x		x					x				x	x	x
Virginia wild-rye	*Elymus virginica*		N		x			x					x	x			x		
Vitex	*Vitex agnus-castus*		I																x
Washerwoman	*Alternanthera caracasana*		E		x					x			x	x		x		x	x
Water starwort	*Callitriche sp.*		N				x												
West Indian lantana	*Lantana camara*		I														x		x
western umbrella-sedge	*Fuirena simplex*	*OBL*	N				x												
White boneset	*Eupatorium havanense*		N		x			x	x	x			x				x	x	
White honeysuckle	*Lonicera albiflora*		N			x													
White morning-glory	*Ipomoea lacunosa*	*FACW*	N			x													
White mulberry	*Morus alba*		I		x				x					x					x
Wild carrot	*Daucus pusillus*		N		x			x									x		x
Wild lettuce	*Lactuca floridana cf*	*FAC*	N		x	x			x	x			x				x	x	x
Wild mercury	*Ditaxis mercurialina*		N													x			
Wild mercury	*Ditaxis simulans*		N		x														
Wild oats	*Avena fatua*		E		x			x		x									
Wild petunia	*Ruellia humilis*	*FAC*	N		x	x	x	x	x				x		x	x	x	x	x
Wild poinsettia	*Euphorbia cyathophora*		N														x		
Windmill grass	*Chloris cucullata*		N		x			x								x	x		x
Yarrow	*Achillea millefolium*		N		x			x								x	x		
Yaupon	*Ilex vomitoria*	*FAC*	N	x	x			x					x			x	x	x	x
Yellow bells CULT	*Tecoma stans*		N																x
Yellow passionflower	*Passiflora lutea*		N		x			x	x										
Zexmenia	*Wedelia hispida*		N		x			x								x	x	x	
Zizotes milkweed	*Asclepias oenotheroides*		N		x														

MEASURING THE URBAN FOREST

Urban forests serve important functions such as cleaning the air,[7] reducing noise,[77] intercepting rainfall and enhancing water quality,[78] sequestering carbon and building soil,[10] mitigating flooding,[79] reducing erosion and protecting shorelines,[13] decreasing urban temperatures,[80] providing wildlife habitat,[81] increasing public health,[1] increasing property values,[82] and serving as cost-effective green infrastructure elements.[83]

To better understand the health of Zilker Park's forests, Siglo Group inventoried over 1,000 trees in the highest priority areas identified by Barton Springs Conservancy (Figure 3.9). Surveyed areas include the north and south sides of Barton Creek and parts of the Degraded Barton Riparian Woodland. This

A massive cypress along the shoreline of Lady Bird Lake in Zilker Park

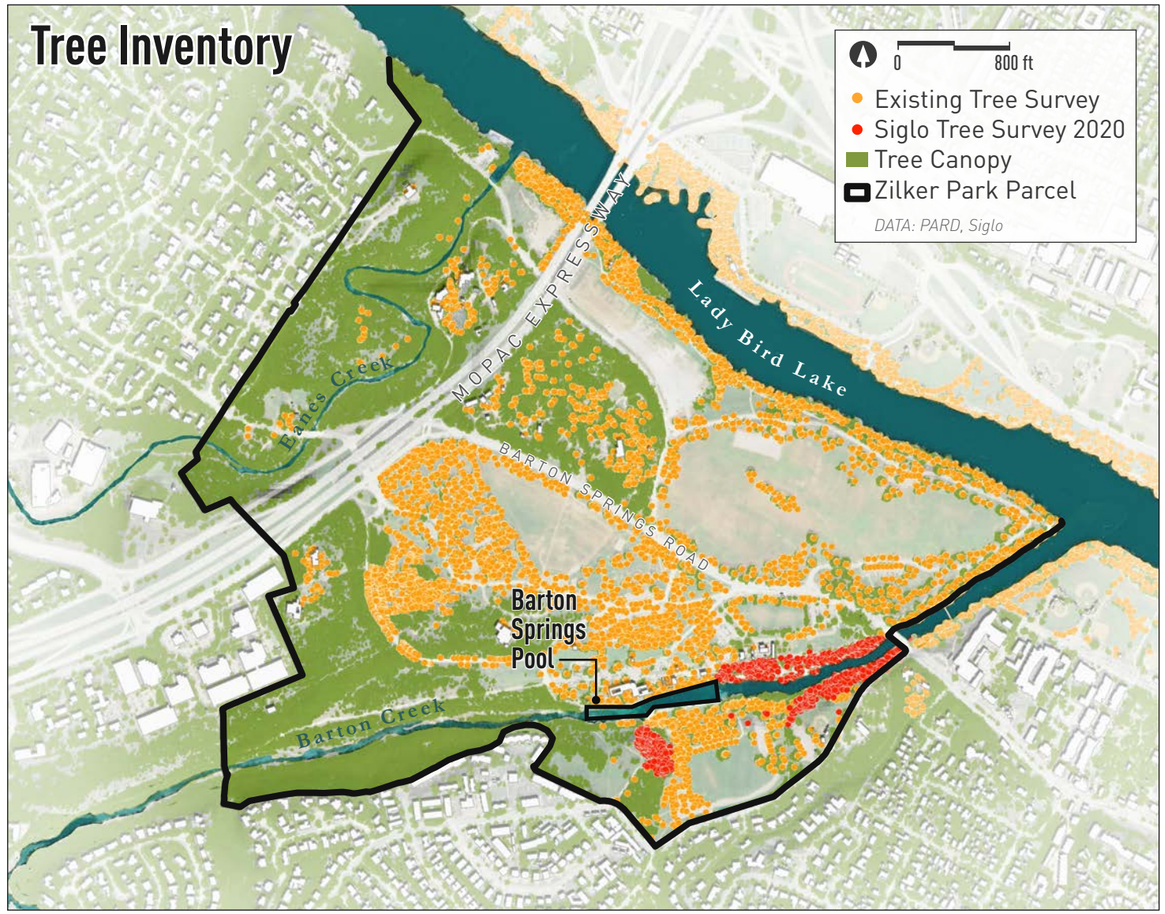


Figure 3.9. *Tree inventory*

Table 3.2 *Tree Survey summary at Zilker Park. Summary by species organized from most abundant to least abundant based on all inventories.*

Tree Survey (all trees)

	Total Count	2020 Count	Avg DBH	2020 Avg DBH	Total Protected	2020 Protected	Total Heritage	2020 Heritage
All tree species	**4086**	**1046**	**12.9**	**9.0**	**751**	**70**	**424**	**31**
# of invasives	209	124						
% of total	5.11%	11.85%						

Tree Survey (by species)

Species	Total Count	2020 Count	Avg DBH	2020 Avg DBH	Total Protected	2020 Protected	Total Heritage	2020 Heritage	Invasive
Live Oak	787	13	16.1	8.2	231	1	135	0	
Hackberry	728	314	9.0	6.1	22	0	0	0	
Cedar Elm	572	109	9.2	8.3	33	4	8	2	
Pecan	511	85	21.4	19.5	275	36	224	26	
American Elm	377	241	10.2	8.2	39	9	17	3	
Juniper	228	20	10.7	10.8	18	3	0	0	
Box Elder	95	34	10.0	7.2	4	1	0	0	
Ligustrum	89	84	11.4	11.5	1	1	0	0	yes
Bald Cypress	66	1	27.5	11.0	39	0	32	0	
Chinaberry	53	27	13.5	14.4	7	7	0	0	yes
Sycamore	46	8	14.8	11.3	12	1	0	0	
Chinese tallow	44	11	13.2	11.5	8	1	0	0	yes
Texas Persimmon	40	39	5.5	5.5	0	0	0	0	
Evergreen Sumac	35	0	8.3		0	0	0	0	
Gum Bumelia	34	22	9.7	8.5	1	1	0	0	
Bur Oak	30	0	9.5		1	0	0	0	
Texas Mountain Laurel	25	0	5.7		0	0	0	0	
Huisache	24	3	14.0	18.0	3	1	0	0	
Black Willow	24	7	15.9	9.6	7	0	0	0	
Cottonwood	22	9	22.9	12.2	13	2	0	0	
Mexican Buckeye	21	0	3.9		0	0	0	0	
Green Ash	21	2	15.4	16.0	5	1	0	0	
Desert Willow	18	0	2.7		0	0	0	0	
Mesquite	18	6	16.0	17.7	6	1	0	0	
Chinquapin Oak	17	1	4.7	7.0	0	0	0	0	
Texas Red Oak	17	0	11.4		3	0	1	0	
Black Walnut	15	5	20.0	8.0	7	0	7	0	
Texas Redbud	13	1	3.6	5.0	0	0	0	0	
Unknown	12	0	14.3		2	0	0	0	
Goldenrain Tree	9	0	15.8		5	0	0	0	yes
Monterrey oak	8	0	8.8		0	0	0	0	
Black locust	7	0	4.3		0	0	0	0	
Mexican White Oak	7	0	9.9		0	0	0	0	
Chinese Pistache	6	0	10.5		0	0	0	0	yes
Arizona Ash	6	0	16.5		2	0	0	0	
Yaupon	5	0	5.6		0	0	0	0	
Loblolly Pine	5	0	10.0		1	0	0	0	
White Mulberry	5	0	13.8		0	0	0	0	yes
Eastern Redbud	4	0	3.0		0	0	0	0	
Anacacho Orchid Tree	4	0	4.0		0	0	0	0	
Possumhaw	4	0	5.5		0	0	0	0	
Deodar Cedar	4	0	17.3		2	0	0	0	
Mexican Plum	3	0	4.3		0	0	0	0	
Texas Ash	3	0	10.0		0	0	0	0	
Crapemyrtle	3	0	12.3		0	0	0	0	
Lacey oak	2	0	4.5		0	0	0	0	
Bigtooth Maple	2	0	5.0		0	0	0	0	
Other	2	2	8.0	8.0	0	0	0	0	
Retama	2	0	9.5		0	0	0	0	
Eastern Red Cedar	2	0	36.0		2	0	0	0	
American Smoketree	1	0	2.0		0	0	0	0	
Common Persimmon	1	0	3.0		0	0	0	0	
Bradford Pear	1	1	8.0	8.0	0	0	0	0	yes
Ginkgo biloba	1	0	8.0		0	0	0	0	
Shummard red oak	1	0	8.0		0	0	0	0	
Lacebark Elm	1	1	9.0	9.0	0	0	0	0	yes
Soapberry	1	0	9.0		0	0	0	0	
Arizona Cypress	1	0	11.0		0	0	0	0	
Chinese Parasol Tree	1	0	15.0		0	0	0	0	yes
Red Mulberry	1	0	21.0		1	0	0	0	
Mulberry	1	0	31.0		1	0	0	0	

inventory builds on past inventories conducted by the City of Austin and Siglo Group. The combined results by species can be found in Figure 3.10 and Table 3.2. The survey includes all native trees over four inches diameter at breast height (DBH) and all invasive trees over eight inches DBH. Each inventoried tree was marked with a numbered tag and the following data was recorded: tree ID; tree species; DBH; whether or not the tree is multi-stemmed; and presence of overhead power lines.

In the 2020 inventory, hackberry was the most abundant species, with 314 hackberry individuals and an average DBH of 6.1 inches. Other common species include American elm, cedar elm, Ligustrum, and pecan. Of the inventoried trees, 124 were invasive species (nearly 12% of the total). Because only invasive trees over 8 inches were inventoried (compared to a 4-inch minimum for native trees), the true proportion of invasive trees is likely much greater. Most trees were relatively small, except for pecans, which had an average DBH of 19.5 inches but lacked smaller, younger individuals. Even including the large pecans, the average DBH in the 2020 survey area is 9 inches. There are 70 trees over 19 inches, qualifying as protected by the City of Austin. Of those, 31 are heritage trees, 26 of which are pecans (Figure 3.11).

Live oak (Quercus fusiformus) is the most abundant species within Zilker Park.

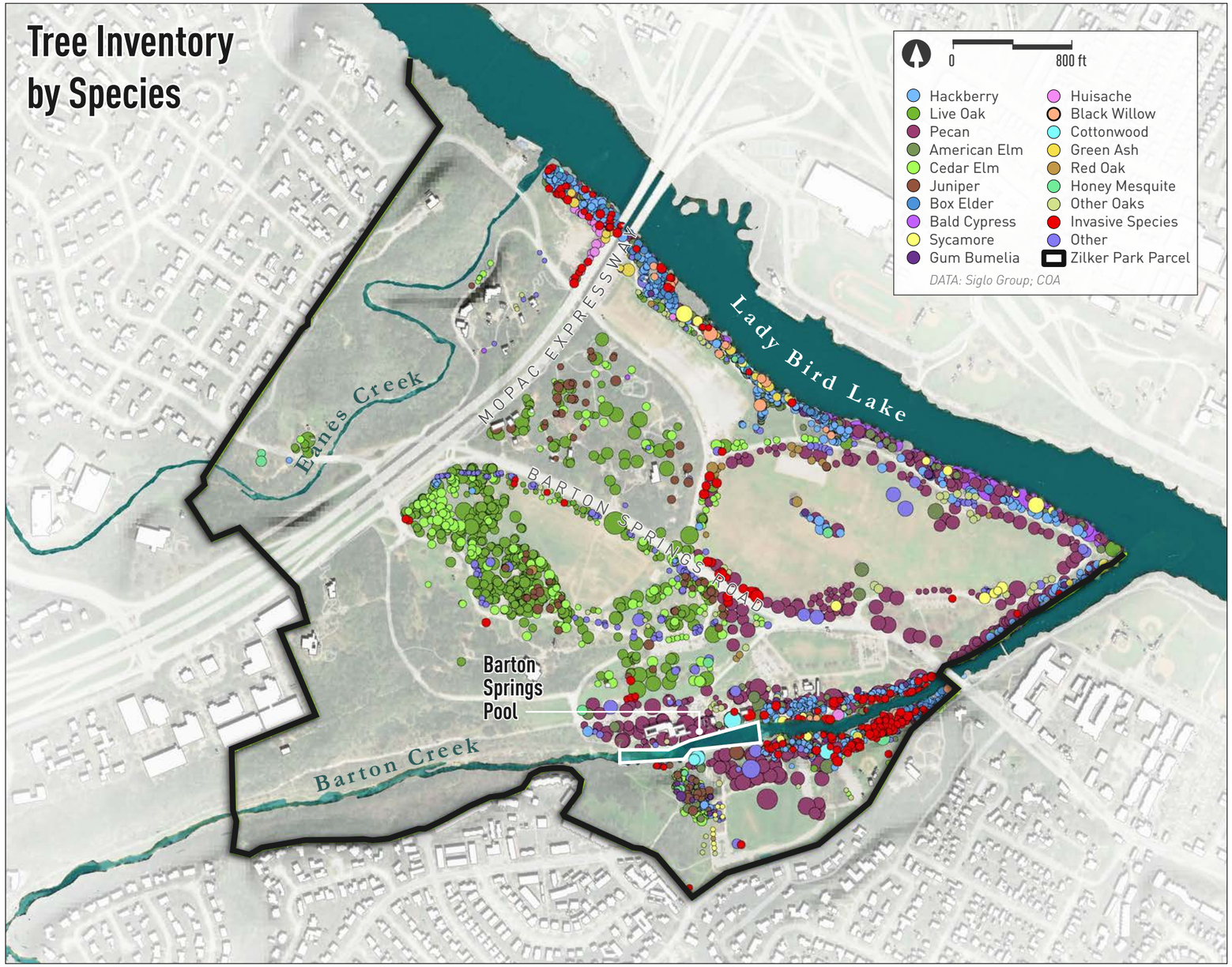


Figure 3.10. *Tree inventory by species*

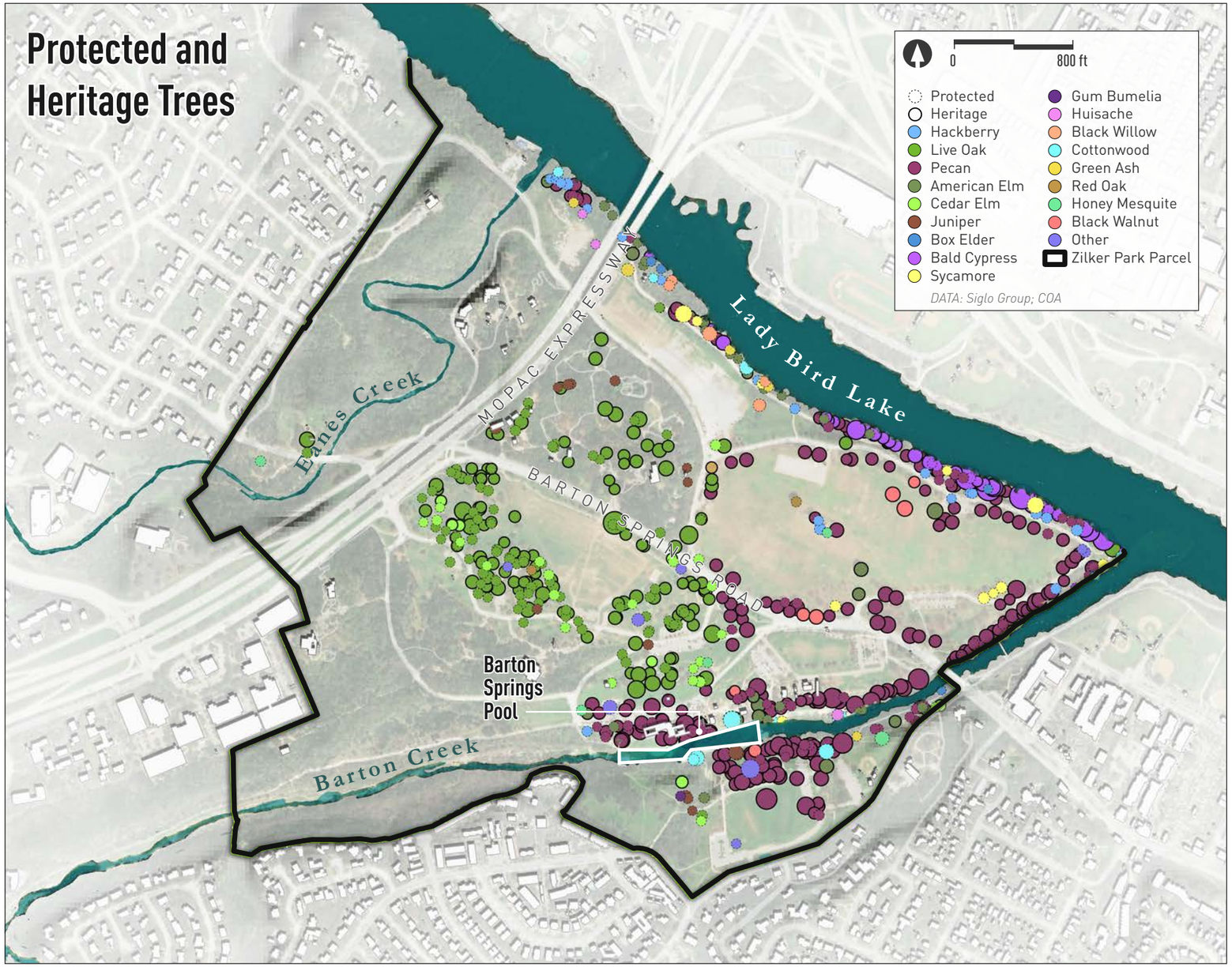


Figure 3.11. *Heritage and protected trees*

Measuring DBH on a large American Elm on Lower Barton Creek.

With all inventories combined (61 different species, 4,087 specimens), live oak is the most abundant species, with hackberry, cedar elm, pecan, and American elm also common. Overall, the average DBH is 12.9 inches. The largest tree recorded was a bald cypress with a DBH of 100 inches. There are 751 protected trees, including 424 heritage trees (Figure 3.11). These inventories do not include the majority of the Zilker Nature Preserve or along Barton Creek upstream of the pool. Both of these areas likely to have numerous protected and heritage trees. Improvements around Protected and Heritage trees is prohibited in the half-critical root zone and limited in the full critical root zone.

CRITICAL ENVIRONMENTAL FEATURES

A Critical Environmental Feature (CEF) is a feature that is of critical importance to the protection of environmental resources, and includes bluffs, canyon rimrock, caves, point recharge features, sinkholes, springs, and wetlands. Features designated as CEFs in Title 25, section 8 of the City of Austin Code of Ordinances were documented using data from the City of Austin CEF database, the National Wetlands Inventory, and surveys conducted in conjunction with this project (Figure 3.12).[75] The Code of Ordinances requires a buffer of 150 ft around CEFs. Inside that buffer, natural vegetation must be retained as much as is practical; construction, wastewater disposal, and irrigation are prohibited. Hiking trails are allowed within the buffer if they are at least 50 ft from the CEF. CEFs found within the study area include springs, seeps, and canyon rim rock. As efforts move from vision planning to site plans, CEFs may require additional buffers including wetland areas along Lady Bird Lake.

SPRINGS & SEEPS

As discussed in the hydrology section, there are four major locations where groundwater flows onto land or into a body of water have been identified in Zilker Park. These four major springs form the Barton Springs complex and includes Barton, Sunken Gardens (Old Mill), Eliza, and Upper Barton Springs.

Seeps are areas where just enough groundwater percolates to the surface to wet the soil, usually without creating flowing water. There are 9 additional small seeps and springs that have been identified in Zilker Park. While most of the vegetation in these areas is not distinct, several hillside seeps contain populations of facultative wetland plants (FACs) such as maidenhair fern. Facultative wetland plants can grow in upland soils but prefer wetland areas.

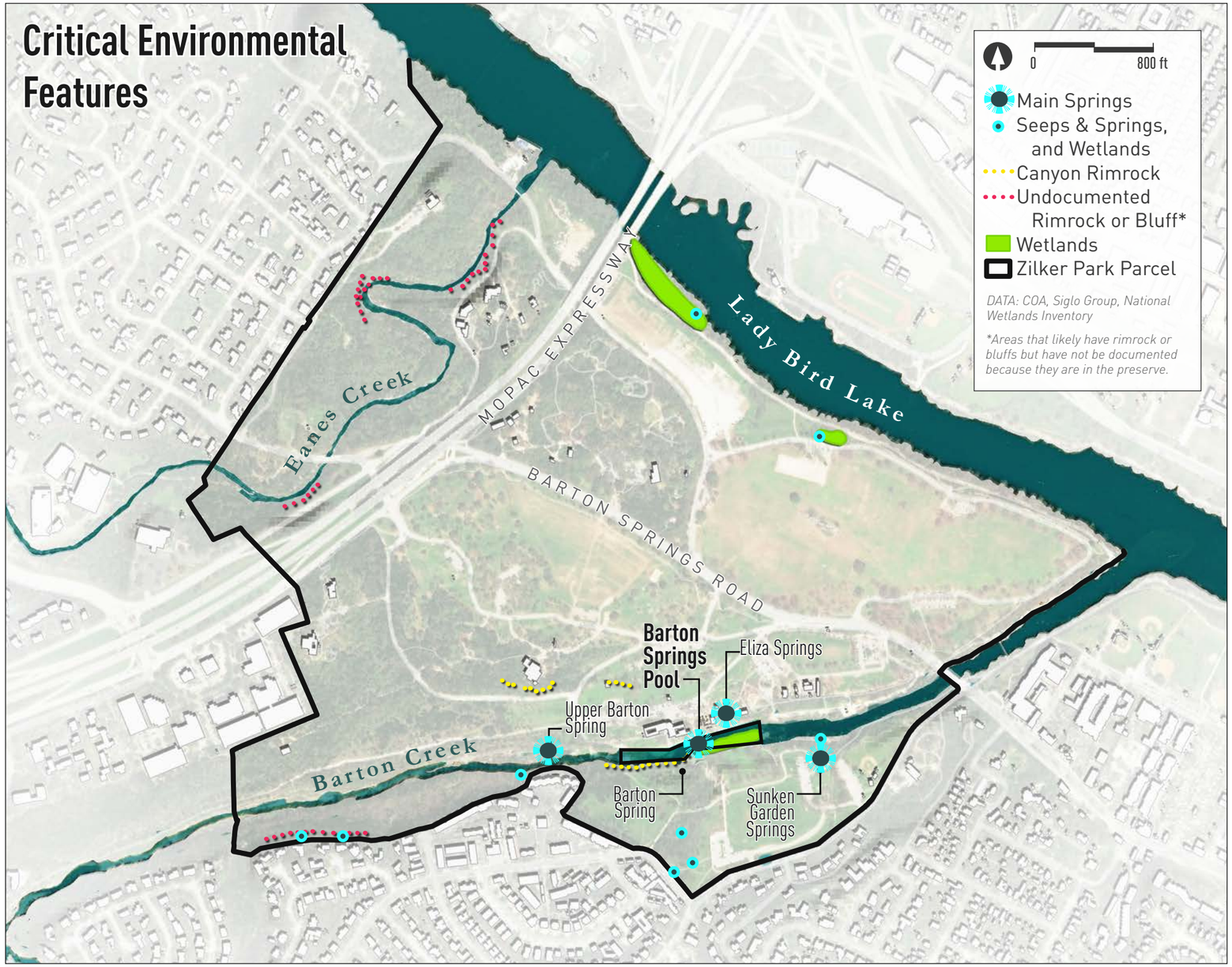


Figure 3.12. *Critical Environmental Features*

CANYON RIMROCKS AND BLUFFS

Canyon rimrocks are areas with a gradient over 60% for a vertical distance of at least 4 ft that are exposed 50 ft horizontally.[75] Canyon rimrocks are present along Columbus Drive, the Rock Garden & Hillside Theater, and the southern bank of Barton Springs Pool and Barton Creek.

Bluffs are an abrupt vertical change in topography of more than 40 feet with an average slope steeper than four feet of rise for one foot of horizontal travel (400% or 76 degrees).[75] While not in the city critical environmental feature database, it is likely that there are bluffs and additional canyon rimrock in the Zilker Nature Preserve area and on the southwestern edge of the site, just south of Barton Creek. These “undocumented rimrock or bluff” areas were mapped based on field observation and analysis of slope data and are recommended for field verification moving forward.

WETLANDS

The City of Austin does not have any wetlands mapped within Zilker Park, therefore data from the National Wetlands Inventory (NWI) was used. According to the NWI, there are three wetlands in Zilker Park—one lying along the lakeshore side of the Butler Trail, just east of Mopac; one in a depression just east of the Butler Landfill; and one within the bounds of Barton Springs Pool. This data is very coarse and the geographic extent was last mapped using imagery from 1982. A wetland delineation of the areas from the NWI, as well as the shoreline along Lady Bird Lake is recommended in order to refine the boundaries of these critical environmental features.

WILDLIFE

Zilker Park is an oasis for urban wildlife. It includes the critical aquatic habitat of the endangered Austin Blind and Barton Springs Salamanders and supports many resident and migratory species. The Park is home to a total of 262 wildlife species, including 224

Table 3.3 *Bird Survey at Zilker Park*

** Species of Greatest Conservation Need (SGCN)*

*** Federally Endangered Species*

***Bolded species** are the 48 likely breeding species at Zilker (as opposed to lingering winter species; migrant species—non-breeding; or status unknown species—presumed migrant species)*

Note: Data included in this list is compiled from eBird and iNaturalist web platforms as well as on the ground survey by Siglo Group. It is important to note that only iNaturalist records with a "research grade" ranking were included (36 species).

Bird Survey

Common Name	Scientific Name
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Golden-Plover*	*Pluvialis dominica*
American Goldfinch	*Spinus tristis*
American Kestrel*	*Falco sparverius*
American Pipit	*Anthus rubescens*
American Redstart	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
American Wigeon	*Mareca americana*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Baltimore Oriole	*Icterus galbula*
Bank Swallow	*Riparia riparia*
Barn Owl	*Tyto alba*
Barn Swallow	*Hirundo rustica*
Barred Owl	*Strix varia*
Bay-breasted Warbler	*Setophaga castanea*
Bell's Vireo*	*Vireo bellii*
Belted Kingfisher	*Megaceryle alcyon*
Bewick's Wren*	*Thryomanes bewickii*
Black Vulture	*Coragyps atratus*
Black-and-white Warbler	*Mniotilta varia*
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*
Blackburnian Warbler	*Setophaga fusca*
Black-chinned Hummingbird	*Archilochus alexandri*
Black-crested Titmouse	*Baeolophus atricristatus*
Black-crowned Night-Heron	*Nycticorax nycticorax*
Black-crowned/Yellow-crowned Night-Heron	*Nyctanassa spp.*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Black-throated Green Warbler	*Setophaga virens*
Blue Grosbeak	*Passerina caerulea*
Blue Jay	*Cyanocitta cristata*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Blue-headed Vireo	*Vireo solitarius*
Blue-winged Teal	*Anas discors*
Brewer's Blackbird	*Euphagus cyanocephalus*
Broad-winged Hawk	*Buteo platypterus*
Bronzed Cowbird	*Molothrus aeneus*
Brown Creeper	*Certhia americana*
Brown Thrasher	*Toxostoma rufum*
Brown-headed Cowbird	*Molothrus ater*
Bufflehead	*Bucephala albeola*
Calliope Hummingbird	*Selasphorus calliope*
Canada Goose	*Branta canadensis*
Canada Warbler	*Cardellina canadensis*
Canvasback	*Aythya valisineria*
Canyon Wren	*Catherpes mexicanus*
Carolina Chickadee*	*Poecile carolinensis*
Carolina Wren	*Thryothorus ludovicianus*
Cattle Egret	*Bubulcus ibis*
Cave Swallow	*Petrochelidon fulva*
Cedar Waxwing	*Bombycilla cedrorum*
Chestnut-sided Warbler	*Setophaga pensylvanica*
Chimney Swift	*Chaetura pelagica*
Chipping Sparrow	*Spizella passerina*
Chuck-will's-widow*	*Antrostomus carolinensis*
Clay-colored Sparrow	*Spizella pallida*
Cliff Swallow	*Petrochelidon pyrrhonota*
Common Grackle	*Quiscalus quiscula*
Common Ground Dove	*Columbina passerina*
Common Loon	*Gavia immer*
Common Nighthawk	*Chordeiles minor*
Common Poorwill	*Phalaenoptilus nuttallii*
Common Raven	*Corvus corax*

Produced by Siglo Group

Bird Survey (continued)

Common Name	**Scientific Name**
Common Yellowthroat*	*Geothlypis trichas*
Cooper's Hawk	*Accipiter cooperii*
Couch's Kingbird	*Tyrannus couchii*
Crested Caracara	*Caracara cheriway*
Dabbling Duck	*Anatinae*
Dark-eyed Junco	*Junco hyemalis*
Dickcissel*	*Spiza americana*
Domestic Goose	*Anser anser domesticus/A. cygnoides domesticus*
Domestic Muscovy Duck	*Cairina moschata domestica*
Double-crested Cormorant	*Phalacrocorax auritus*
Downy Woodpecker	*Dryobates pubescens*
Eared Grebe	*Podiceps nigricollis*
Eastern Bluebird	*Sialia sialis*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Meadowlark*	*Sturnella magna*
Eastern Phoebe	*Sayornis phoebe*
Eastern Screech-Owl	*Megascops asio*
Eastern Wood-Pewee	*Contopus virens*
Egyptian Goose	*Alopochen aegyptiaca*
Eurasian Collared-Dove	*Streptopelia decaocto*
European Starling	*Sturnus vulgaris*
Field Sparrow*	*Spizella pusilla*
Fox Sparrow	*Passerella iliaca*
Franklin's Gull*	*Leucophaeus pipixcan*
Gadwall	*Mareca strepera*
Golden-cheeked Warbler*	*Setophaga chrysoparia*
Golden-crowned Kinglet	*Regulus satrapa*
Golden-fronted Woodpecker	*Melanerpes aurifrons*
Golden-winged Warbler	*Vermivora chrysoptera*
Grasshopper Sparrow*	*Ammodramus savannarum*
Gray Catbird	*Dumetella carolinensis*
Graylag Goose	*Anser anser*

Common Name	**Scientific Name**
Graylag x Swan Goose hybrid	*Anser spp.*
Great Blue Heron	*Ardea herodias*
Great Crested Flycatcher	*Myiarchus crinitus*
Great Egret	*Ardea alba*
Great Horned Owl	*Bubo virginianus*
Great Roadrunner	*Geococcyx californianus*
Greater Scaup	*Aythya marila*
Greater White-fronted Goose	*Anser albifrons*
Greater/Lesser Scaup	*Aythra spp.*
Great-tailed Grackle	*Quiscalus mexicanus*
Green Heron*	*Butorides virescens*
Green Kingfisher	*Chloroceryle americana*
Green-winged Teal	*Anas carolinensis*
Harris's Sparrow*	*Zonotrichia querula*
Hermit Thrush	*Catharus guttatus*
Hooded Warbler	*Setophaga citrina*
House Finch	*Haemorhous mexicanus*
House Sparrow	*Passer domesticus*
House Wren	*Troglodytes aedon*
Hutton's Vireo	*Vireo huttoni*
Inca Dove	*Columbina inca*
Indian Peafowl	*Pavo cristatus*
Indigo Bunting	*Passerina cyanea*
Killdeer	*Charadrius vociferus*
Ladder-backed Woodpecker	*Dryobates scalaris*
Lark Sparrow*	*Chondestes grammacus*
Least Flycatcher	*Empidonax minimus*
Least Grebe	*Tachybaptus dominicus*
LeConte's Sparrow*	*Ammodramus leconteii*
Lesser Goldfinch	*Spinus psaltria*
Lesser Scaup	*Aythya affinis*
Lincoln's Sparrow	*Melospiza lincolnii*
Little Blue Heron*	*Egretta caerulea*

Common Name	**Scientific Name**
Loggerhead Shrike*	*Lanius ludovicianus*
Long-tailed Duck	*Clangula hyemalis*
Louisiana Waterthrush*	*Parkesia motacilla*
Magnolia Warbler	*Setophaga magnolia*
Mallard	*Anas platyrhynchos*
Mandarin Duck	*Aix galericulata*
Merlin	*Falco columbarius*
Mississippi Kite*	*Ictinia mississippiensis*
Monk Parakeet	*Myiopsitta monachus*
Mourning Dove	*Zenaida macroura*
Mourning Warbler	*Geothlypis philadelphia*
Muscovy Duck	*Cairina moschata*
Mute Swan	*Cygnus olor*
Nashville Warbler	*Leiothlypis ruficapilla*
Neotropic Cormorant	*Phalacrocorax brasilianus*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	*Colaptes auratus*
Northern Harrier	*Circus hudsonius*
Northern Mockingbird	*Mimus polyglottos*
Northern Parula	*Setophaga americana*
Northern Pintail*	*Anas acuta*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Northern Shoveler	*Spatula clypeata*
Northern Waterthrush	*Parkesia noveboracensis*
Olive-sided Flycatcher	*Contopus cooperi*
Orange-crowned Warbler	*Vermivora celata*
Orchard Oriole*	*Icterus spurius*
Osprey	*Pandion haliaetus*
Ovenbird	*Seiurus aurocapilla*
Painted Bunting*	*Passerina ciris*
Peregrine Falcon*	*Falco peregrinus*
Philadelphia Vireo	*Vireo philadelphicus*

Bird Survey (continued)

Common Name	Scientific Name
Pied-billed Grebe	*Podilymbus podiceps*
Pileated Woodpecker*	*Dryocopus pileatus*
Pine Siskin	*Spinus pinus*
Pine Warbler	*Setophaga pinus*
Prothonotary Warbler*	*Protonotaria citrea*
Purple Martin	*Progne subis*
Pyrrhuloxia	*Cardinalis sinuatus*
Red-bellied Woodpecker	*Melanerpes carolinus*
Red-breasted Nuthatch	*Sitta canadensis*
Red-eyed Vireo	*Vireo olivaceus*
Redhead	*Aythya americana*
Red-shouldered Hawk*	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
Red-winged Blackbird	*Agelaius phoeniceus*
Ring-billed Gull	*Larus delawarensis*
Ringed Kingfisher	*Megaceryle torquata*
Ring-necked Duck	*Aythya collaris*
Rock Pigeon	*Columba livia*
Rock Wren	*Salpinctes obsoletus*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Ruby-crowned Kinglet	*Regulus calendula*
Ruby-throated Hummingbird	*Archilochus colubris*
Ruby-throated/Black-chinned Hummingbird	*Archilochus spp.*
Ruddy Duck	*Oxyura jamaicensis*
Rufous Hummingbird	*Selasphorus rufus*
Sandhill Crane	*Grus canadensis*
Savannah Sparrow	*Passerculus sandwichensis*
Scissor-tailed Flycatcher*	*Tyrannus forficatus*
Sharp-shinned Hawk	*Accipiter striatus*
Sharp-shinned/Cooper's Hawk	*Accipiter spp.*
Snow Goose	*Chen caerulescens*
Snowy Egret*	*Egretta thula*
Song Sparrow	*Melospiza melodia*
Spotted Sandpiper	*Actitis macularius*
Spotted Towhee	*Pipilo maculatus*
Summer Tanager*	*Piranga rubra*
Swainson's Hawk*	*Buteo swainsoni*
Swainson's Thrush	*Catharus ustulatus*
Swan Goose	*Anser cygnoides*
Tennessee Warbler	*Leiothlypis peregrina*
Tree Swallow	*Tachycineta bicolor*
Tufted Titmouse	*Baeolophus bicolor*
Turkey Vulture	*Cathartes aura*
Vesper Sparrow	*Pooecetes gramineus*
Warbling Vireo	*Vireo gilvus*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
White-crowned Sparrow	*Zonotrichia leucophrys*
White-eyed Vireo	*Vireo griseus*
White-throated Sparrow	*Zonotrichia albicollis*
White-winged Dove	*Zenaida asiatica*
Wild Turkey*	*Meleagris gallopavo*
Wilson's Warbler	*Cardellina pusilla*
Winter Wren	*Troglodytes hiemalis*
Wood Duck	*Aix sponsa*
Woodhouse's Scrub-Jay	*Aphelocoma woodhouseii*
Yellow Warbler	*Setophaga petechia*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Yellow-billed Cuckoo	*Coccyzus americanus*
Yellow-breasted Chat	*Icteria virens*
Yellow-crowned Night-Heron	*Nyctanassa violacea*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Yellow-rumped Warbler	*Setophaga coronata*
Yellow-throated Vireo	*Vireo flavifrons*
Yellow-rumped Warbler	*Setophaga coronata*
Yellow-throated Vireo	*Vireo flavifrons*

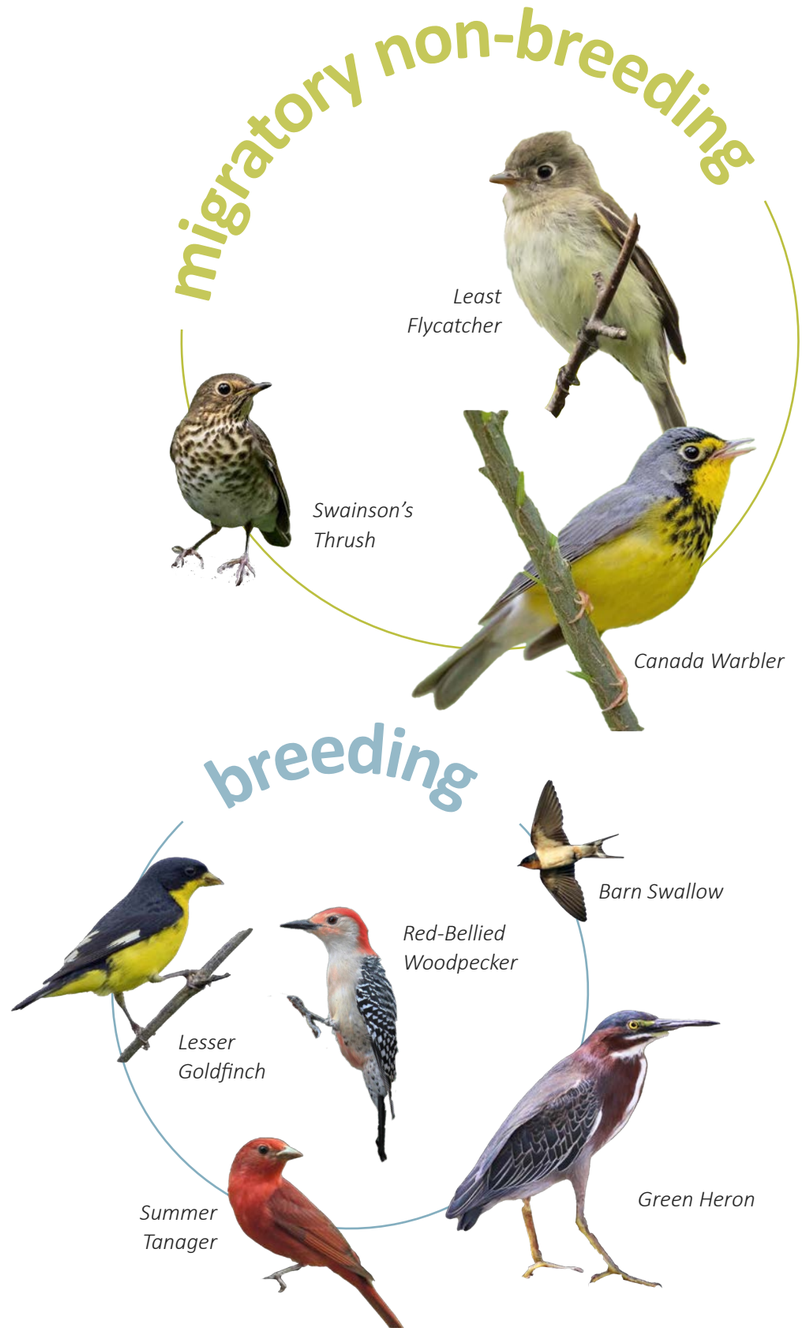


Table 3.4 *Wildlife Survey*

Wildlife Survey

MAMMALS

Common Name	Scientific Name
Common Raccoon	*Procyon lotor*
Coyote	*Canis latrans*
Eastern Cottontail	*Sylvilagus floridanus*
Fox Squirrel	*Sciurus niger*
Gray Fox	*Urocyon cinereoargenteus*
Nine-banded Armadillo	*Dasypus novemcinctus*
Rock Squirrel	*Otospermophilus variegatus*
Virginia Opossum	*Didelphis virginiana*
White-tailed Deer	*Odocoileus virginianus*

AMPHIBIANS

Common Name	Scientific Name
Austin Blind Salamander**	*Eurycea waterlooensis*
Barton Springs Salamander**	*Eurycea sosorum*
Cliff Chirping Frog	*Eleutherodactylus marnockii*
Gulf Coast Toad	*Incilius nebulifer*
Rio Grande Leopard Frog	*Lithobates berlandieri*
Southern Leopard Frog	*Lithobates sphenocephalus*

AQUATIC

Common Name	Scientific Name
Asian Clam (mollusk)	*Corbicula fluminea*
Bluegill (fish)	*Lepomis macrochirus*
Western Mosquitofish (fish)	*Gambusia affinis*

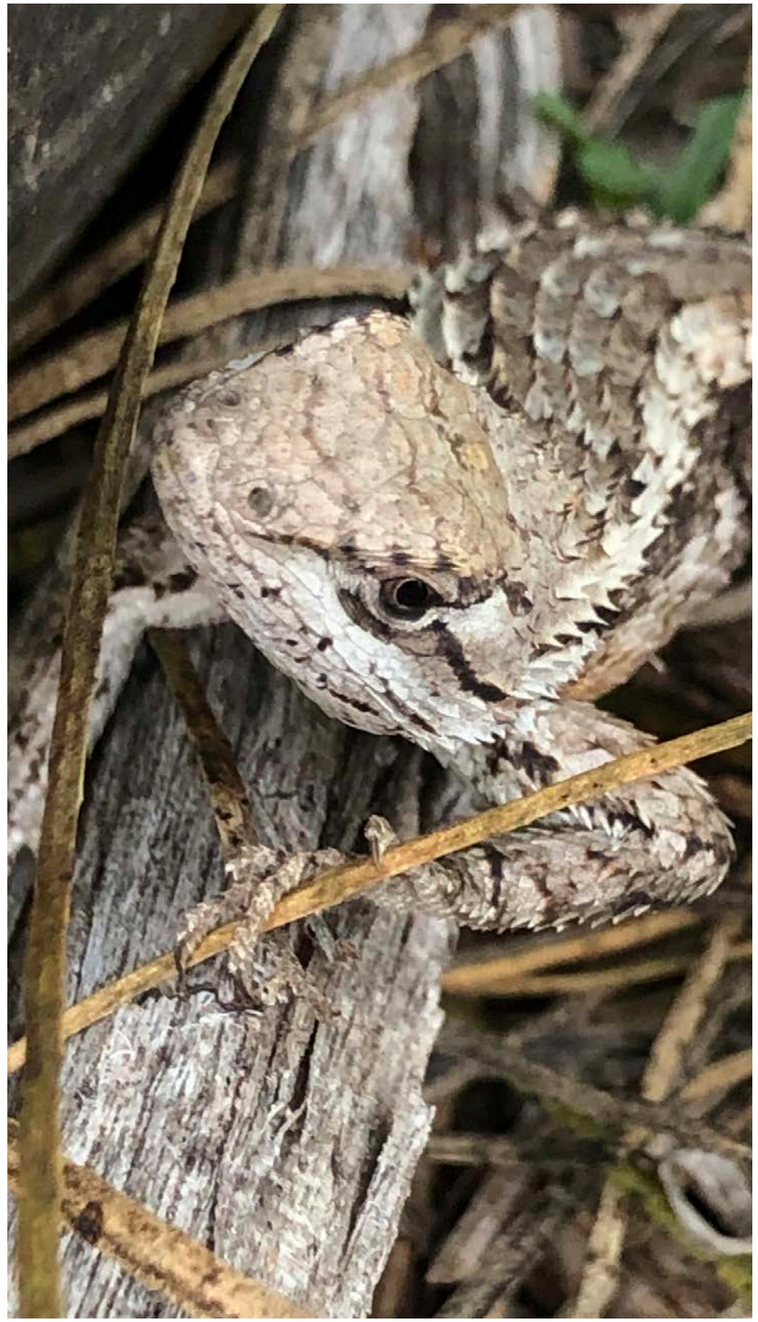
REPTILES

Common Name	Scientific Name
Common Snapping Turtle*	*Chelydra serpentina*
Common Spotted Whiptail	*Aspidoscelis gularis*
Checkered Garter Snake	*Thamnophis marcianus*
Dekay's Brownsnake	*Storeria dekayi*
Diamondback Watersnake	*Nerodia rhombifer*
Eastern Hognose Snake	*Heterodon platirhinos*
Flat-headed Snake	*Tantilla gracilis*
Green Anole	*Anolis carolinensis*
Little Brown Skink	*Scincella lateralis*
Mud Turtle	*Kinosternon spp.*
Plain-bellied Watersnake	*Nerodia erythrogaster*
Red-eared Slider*	*Trachemys scripta elegans*
Rough Greensnake	*Opheodrys aestivus*
Texas Alligator Lizard	*Gerrhonotus infernalis*
Texas Blind Snake	*Rena dulcis*
Texas Coral Snake	*Micrurus tener*
Texas Map Turtle*	*Graptemys versa*
Texas Spiny Lizard	*Sceloporus olivaceus*
Western Diamondback Rattlesnake*	*Crotalus atrox*
Western Ratsnake	*Pantherophis obsoletus*

** Species of Greatest Conservation Need (SGCN)*

*** Federally Endangered Species*

Note: Data included in this list is compiled from eBird and iNaturalist web platforms as well as on the ground survey by Siglo Group. It is important to note that only iNaturalist records with a "research grade" ranking were included (32 species).



Texas Spiny Lizard (iNaturalist)

birds, 6 amphibians, 2 fish, 1 mollusk, 9 mammals, and 20 reptiles (Table 3.3 and 3.4). Four of these are Species of Great Conservation Need (SGCN)—the common snapping turtle, red-eared slider, Texas map turtle, and western diamondback rattlesnake. This list was compiled from on-the-ground surveys, eBird lists, and iNaturalist observations. The iNaturalist contribution is not a comprehensive inventory, it includes only species records with a "research grade" ranking (68 species total). In total, there were 164 species recorded in Zilker Park and 1,356 total observations as of 03/26/2021 on iNaturalist with either a research grade or "needs id" quality rating. According to iNaturalist, the 10 most commonly observed native wildlife are the Yellow-Crowned Night Heron, Texas spiny lizard, white-tailed deer, Great-tailed Grackle, Gulf Coast toad, plain-bellied water snake, Western rat snake, Great Egret, coyote, and diamondback water snake. By maintaining and improving habitat quality, Zilker Park can continue to serve as a refuge for these animals. This section provides an overview of the park's birds, endangered species, and other wildlife based on surveys and crowdsourced data from mobile applications (eBird and iNaturalist).

BIRDS

Barton Springs salamander by Thomas J. Devitt

Breeding bird surveys were completed in Zilker Park from mid-May to mid-June 2020, coinciding with the peak of nesting season and the tail end of spring migration. These surveys provide a repeatable baseline of resident and migrant birds for the study area. Nearly 600 individuals, representing 58 bird species, were identified in the park. Of these species, 48 likely nest in or directly adjacent to Zilker Park (bolded in Table 3.3). According to eBird and iNaturalist, 166 additional bird species have also been observed at the site.[84,85]

The highest bird diversity was observed along Barton Creek in the Degraded Barton Riparian Woodland, Degraded Barton Creek Shoreline, Oak/Juniper/Elm Woodland adjacent to the Barton Creek corridor, and Open Meadow in the trail areas south of the pool. These areas include many different habitats, from relatively dense forest to open meadow, increasing the variety of birds that can live there.

Several neo-tropical migratory songbirds, such as Swainson's Thrush, Bay-breasted Warbler, and Canada Warbler, use Zilker Park as a stop-over point en route to breeding grounds in the North. These species were primarily observed in the wooded corridors in the Degraded Barton Riparian Woodland, Degraded Barton Creek Shoreline, and Lakeshore Riparian Woodland.

Barton Creek is used by several species of wading bird including Great Blue Heron, Great Egret, Green Heron, and Yellow-crowned Night-heron, which were noted hunting for prey along the banks and shallow waters upstream of the pool. These observations illustrate the value of clean surface waters to support healthy fish, amphibian, and insect communities.

Thirty-three of the reported species are listed as Species of Greatest Conservation Need (SGCN) in the Texas Conservation Action Plan. These include American Golden-Plover, American Kestrel, Bell's Vireo, Bewick's Wren, Carolina Chickadee, Chuck-will's-widow, Common Yellowthroat, Dickcissel, Eastern Meadowlark, Field Sparrow, Franklin's Gull, Golden-cheeked Warbler, Grasshopper Sparrow, Green Heron, Harris's Sparrow, Lark Sparrow, LeConte's Sparrow, Little Blue Heron, Loggerhead Shrike, Louisiana Waterthrush, Mississippi Kite, Northern Pintail, Orchard Oriole, Painted Bunting, Peregrine Falcon, Prothonotary Warbler, Red-shouldered Hawk, Scissor-tailed Flycatcher, Snowy Egret, Summer Tanager, Swainson's Hawk, and Wild Turkey. Additionally, the Oaks and Prairies Joint Venture considers Bewick's Wren a species of conservation concern.

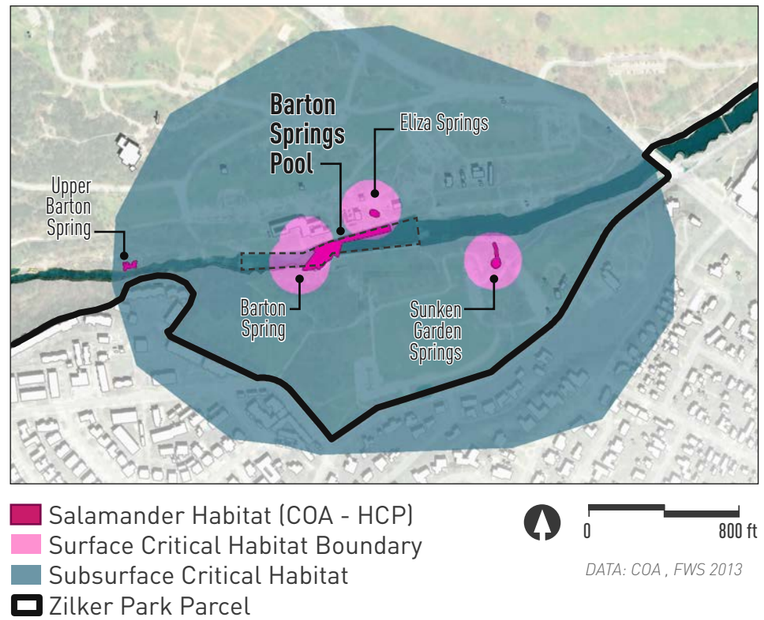


Figure 3.13. *Salamander Habitat*

ENDANGERED SPECIES

The Austin Blind Salamander (*Eurycea waterlooensis*) and the Barton Springs Salamander (*Eurycea sosorum*) are federally endangered species living in Zilker Park's major springs. Averaged over a 10-year period, Eliza Spring had the highest population of the Barton Springs Salamander (4.32/m^2), followed by Barton Springs (0.25/m^2), Upper Barton Springs (0.24/m^2), and Sunken Gardens (Old Mill) Springs (0.093/m^2).[86]

BIOLOGY

Barton Springs Salamanders are members of the family, Plethodontidae (lungless salamanders), and are aquatic throughout its life cycle.[87] They were first collected from Barton Springs in 1946, formally described in 1993, and listed as federally endangered in 1997.[88,89] They have since been identified at other locations in Travis and Hays counties.[90] These salamanders have been studied for more over 20 years, both around spring outlets and in specialized salamander laboratories/refugia operated by the City of Austin.[86,91–93] Austin Blind Salamanders are also members of the lungless salamander family and remain aquatic throughout their life cycle. They were first described in 2001 and listed as federally endangered in 2013.[94,95] They are closely related to Texas blind salamanders (Eurycea [formerly Typhlomolge] rathbuni), which are found in the San Antonio segment of the Edwards Aquifer in San Marcos.[94,96]

HABITAT RANGE & THREATS

The two salamanders live in overlapping habitats. Austin Blind Salamanders are a subterranean species, found on the surface only occasionally. Barton Springs Salamanders are usually found aboveground and are therefore easier to study. Both salamanders are found around outlets of the Barton Springs complex, but their habitat also extends into the subsurface of the Edwards Aquifer.[88,94,97] The two species have been found in all springs on the site except for Upper Barton Spring, where only the Barton Springs Salamander has been found.

Threats to the salamanders include increased withdrawal of groundwater and decreasing water quality because of urbanization, pollution, construction, climate change, increased well use, drought, or other changes in water chemistry; habitat modification; disease or predation; overuse of the springs; and the potential inadequacy of existing regulatory mechanisms.[32,74] A critical habitat boundary—areas of habitat believed to be essential to

Great Egret by Romey Swanson

the species' conservation[98]—has been established for the Austin Blind Salamander (Figure 3.13).[95] It includes both surface and subsurface components. While no critical habitat boundary has been designated for the Barton Springs Salamander, the critical habitat boundary for the Austin Blind Salamander can be used as a rough reference. The critical habitat boundary includes approximately 120 acres that stretches from Barton Springs Road to Barton Creek upstream from the pool. Surface habitats from the City of Austin's Barton Springs Pool Habitat Conservation Plan (HCP) are marked in dark pink.[99] These are areas that the City manages. Only City biologists listed under current federal Endangered Species Act 10(a)(1)(A) and state scientific permits are authorized to manage vegetation in salamander habitat areas. These protected salamander habitat areas in Barton Springs Pool have been redrawn to include more habitat that is, or can be, maintained as suitable habitat and exclude unsuitable habitat areas of Beach.

Existing conservation measures are described in the Barton Springs Pool HCP permit. The original permit was initiated in 1998 and the amended HCP was issued in 2013. This extensive list includes providing educational programs to enhance public awareness and community support for *Eurycea sosorum, Eurycea waterlooensis*, Barton Springs, and the Edwards Aquifer, restricting access to Eliza and Sunken Gardens (Old Mill) Springs, limiting the use of spring water for pool grounds irrigation, inspecting the habitat four days per week, and habitat restoration such as the Eliza daylighting project and planned restoration at Old Mill Springs.[74] The city also maintains a catastrophic spill response plan and, to the maximum extent feasible, diverts polluted stormwater away from the springs and rebuilds them as necessary.

In the next chapter, management recommendations from the salamanders' Habitat Management Plan are integrated into the Natural Area Management Guidelines.[65]

THREATS TO ZILKER PARK'S NATURAL AREAS

Invasive species and soil disturbance are the primary threats to ecological health in Zilker Park.

Top Invasives at Zilker Park

Invasive species were introduced from other countries or regions and cause economic and/or ecological harm. They are one of the primary ecological threats in Zilker Park. Their aggressive growth threatens native plant communities by altering soil chemistry, direct displacement ("crowding out"), and changing the light in or below the canopy. In doing so, they also impact native animals and insects by interfering with their food, shelter, and protection.

A 2006 Austin study found that sites with intact native plant communities had more birds and bird species than those dominated by non-native plants.[100] The impact of invasive species ranks second only to direct habitat destruction as the principal threat to rare species globally, with an estimated 49% of imperiled species being negatively impacted.[101] To maintain and restore

Invasive Plants

Common Name	Botanial Name	TX Invasive	COA	Siglo
Arundo	*Arundo donax*	x	x	x
Bamboo	*Phyllostachys aurea*	x	x	
Bastard cabbage	*Rapistrum rugosum*	x	x	x
Bermudagrass	*Cynodon dactylon*	x	x	x
Catclaw vine	*Macfadyena unguis-cati*		x	x
Chinaberry	*Melia azedarach*	x	x	x
Chinese parasol tree	*Firmiana simplex*	x	x	x
Chinese pistache	*Pistacia chinensis*	x	x	x
Chinese tallow	*Triadica sebifera*	x	x	
Nandina	*Nandina domestica*	x	x	x
Hedge parsley	*Torilis arvensis*	x		x
Japanese honeysuckle	*Lonicera japonica*	x	x	x
Johnsongrass	*Sorghum halepense*	x	x	x
King Ranch bluestem	*Bothriochloa ishaemum*	x	x	x
Ligustrum	*Ligustrum lucidum and L. sinense*	x	x	x
Malta star thistle	*Centaurea melitensis*	x	x	x
Paper mulberry	*Broussonetia papyrifera*	x	x	x
Sweet autumn clematis	*Clematis terniflora*			x
Tree of heaven	*Ailanthus altissima*	x	x	x

Table 3.5 *Invasives at Zilker Park. These have been identified through cross-checking lists from Texas Invasives, the City of Austin Invasive Species Management Plan, and Siglo Group's expertise.*

Arundo along Barton Creek

Chinaberry flowers, an invasive at Zilker

thriving native plant communities at Zilker Park, invasive plants will need to be managed and reduced.

Over 70 non-native species were recorded during the plant survey, with 38 species considered invasive due to their aggressive growth and spread. Of these, 20 species were included in at least one of these 3 lists (Table 3.5)—Texas Invasives, the City of Austin's Top 24 Invasive Species list, or Siglo Group's internal lists.[102] The high priority species from this list include Arundo, bamboo, bastard cabbage, Bermudagrass, catclaw vine, Chinaberry, Chinese parasol tree, Chinese pistache, Chinese tallow, Nandina, hedge parsley, Japanese honeysuckle, Johnsongrass, King Ranch bluestem, Ligustrum, Malta star thistle, paper mulberry, sweet autumn clematis, and tree of heaven.

ARUNDO Arundo (*Arundo donax*) is a tall, thick grass that forms nearly impenetrable monocultures in moist areas. It has dense above-ground growth and large rhizomes that form a thick mat, making revegetation by native species difficult even when above-ground stems have been treated and removed. Arundo is found in dense patches along Barton Creek. It is ranked High both by the City of Austin and within the study area.

BAMBOO Bamboo (*Phyllostachys aurea*) is a fast-growing plant that will quickly spread via underground roots. Its stems turn yellow with exposure to sunlight. This plant can reach a height of 30 ft and grows in dense clusters. It is ranked High by the City of Austin and High within the study area.

BASTARD CABBAGE Bastard cabbage (*Rapistrum rugosum*) is an annual herbaceous plant that can grow up to 5 ft tall. It germinates in the fall and early winter and produces noticeable yellow flowers in early spring and summer. It also has a deep taproot that anchors it to the soil and helps it outcompete native plants. It is ranked High by the City of Austin and High within the study area.

BERMUDAGRASS Bermudagrass (*Cynodon dactylon*) is an aggressive, mat-forming perennial grass that spreads prolifically via seeds, rhizomes, and above-ground runners (stolons). Bermudagrass can sprout easily from stem fragments that are commonly spread in contaminated soils, particularly from nurseries. This grass will often form monocultures, displacing native vegetation and reducing biodiversity. It is found near former and current infrastructure. It is ranked Moderate by the City of Austin and High within the study area.

CATCLAW VINE Catclaw vine (*Macfadyena unguis-cati*) is an aggressive, fast-growing evergreen perennial that can climb over canopy trees. Difficult to control, it grows from underground tubers with vast stores of energy. It is growing aggressively near the Mopac bridge, where it is dominating parts of the understory. Also, one plant has been found in the Degraded Barton Riparian Woodland just south of Barton Creek. Removing individuals before they spread is crucial. It is ranked Moderate by the City of Austin and High within the study area.

CHINABERRY Chinaberry (*Melia azedarach*) is a deciduous tree that forms dense stands, crowding out native vegetation and drastically reducing biodiversity. Its leaf litter can alter soil chemistry, changing conditions for native plants. The largest, densest stand is located along Eanes Creek under Stratford Drive. Here, the varied age classes pose a risk of growing into dense stands if left unchecked. Chinaberry is also common in the Degraded Barton Riparian Woodland. It is ranked High both by the City of Austin and within the study area.

CHINESE PARASOL TREE Chinese parasol tree (*Firmiana simplex*) is a deciduous tree that is noticeable due to its green stems and bark, along with its extremely large three to five-lobed leaves that can turn bright yellow in the fall. Each leaf can grow to be up to 1 ft across and cast significant shade, leading to its name. The tree can reach up to 50 ft in height. It is ranked Moderate by the City of Austin and High within the study area.

CHINESE PISTACHE Chinese pistache (*Pistacia chinensis*) is a deciduous tree that grows up to 25 ft tall. Its glossy green leaves turn yellow, orange, or scarlet in the fall. Female trees will

only produce viable fruit if there is a male tree nearby (seeds from unpollinated fruit will not germinate) but once pollinated can produce large amounts of seed. Chinese pistache grows in forests and grasslands. Pistache competes with native trees and shrubs. It is ranked Moderate by the City of Austin and High within the study area.

CHINESE TALLOW Chinese tallow (*Triadica sebifera*) is a deciduous tree that can form dense stands, crowding out native vegetation. It is found throughout Zilker Park, but generally near water. While Chinese tallow does not currently grow in dense stands at Zilker, it is abundant and could become more dense if not controlled. It is ranked Moderate by the City of Austin and High for the study area.

ELEPHANT EAR Elephant ear (*Colocasia esculenta*) is a perennial herb that can grow up to 4 feet tall. It has thick shoots that emerge from the ground and arrowhead-shaped leaf blades that can reach 24 inches long and 20 inches wide. Underground, the plant has a corm, which is a rounded underground storage organ, consisting of a swollen stem base. The leaves are a dark green color and velvety in texture. The flowers are tiny and densely clustered on the supper part of a fleshy stalk with female flowers below and male flowers above. The fruit are small berries. It is ranked Moderate by the City of Austin and Moderate for the study area.

HEDGE PARSLEY Hedge parsley (*Torilis arvensis*) is an annual weed that produces showy white flowers in early summer and grows up to 3 ft tall. It is commonly found in disturbed soils—especially the southern degraded meadow—and is often associated with clay loams and calcareous clays. It also has a taproot, self-seeds, and scatters its bristly seeds on fur and clothing. While not listed in Austin's top 24 invasive species list, it is ranked Moderate in Zilker Park due to the threat it poses to the natural areas.

JAPANESE HONEYSUCKLE Japanese honeysuckle (*Lonicera japonica*) is an extremely vigorous, fast growing woody perennial that shades the native plants it uses as a trellis. It can grow 15–30 ft in length and has a spread of 3 to 6 ft. At Zilker Park, Japanese honeysuckle is mostly found in the moist soils of riparian areas. It is ranked Moderate both by the City of Austin and within the study area.

JOHNSONGRASS Johnsongrass (*Sorghum halepense*) easily overpowers native vegetation by forming vast monocultures and inhibiting the growth of other plants. It spreads from rhizomes, seed dispersal, and in contaminated soil. It is most abundant in the southern Open Meadows. It is ranked High by the City of Austin and High within the study area.

KING RANCH BLUESTEM King Ranch bluestem (*Bothriochloa ischaemum* var. *songarica*) is a bunchgrass that grows to 3 ft tall in dense monocultures that severely reduce diversity. It is found in sunny, flat patches in higher elevations and spreads vigorously via seed—which is either intentionally planted or dispersed by vehicles, maintenance equipment, or wind. It has an unknown ranking from the City of Austin and is ranked Moderate within the study area.

LIGUSTRUM Ligustrum (*Ligustrum* spp.) are small evergreen trees, several species of which can form dense monocultures that crowd out native vegetation. Such patches can be seen on the banks of Barton Creek between the pool and Barton Springs Road. In addition, there are patches dominated by Ligustrum upslope from the Violet Crown Trail. In these areas, as well as patchy areas throughout the park, Ligustrum is having a substantial impact. It is ranked High by the City of Austin and High within the study area.

MALTA STAR THISTLE Malta star thistle (*Centaurea melitensis*) is a cool-season annual with spiny flowerheads. It grows as a rosette during the fall and winter and flowers in the spring. It spreads primarily by seeds carried by birds, vehicles, or maintenance equipment. Malta star thistle grows best in frequently disturbed or mowed sites like roadsides but can invade most grasslands. It can crowd out native cool-season species, which

Catclaw vine infestation at the Botanical Garden

includes most of our spring wildflowers. It is ranked Moderate by the City of Austin and Moderate within the study area.

NANDINA Nandina (*Nandina domestica*) is an upright woody plant with long basal cane-like stems. It has varied green-red foliage and cream flowers that develop into red berries. It can grow up to 6-10 ft tall and spreads via rhizomes and animal-dispersed seeds. It is found along Barton Creek, in the uplands near Barton Springs Pool, and around the Austin Nature & Science Center. It is ranked Moderate by the City of Austin and High for the study area.

PAPER MULBERRY Paper mulberry (*Broussonetia papyrifera*) is a deciduous tree that can reach 45 ft in height. Its leaves have a characteristic rough texture and vary in shape from simple to lobed or mitten shaped. Paper mulberry is spread by birds and by root sprouts. It thrives in open forests, field edges and disturbed sites. It is ranked Moderate by the City of Austin and Moderate within the study area.

SWEET AUTUMN CLEMATIS Sweet autumn clematis (*Clematis terniflora*) is a climbing vine that forms dense blankets over trees, shrubs, and other vegetation, blocking vital sunlight. Dense patches are common throughout the entire study area. While not listed in Austin's top 24 invasive species list, it is ranked Moderate in Zilker Park due to the threat it to the natural areas.

TREE OF HEAVEN Tree of heaven (*Ailanthus altissima*) is a rapidly growing tree that can reach up to 80 ft tall. Its other common name (stinking sumac) hints at the foul odor of the flowers and leaves. Tree of heaven produces prolific seeds that are spread by wind and water. It will also create thickets from root sprouts. It is common in disturbed areas and tolerates shade and sun. The dense thickets will outcompete native plants through competition for light and by producing toxins that prevent other plants from growing. It is ranked Moderate by the City of Austin and Moderate within the study area.

Poison ivy

A NOTE ON POISON IVY

Though poison ivy (*Toxicodendron radicans*) is native, it can be problematic in areas close to trails where people can easily brush against the plants. In areas without human recreation, however, poison ivy is a desirable plant, providing groundcover, erosion control, lovely fall foliage, a food source for wildlife, and the ability to outcompete many invasive species. PARD recommends cutting back poison ivy back from the trail but not completely removing it. This practice should continue as it enhances the user experience while protecting and restoring the natural systems.

A NOTE ON GIANT RAGWEED

While giant ragweed (*Ambrosia trifida*) is known for its dense and aggressive growth and as a common cause of allergies, this plant also has ecological benefits.[103] It reduces off trail activity and provides shade during hot Texas summers, cooling the soil and keeping it moist. This creates ideal growing conditions for young tree seedlings. Ragweed's taproot also penetrates deep into the soil, preventing compaction, reducing runoff, and increasing water infiltration. Over time, tree seedlings will grow tall enough to shade the ragweed and create a new woodland.

Giant ragweed

SOIL DISTURBANCE: EROSION, DEPOSITION, AND COMPACTION

Any action or infrastructure that removes, compacts, or covers soil will have an impact on a site's ability to support a healthy ecosystem. The primary causes of soil disturbance in Zilker Park are stormwater flow, poorly functioning or absent infrastructure, mowing and use of other heavy machinery, off-trail recreation, formal recreation without suitable supporting infrastructure, and erosion of trail material. Soil disturbance is problematic in all areas but is particularly concerning along environmentally sensitive waterways.

Field data were taken on soil erosion issues at 140 points throughout the study area as seen in Figure 3.14. The following characteristics were recorded:

- Erosion type (described below)
- Size of the disturbance (under 100 ft2, 100 to 650 ft2, 650 ft2 to 0.25 acres, and > 0.25 acres)
- Disturbance stability (needs immediate attention, needs to be put into management plan, or stable and low priority)
- Probable cause of the disturbance (pet traffic, unauthorized or authorized human traffic, wildlife traffic, flood events along waterways, stormwater flow from infrastructure, habitat improvement project, or other)

INFORMAL TRAILS

Informal trails are paths created by foot traffic and are not created or maintained by park staff. Informal trails with trampled vegetation and compacted soils often lead to sheet erosion, rills, or gullies. These trails are found throughout the park in areas where people want to access water along Barton Creek and Lady Bird Lake; where people are moving between park areas, such as from parking areas to parkland; and where people who are experiencing homelessness access sleeping areas. Several informal trails terminated in areas with tents, clothing, cooking utensils, and bedrolls.

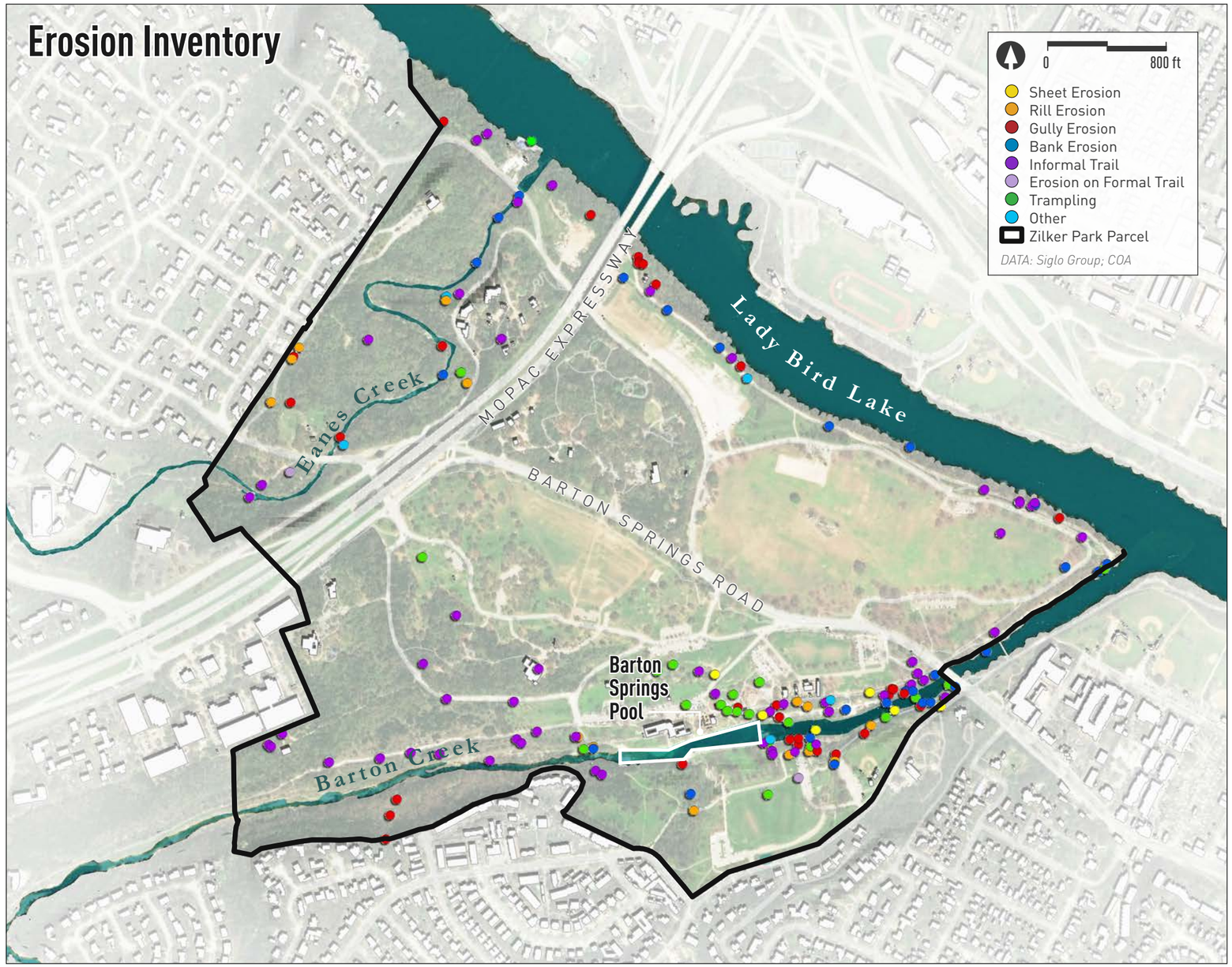


Figure 3.14. *Erosion Inventory*

TRAMPLING

Trampling is a result of off-trail foot traffic not confined to a trail. Trampling destroys vegetation and prevents its reestablishment. It also compacts the soil, reducing water infiltration and seedling establishment, decreasing organic matter, increasing soil temperature, altering soil biota, increasing runoff, and causing erosion.

Numerous areas are impacted by trampling including the stretch of Barton Creek between Barton Springs Pool and the Barton Springs Road Bridge, much of the Disc Golf Course area, and between parking areas and Barton Springs Pool. Trampling is a critical concern along Barton Creek where formal water access has not kept pace with the area's popularity, resulting in substantial ecological degradation.

COMPACTION

Compaction is a loss of soil porosity. It inhibits plant growth and can lead to erosion. Over the years, the weight of music festival stages in the Great Lawn near Lou Neff Point has led to compaction around tree roots so severe it resulted in tree death.[104] Soils in the Polo Fields have also been heavily compacted by overflow parking, leading to soil compression so great it is almost like a road.[71]

SHEET EROSION

Sheet erosion is the removal of thin layers of soil due to precipitation and shallow surface flow. At Zilker Park, it is found associated with trampling and slopes in areas like the Degraded Barton Riparian Woodland and along the slopes from the trail to the Lady Bird Lake shoreline. It also occurs in areas with less slope like the Disc Golf Course area. Sheet erosion results in the loss of topsoil critical for vegetation establishment and can result in larger erosion issues like rill and gully erosion if not addressed.

Decomposed granite decomposition near water edge

Gully erosion forming from stormwater off paved areas

RILL AND GULLY EROSION

Rill erosion is the formation of one or more small channels less than 1 ft deep; gullies are deeper than 1 ft. If the conditions that led to their formation continue unchecked, these channels may deepen. Rill erosion is most often found in washes adjacent to parking areas or roads, as well as on slopes leading to Barton Creek and the lake. The most gullies were observed on the north shore of Barton Creek between the pool and Barton Springs Road as well as on the lakeshore under and just to the east of Mopac. Gullies and rills that have not been armored or stabilized pose a threat to trails as they may eventually intercept and damage them.

Causes of rill and gully erosion include:

- Areas with high amounts of off-trail recreation, including informal trails and trampled areas on slopes, where vegetation is removed and soil begins to erode.
- Low-lying areas, including any areas where the topography of the landscape funnels water. When this occurs in areas that lack infrastructure to disperse or slow the water, the concentration of runoff can erode the landscape.
- Infrastructure that does not account for storm water runoff such as the parking areas adjacent to the Rugby Fields and around Mopac and the culverts that move water beneath the Butler Trail but are not armored below their outlet.

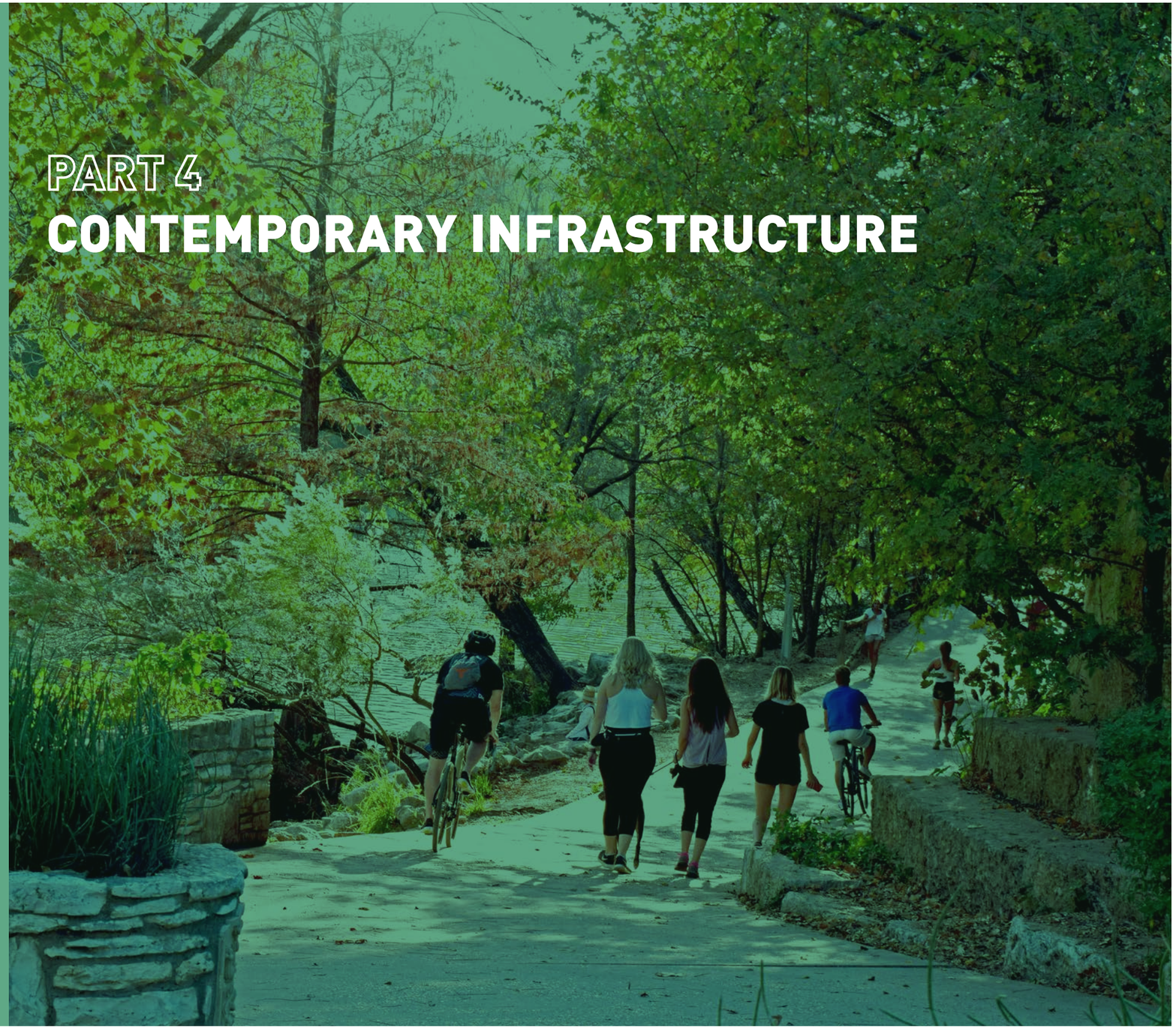
BANK EROSION

Bank erosion is found along both creeks and the Lady Bird Lake shoreline. It is a result of their urban setting and the powerful force of water after major rain events. These erosion issues are created by watershed-wide conditions that cannot be mitigated within the park. Long-term solutions are expensive and often require large capital improvements. Along Barton Creek, streambank erosion is intensified by trampling. Areas of Eanes Creek show cut banks of up to 20 ft just upstream from Stratford Drive. This bank erosion is resulting in tree mortality with numerous large trees recently falling over due to compromised banks.

EROSION ON FORMAL TRAILS

In some areas, decomposed granite is leaving the trail and entering either natural areas or waterways. This material can bury native plants and make the soil more susceptible to erosion, thus lowering the quality of the natural area. Deposition is occurring throughout the park but is pronounced near the Violet Crown Trailhead, on steep slopes in the Degraded Barton Riparian Woodland, and throughout much of the Butler Trail along the lake and creek.

Trampling from human traffic compacts soil and prevents plant establishment



PART 4
CONTEMPORARY INFRASTRUCTURE

Modern-day Zilker Park is the culmination of park use and development, as summarized in the Historic & Cultural Use chapter. The contemporary infrastructure of Zilker Park has a direct impact on the quality and quantity of the park's natural resources. By assessing the current infrastructure of the park, areas for improvement can be determined to improve the integration of infrastructure with the natural environment. In addition, the information here will support the upcoming Zilker Vision Plan process that will consider the needs and quality of infrastructure throughout the park in greater detail.

2021

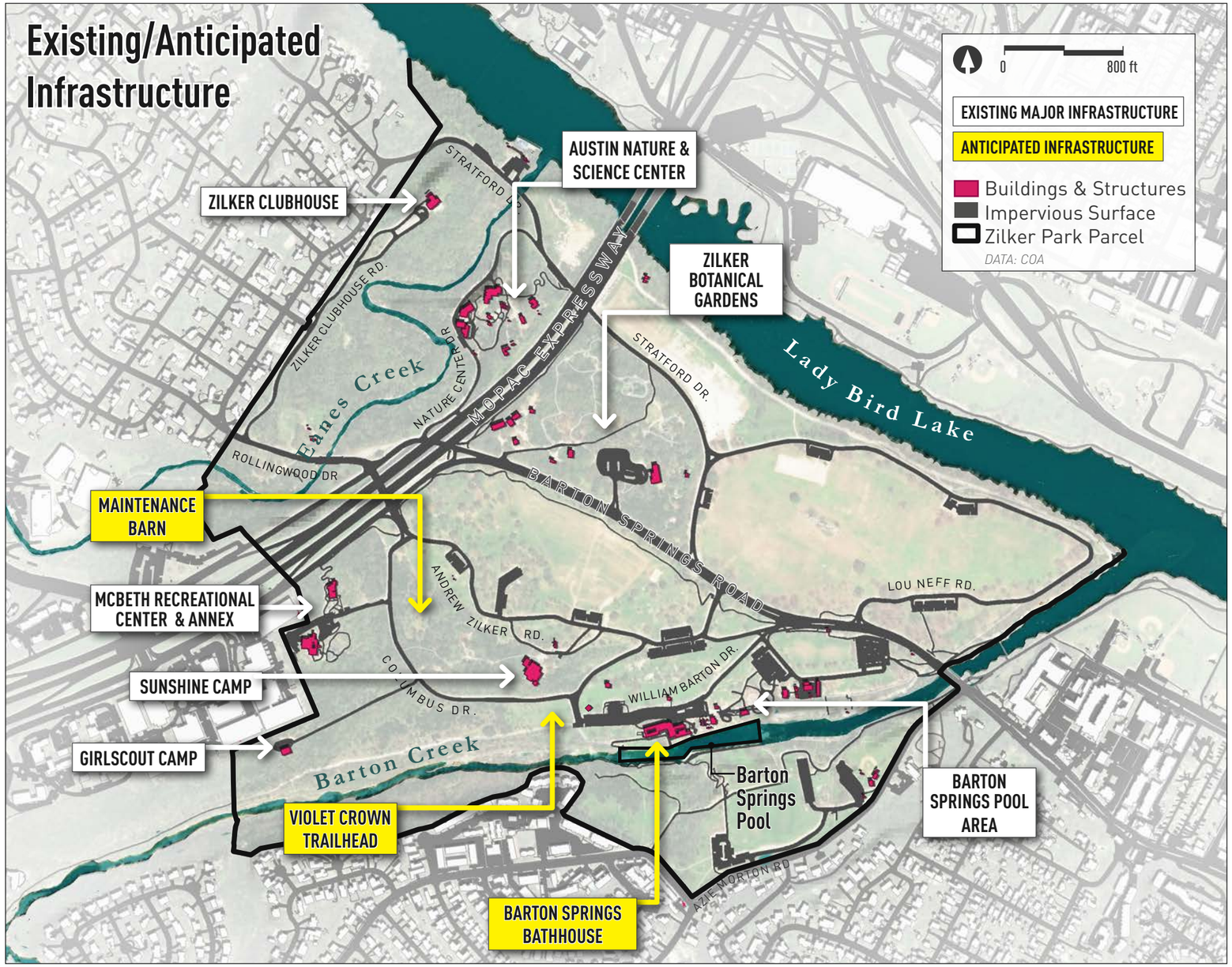


Figure 4.1 *Existing/Anticipated Infrastructure*

INFRASTRUCTURE

EXISTING INFRASTRUCTURE

There are 51 acres of built structures and associated impervious cover in Zilker Park (Figure 4.1). This includes 2.4 acres of buildings, 12.7 acres of parking lots, 1.3 acres of access roads (for more detail on parking lots see Vehicle Circulation section), 20.2 acres of roads (for more detail on road types see Vehicle Circulation section), 8.8 acres of Mopac Expressway, and 5.6 acres of impervious pedestrian infrastructure (for more detail on pedestrian infrastructure see Active Transportation section). Major areas of existing infrastructure are marked by groups of built structures and associated pedestrian and vehicle access. These include the Barton Springs Pool Area, Zilker Caretaker's Cottage, Zilker Botanical Garden, Austin Nature & Science Center, Zilker Clubhouse, McBeth Recreation Center & Annex, Girl Scout Hut, and the Sunshine Camp.

BARTON SPRINGS POOL AREA

Barton Springs Pool received 975,000 visitors in 2018, with an estimated 200,000-person increase in visitorship each year since 2014.[63] The existing infrastructure surrounding Barton Springs Pool includes the Barton Springs Bathhouse, Zilker Hillside Theater, Beverly S. Sheffield Education Center, Zilker Café, Zilker Zephyr Train Station, and the Zilker Metropolitan Park Playscape Shelter. In 2020, the Zilker Zephyr train tracks were removed, but the City plans to relaunch the train system in August 2021.[66,67]

ZILKER CARETAKER'S COTTAGE

The Zilker Caretaker's Cottage is a one-story masonry I-plan residence with a steeply gabled roof. Multicolored masonry exhibits a "peanut brittle" pattern. It features double-hung, six-over-six and nine-over-nine windows. Many families have lived in this cottage over its history. The Robinsons lived there from the 1930s until the early 1970s, and at least two other families later raised children

The Girl Scout Hut is on the far west side of Zilker Park.

there.[105] The building closed as a residence in 2010 and became the Park Ranger Headquarters in 2017 following a complete rehabilitation.

ZILKER BOTANICAL GARDEN

The Zilker Botanical Garden is open year-round, with an estimated annual attendance of over 125,000 visitors per year.[106] This 28-acre area includes the Garden Center, formal gardens, the Taniguchi Japanese Garden Tea House, and service structures.[107]

AUSTIN NATURE & SCIENCE CENTER

The Austin Nature & Science Center hosts over 230,000 visitors annually.[108] Existing infrastructure includes the Austin Nature & Science Center main building, Nature's Way Preschool, and six other supporting buildings.

ZILKER CLUBHOUSE

The Zilker Clubhouse is a hilltop ranch-style lodge owned by City of Austin that offers a panoramic view of downtown Austin. This space is rentable and is typically booked for weddings, parties, and meetings. It can hold 200 people at a time.[109]

MCBETH RECREATION CENTER & ANNEX

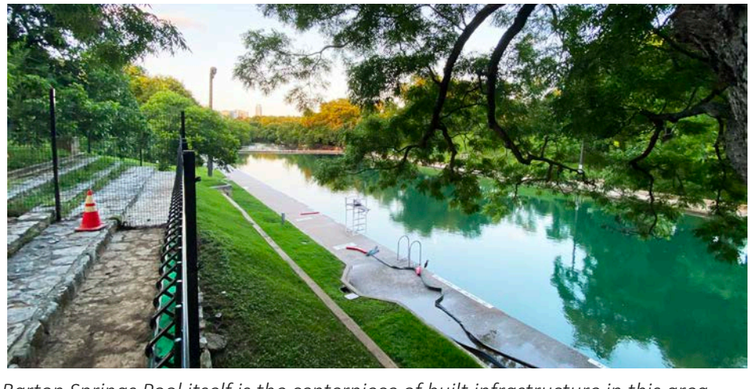
The Danny G. McBeth Recreation Center (also known as the McBeth Recreation Center) and Annex offers year-round programs for youth, teens, and adults.[110] This complex has direct access to the Violet Crown Trail.

GIRL SCOUT HUT

The Girl Scout Hut (also known by the Girl Scouts as Zilker Cabin) is a rustic building available for overnight trips, with a maximum capacity of 32 for overnight use and 50 for day use.[111]

SUNSHINE CAMP

The Sunshine Camp features camp offices and the 21,000 sq ft Zilker Lodge. This area of the park is home to summer camps for local schoolchildren, aged 8-15. In 2019, the summer camp program served 1,093 campers and over 9,000 guests were invited to the lodge through the Zilker Lodge Rental Program.[112]



Barton Springs Pool itself is the centerpiece of built infrastructure in this area.

ANTICIPATED INFRASTRUCTURE

According to communications with City of Austin officials and review of relevant site plans, there are several improvements slated for installation in Zilker Park in the coming years. These include a new maintenance barn, the Violet Crown Trailhead, and Barton Springs Bathhouse updates at Barton Springs Pool (Figure 4.1).

MAINTENANCE BARN

The existing maintenance facility is located on the northern side of Barton Creek, just downstream from Barton Springs Pool. The proposed new maintenance facility (the 'Maintenance Barn') will still be located in Zilker Park, at 2328 Columbus Drive, Austin, TX 78746. The new facility will include roughly 2 acres in new buildings and impervious cover.

VIOLET CROWN TRAILHEAD

The existing Violet Crown Trailhead begins at the west end of the Barton Springs Pool parking lot and hugs the riparian tree line on its path westward. The new trailhead will feature a simplified access plaza with safer access to the trailhead from the Hillside Theater; an 8–10-foot-wide trail through a wildflower meadow with informational signage; a meadow pavilion; a Barton Creek overlook at an existing pecan tree; a restroom facility; and access to Barton Springs Pool.

BARTON SPRINGS BATHHOUSE

Renovations to the Barton Springs Bathhouse at Barton Springs Pool are planned for the near future. While the building's footprint will remain unchanged, several improvements will take place in the interior. Changes include reopening the original pool entrance at the central rotunda area, reconfiguration of the Beverly S. Sheffield Education Center and Splash! Exhibit, restoration of the women's changing room, improvements to pedestrian circulation in the Bathhouse Zone, and enhancement of the connection between the Violet Crown Trailhead and Barton Springs Road.

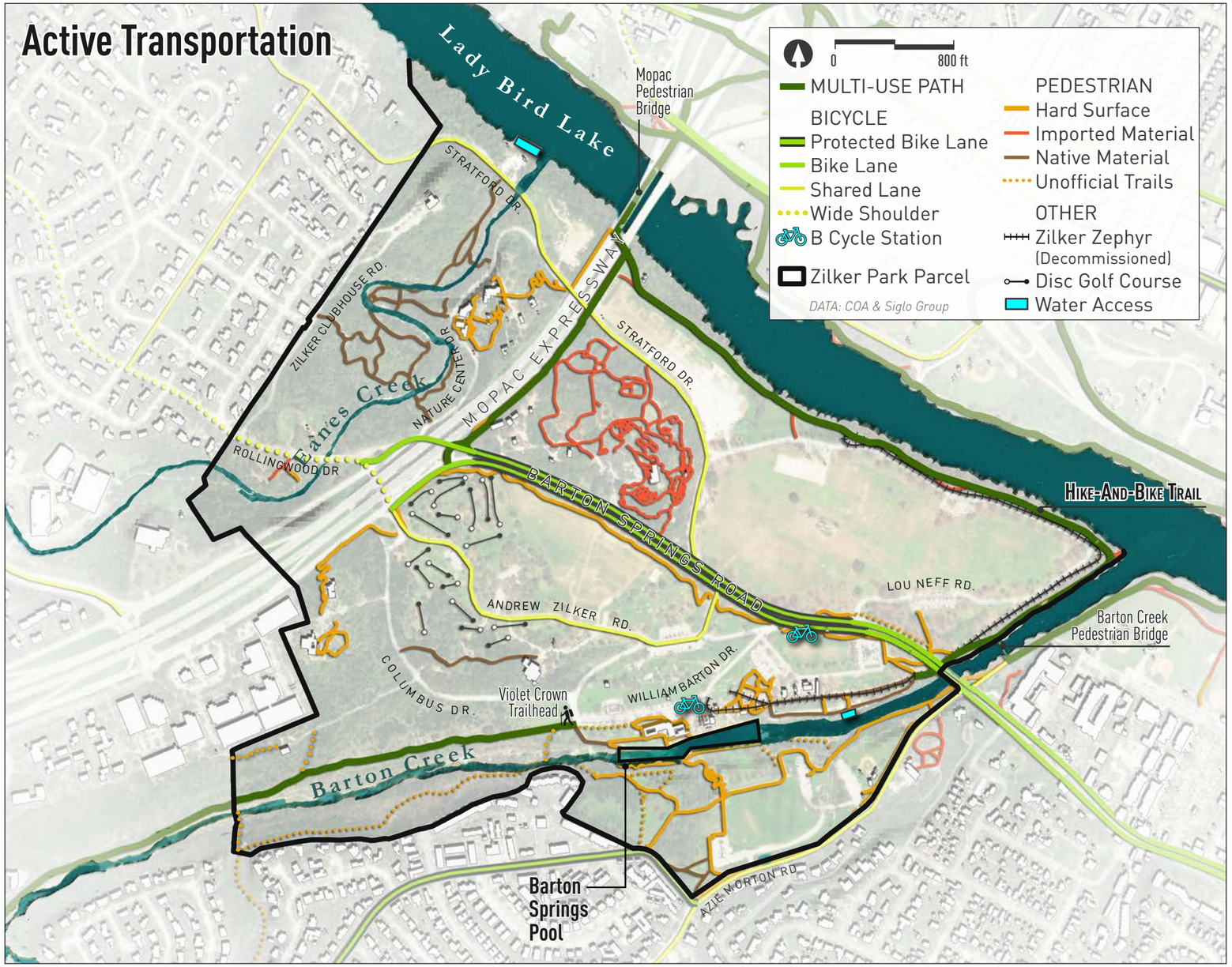


Figure 4.2 *Active transportation*

TRANSPORTATION & CIRCULATION

ACTIVE TRANSPORTATION

Active transportation routes in Zilker Park, consist of multi-use paths, bicycle paths, pedestrian paths, water access points, and other supporting infrastructure (Figure 4.2).

Two of the most popular trails in Austin go through Zilker Park: the Butler Trail that circles Lady Bird Lake and the Violet Crown Trail that gives users access to the Barton Creek Greenbelt. These, as well as other trails in the park, facilitate biking, walking, and running. The Butler Trail's popularity can lead to congestion, especially on weekends or holidays. Further, the close proximity to fast-moving bicyclers can make pedestrians feel unsafe. Numerous possibilities exist to relieve this tension including parallel trails in areas of greatest congestion to accommodate different uses.

Bicycle paths include protected bike lanes, bike lanes, shared lanes, and wide shoulder lanes. Both unprotected and protected bike lanes mainly run along Barton Springs Road. However, these paths can be hot, due to unshaded pavement. Additionally, fast-moving vehicle traffic can make it difficult to cross this busy street by bike. If addressed, this could make circulation within the park more efficient. Shared lane roads are Stratford Drive, Andrew Zilker Road, and Azie Morton Road. Rollingwood Drive is a wide shoulder road.

Pedestrian paths are composed of hard surface (paved paths), imported material (decomposed granite), or native material (bare ground or mulch). Paved paths are predominately found around Barton Springs Pool and along Barton Creek downstream of the pool. They are primarily used to direct foot traffic between buildings, parking lots, and sports areas. Currently, navigating the pedestrian paths from the Butler Trail to Barton Springs can be unclear for trail users. The route includes travel along an unmarked, unofficial trail formerly next to the decommissioned Zilker Zephyr tracks. Formalizing this path would ease the transition between

these two popular areas and improve circulation in the park. Imported material paths mostly lie in the Zilker Botanical Garden, and native material paths are in the natural areas like the Zilker Nature Preserve. Unofficial trails are clustered along Barton Creek. Additionally, the heavily trafficked path to Bark'n Springs and along Barton Creek south of the pool is in need of a better approach to manage access. Bark'n Springs is also important from an equity perspective. Barton Springs Pool access is paid, which excludes people who cannot pay. Bark'n Springs constitutes an alternative to enjoy the cold water and beauty of the area without having to pay the entrance fee. Existing features of this area are not welcoming to park users. There are pointed rocks in the cement matrix lining the banks. However, people still use it even if it is not designed as an amenity. Designing the space for better enjoyment while focusing access to fewer points and enhancing the ecological function of the overall area are critical to the long-term use of the area.

Water access points in Zilker Park include Zilker Park Boat Rentals on Barton Creek downstream of the Pool, the Rowing Dock on Lady Bird Lake west of Mopac, and an access point just upstream of Lou Neff Point. There are unofficial water access points throughout the park with numerous found along both sides of Barton Creek, a few along Lady Bird Lake, and a large access point beneath Mopac.

SHADE OVER TRAILS

Shade over Zilker Park's heavily used trails supports pedestrian circulation, especially during hot Texas summers (Figure 4.3). The most shaded trails in the park occur in and along woodlands, while hard surface trails that line major roads with higher levels of impervious cover tend to be relatively devoid of shade. Nearly a third (39%) of paths in Zilker Park are covered in shade. This leaves the remaining 61% of trails exposed to the harsh heat of direct sun. Shade is particularly important over hard surface trails, because of the relationship between impervious cover and increased ground temperatures. For multiuse paths in particular, shade over the trail facilitates outdoor physical activity, even in hot summer

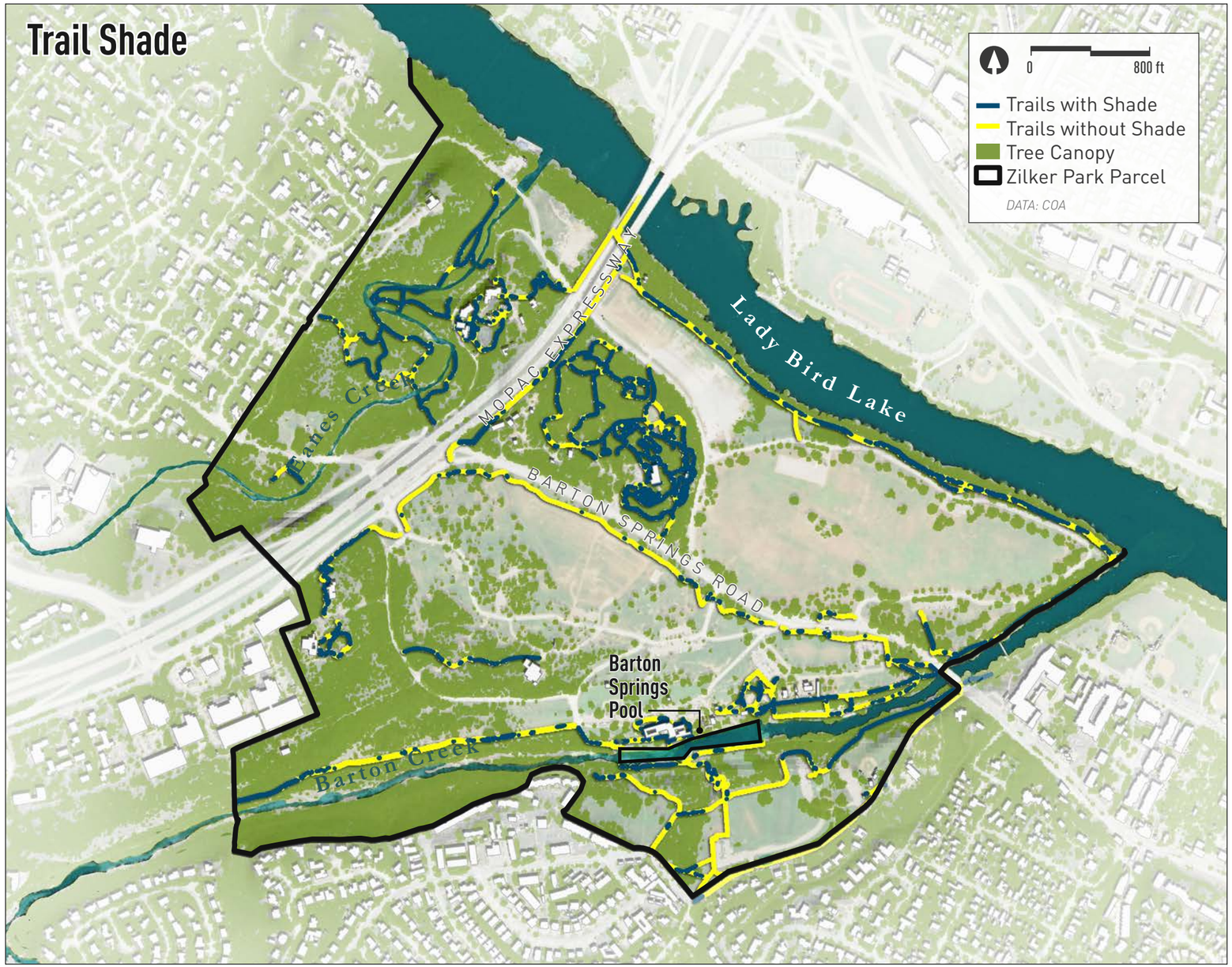


Figure 4.3 *Trail Shade*

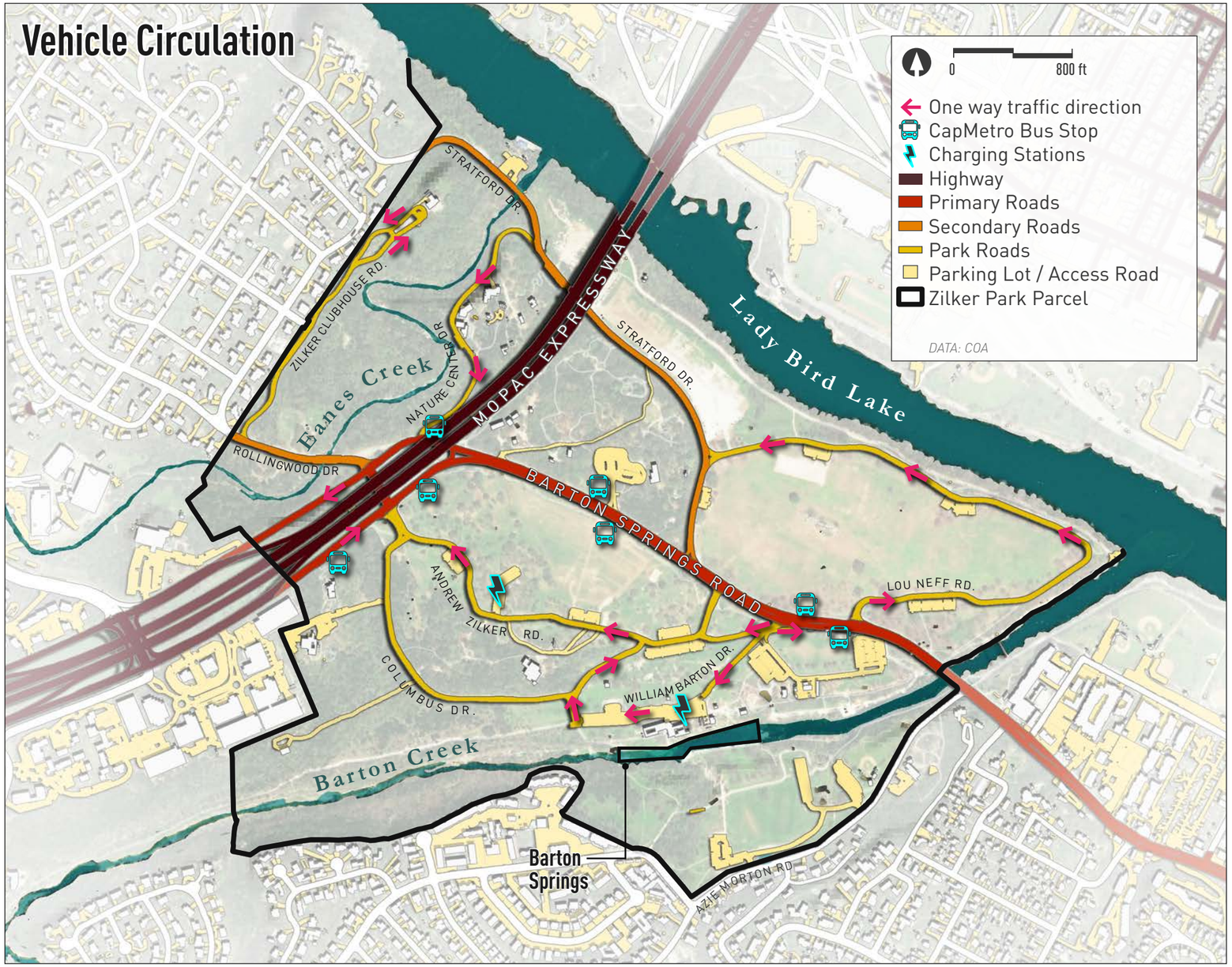


Figure 4.4 *Vehicular circulation*

temperatures. There are four critical areas where a lack of shaded trails is impeding active transportation and park circulation:

- Barton Springs Road is a major active transportation connector. Not only do these paths link park visitors to CapMetro bus stops (discussed in the following Vehicle Circulation section), but they also connect park amenities in northern Zilker Park to those in the south.
- A cluster of unshaded trails south of Barton Springs Pool connects the pool, parking lots, and trails. These paths are in high use during summer, making shade a critical feature.
- The Violet Crown Trail lacks shade in some areas. This is a popular route for hiking, off-road biking, and running—all of which are supported by shade over trail.
- Sections of the Butler Trail are without shade with the largest areas just east of Mopac and just west of Lou Neff Point. Shade in these areas would positively impact the experience of millions of trail users.

VEHICLE CIRCULATION

There are five road types for vehicle circulation in Zilker Park. These include the Mopac Expressway (Mopac) that passes over the park, primary roads, secondary roads, park roads, and supporting infrastructure like bus stops, charging stations, parking lots, and bridges (Figure 4.4).

Mopac bisects the park, running north and south. It was built in 1974 with current discussions of expansion.[113] Mopac is elevated over more than half of the section of the park that it runs through. The area elevated from Stratford Drive to the lake (the Butler Landfill) is utilized for parking. The high levels of impervious cover in this area are a concern and need to be addressed. However, the consolidation of infrastructure makes for efficient use of the area. The area where Rollingwood Drive and Barton Springs Road go under Mopac offer additional opportunities for supporting

infrastructure including stormwater management and parking.

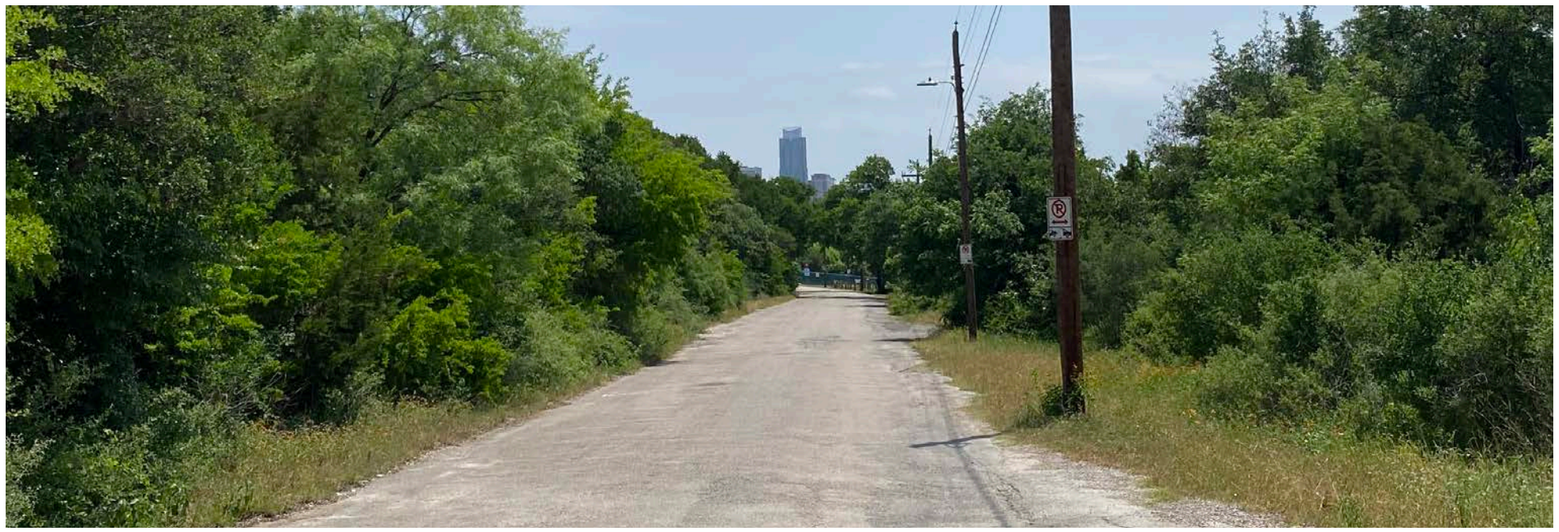
The park's primary road, Barton Springs Road bisects the park, going east and west and connects South-Central Austin to the park and Mopac. Traffic counts on Barton Springs Road west of Azie Morton Road average 22,190 vehicles per day.[114]

Secondary roads connect to Barton Springs Road, moving traffic to and from the park's edge. They are Azie Morton to the south, central Stratford Drive, and Rollingwood Drive to the west.

- Azie Morton Road provides access to Barton Springs Pool's south entrance, as well as the Umlauf Sculpture Garden, picnic areas, baseball fields, and parking lots. It moves an estimated 4,330 vehicles per day, as gauged near the park's southern border.[114]
- Stratford Drive provides access to the Austin Nature & Science Center, the Butler Trail, the Butler Landfill overflow parking area, a rowing dock, and onward out of the park boundary into a residential neighborhood. It carries roughly 2,393 vehicles per day.[114]
- Rollingwood Drive runs through a small portion of the Zilker Nature Preserve in the western side of the study area and provides access to the Pistol & Skeet Range. Vehicle counts were not available for this road.

Park roads include Lou Neff Road, Andrew Zilker Road, Columbus Drive, William Barton Drive, Nature Center Drive, and Zilker Clubhouse Road. Lou Neff is a major looped park road that provides access to the soccer fields, Great Lawn, volleyball courts, and parking areas. William Barton Road provides access to Barton Springs Pool, the Violet Crown Trailhead, and parking lots. It links with Columbus Drive and Andrew Zilker Road, which together provide access to the Disc Golf Course, Polo Field, McBeth Recreation Center, Girl Scout Hut, and Sunshine Camp.

Supporting infrastructure includes seven bus stops, two areas with electric vehicle charging stations, parking lots, and bridges. The seven bus stops within Zilker Park are all positioned along Barton Springs Drive and the Mopac frontage road. Most, if not all, bus stops lack ADA accessibility and connectivity. There is currently one CapMetro bus line that travels within Zilker Park—Route 30, which provides service to, from, and via Downtown Austin along major streets.[115] Zilker Park's four electric vehicle charging stations are all clustered in two areas on the southwest side of Barton Springs Road. Zilker Park contains 632 paved parking spaces.[71] In addition, about 800 unpaved overflow parking lots are located along Stratford Drive and Lou Neff Road, which includes parking over the Butler Landfill.[71] Also, overflow parking directly on the Polo Field provides an additional 1,000 spaces, but the city is currently in discussion about whether to restrict parking in these areas. Zilker Park has two vehicle bridges—the Barton Springs Road bridge, which crosses Barton Creek—and the Mopac bridge, which crosses Lady Bird Lake and passes over the park.



Representative view of paved road on Columbus Drive.

FUTURE TRANSPORTATION NEEDS

The Zilker Park Working Group (ZPWG) was established in 2018 and tasked with providing input for several focus areas related to parking and traffic circulation in the park. A list of transportation recommendations for inclusion in the master plan "scope of work" may be found in Figure 4.5. These recommendations only capture a portion of the full list of suggestions made by the ZPWG. They include: increasing pedestrian and bicycle safety; prioritizing pedestrian and bicycle transportation; minimizing private automobile traffic within the park; options for a circulator system like a shuttle bus or the Zilker Zephyr; a permanent shuttle from off-site parking; prioritizing high-occupancy vehicles and ADA spaces for parking spaces; considering options for pre-paid parking; adding a parking garage; reevaluating CapMetro bus stops; converting Andrew Zilker Rd and Lou Neff Rd to shared use paths with separate pedestrian and bike/scooter lanes; and re-aligning trails and shared-use paths to the best locations for convenient active transportation.[71] Of note, CapMetro bus stop routes will not be altered in the near future, as they were modified as part of Connections 2025/Cap Remap.

In preparation for the master plan, the ZPWG also made short-term transportation recommendations to pilot possible parking

and transportation programs to improve city-wide access to the park. These programs were intended to begin by Summer 2019 and included piloting a shuttle program, implementing and enforcing paid parking, establishing partnerships with nearby parking facilities, increasing the frequency of the #30 Cap Metro bus line, encouraging active transportation, and promoting other metropolitan parks.

In addition to the transportation recommendations, the ZPWG's report included many more short-term parking recommendations, like enacting phased reduction of parking on the Polo Fields, implementing strategies to reduce parking and transportation demand, and considering the possibility of adding new parking in the form of an underground parking structure with a "green" roof to the park. Additionally, new programming, land management changes, and the addition of water quality treatment in the Polo Fields was also recommended. It should be noted that this report also recommends that the Polo Field transition into a natural area—like a savanna or meadow—with an end to the use of the area as temporary parking.

Work towards some of these recommendations is already underway, including: protected bike lanes that were designed in 2019 and installed late 2020/early 2021 along Barton Springs Road; an urban trail along Azie Morton Road which has not been funded yet and has an estimated cost of $550k; and a crosswalk at Azie Morton Road and Lund Street.[71]

The infrastructure described in this chapter supports visitors in the park—whether it be roads, parking lots, bus stops, buildings, or kiosks— and dictates both park usage and the user experience. Zilker Park has a wide variety of existing infrastructure and more planned for the immediate future. By utilizing the infrastructure resources that are already present in the park and rethinking and expanding this system, park managers can direct the user experience while supporting the ecological health of the site and protecting environmentally sensitive areas.

In March 2019, the Zilker Park Working Group put forth the following recommendations to be incorporated into the Zilker Vision Plan scope of work:

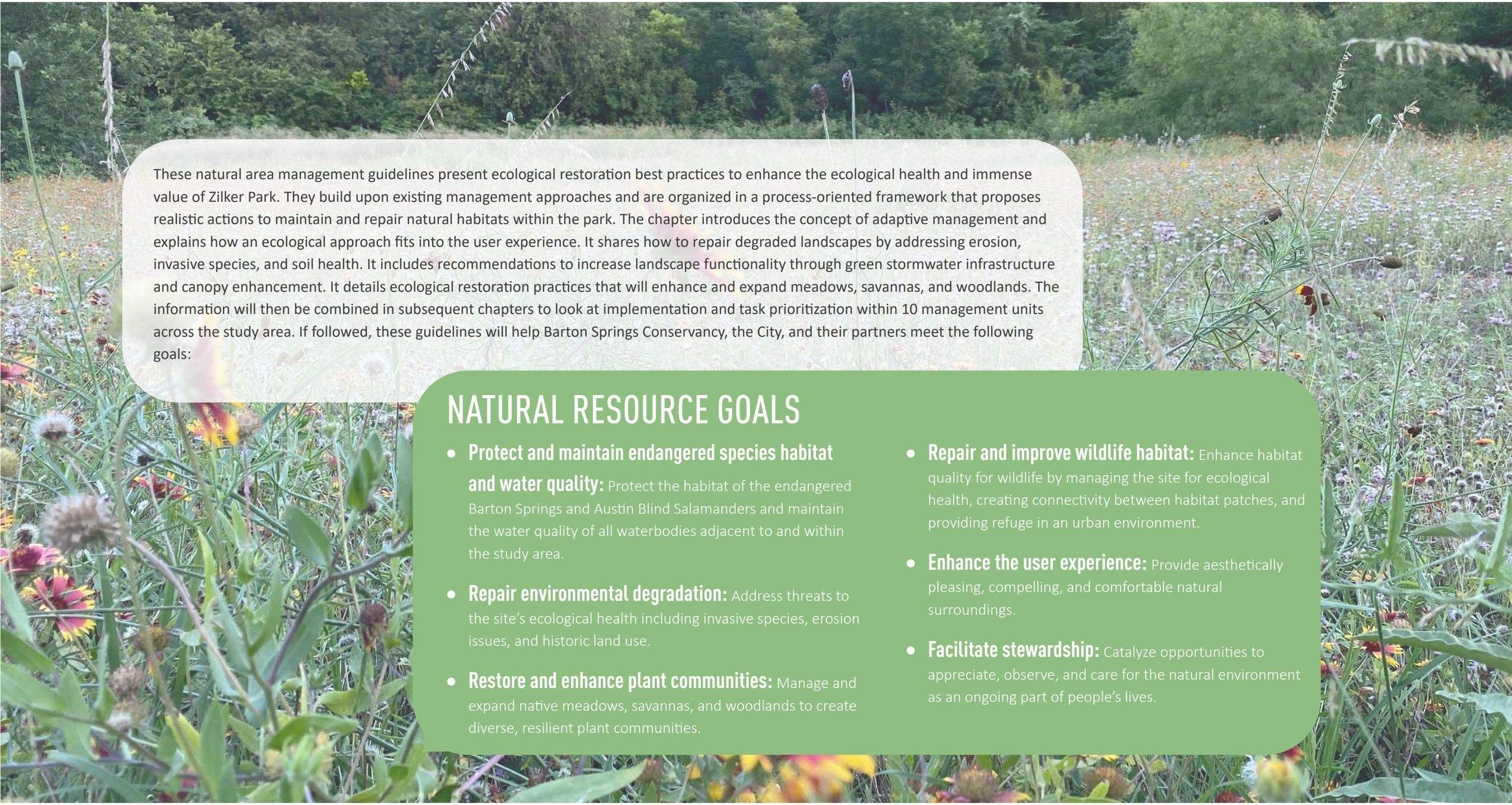
- Opportunities to increase pedestrian and bicycle safety, and to prioritize these active modes in the park.
- Opportunities to minimize private automobile traffic through the park, including the possible reduction of automobile traffic on Barton Springs Road during times of peak demand.
- Options for a circulator system within the park to move visitors from one area of the park to another, including a shuttle bus or expansion of the Zilker Zephyr.
- A permanent shuttle system from off-site parking to the park.
- Limiting closest parking spaces to high-occupancy vehicles, families with small children, or ADA spaces. The plan should also carefully consider accessibility of these groups throughout the park.
- Offering a limited number of parking spaces that correspond to renting a PARD facility, such as a picnic area or sports court.
- Use of parking opportunities north of the river and accessible by the Mopac pedestrian bridge.
- Implementing systems such as "toll tag" upon entering/exiting parking lots; prepurchasing of parking online; or annual parking pass to expedite entering the park.
- A new parking garage within or immedlately adjacent to the park with green infrastructure features such as a green roof, paying close attention to environmental sensitivities and resulting in a net decrease in impervious cover in the park.
- Increasing the frequency of #30 Capitol Metro bus and reevaluate stop locations and improve stop comfort (benches, cover, visibility, and entries from stop to the park) within and without the park, including stops that will conveniently bring visitors to Barton Springs Pool, Umlauf Sculpture Gardens, Zilker Botanical Garden, and other areas of interest. CapMetro should advertise Zilker at stops such as the Westgate Transit Center.
- Viability of converting Andrew Zilker Rd and Lou Neff Rd to shared use paths that can be separated into ped and bike/scooter spaces.
- Re-aligning trails and shared-use paths to the best locations for convenient active transportation.
- Identify missing sidewalks, safe pedestrian crossings, and ADA accessibility issues, and propose solutions.
- Improve connectivity across Barton Springs Rd, studying the opportunity to connect the park over the road (e.g. road in tunnel or pedestrian bridge).
- Routes for permanent protected bike lanes to and through the park, and a plan for improved maintenance of bike lanes.
- Increasing investment in amenities of the City's other metropolitan parks in order to reduce demand on Zilker Metropolitan Park. This should include investment in the types of facilities identified as popular in recent Zilker Park and park-wide surveys.
- Implement a paid parking system for all parking spaces in the park, so there is no free parking during days and times of peak demand, to mitigate the need for more parking spaces.
- On-demand parking capacity notifications.
- Bus drop off and parking strategy.

Figure 4.5 *Zilker Park Working Group transportation recommendations*

Produced by Siglo Group

PART 5
NATURAL AREA MANAGEMENT GUIDELINES

2021



These natural area management guidelines present ecological restoration best practices to enhance the ecological health and immense value of Zilker Park. They build upon existing management approaches and are organized in a process-oriented framework that proposes realistic actions to maintain and repair natural habitats within the park. The chapter introduces the concept of adaptive management and explains how an ecological approach fits into the user experience. It shares how to repair degraded landscapes by addressing erosion, invasive species, and soil health. It includes recommendations to increase landscape functionality through green stormwater infrastructure and canopy enhancement. It details ecological restoration practices that will enhance and expand meadows, savannas, and woodlands. The information will then be combined in subsequent chapters to look at implementation and task prioritization within 10 management units across the study area. If followed, these guidelines will help Barton Springs Conservancy, the City, and their partners meet the following goals:

NATURAL RESOURCE GOALS

- **Protect and maintain endangered species habitat and water quality:** Protect the habitat of the endangered Barton Springs and Austin Blind Salamanders and maintain the water quality of all waterbodies adjacent to and within the study area.
- **Repair environmental degradation:** Address threats to the site's ecological health including invasive species, erosion issues, and historic land use.
- **Restore and enhance plant communities:** Manage and expand native meadows, savannas, and woodlands to create diverse, resilient plant communities.
- **Repair and improve wildlife habitat:** Enhance habitat quality for wildlife by managing the site for ecological health, creating connectivity between habitat patches, and providing refuge in an urban environment.
- **Enhance the user experience:** Provide aesthetically pleasing, compelling, and comfortable natural surroundings.
- **Facilitate stewardship:** Catalyze opportunities to appreciate, observe, and care for the natural environment as an ongoing part of people's lives.

ADAPTIVE MANAGEMENT AND PROCESS APPROACH

Adaptive management is a process through which land stewards adjust their approach based on changing conditions and outcomes from previous management (Figure 5.1). Such adjustments are especially important in the face of potential climate change and prolonged drought. Adaptive management informs ongoing land management practices by assessing changes over time using photo points, observing new issues through early detection monitoring, reviewing successes through land management task monitoring, and tracking changes in plant and animal communities. This dynamic approach allows land managers to build off previous successes and use finite resources most efficiently to move towards long-term management goals.

NATURAL AREA MANAGEMENT AND ECOLOGICAL RESTORATION

Natural area management recognizes that people have a role to play to heighten ecological health, create resilient natural areas for park users to enjoy, and protect the plants and animals that inhabit Zilker Park. This is particularly true in urban areas that experience ongoing impacts and influences from surrounding areas and recreational usage, including stormwater flows, soil compaction, introduction of invasive species, and limited connection with other natural areas. 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, are impaired, or simply can be improved. In this section, we describe how to repair environmental degradation and enhance natural habitats to create resilient, aesthetically pleasing, and ecologically functional natural areas that support the user experience with a focus on the unique and endangered resources of Zilker Park.

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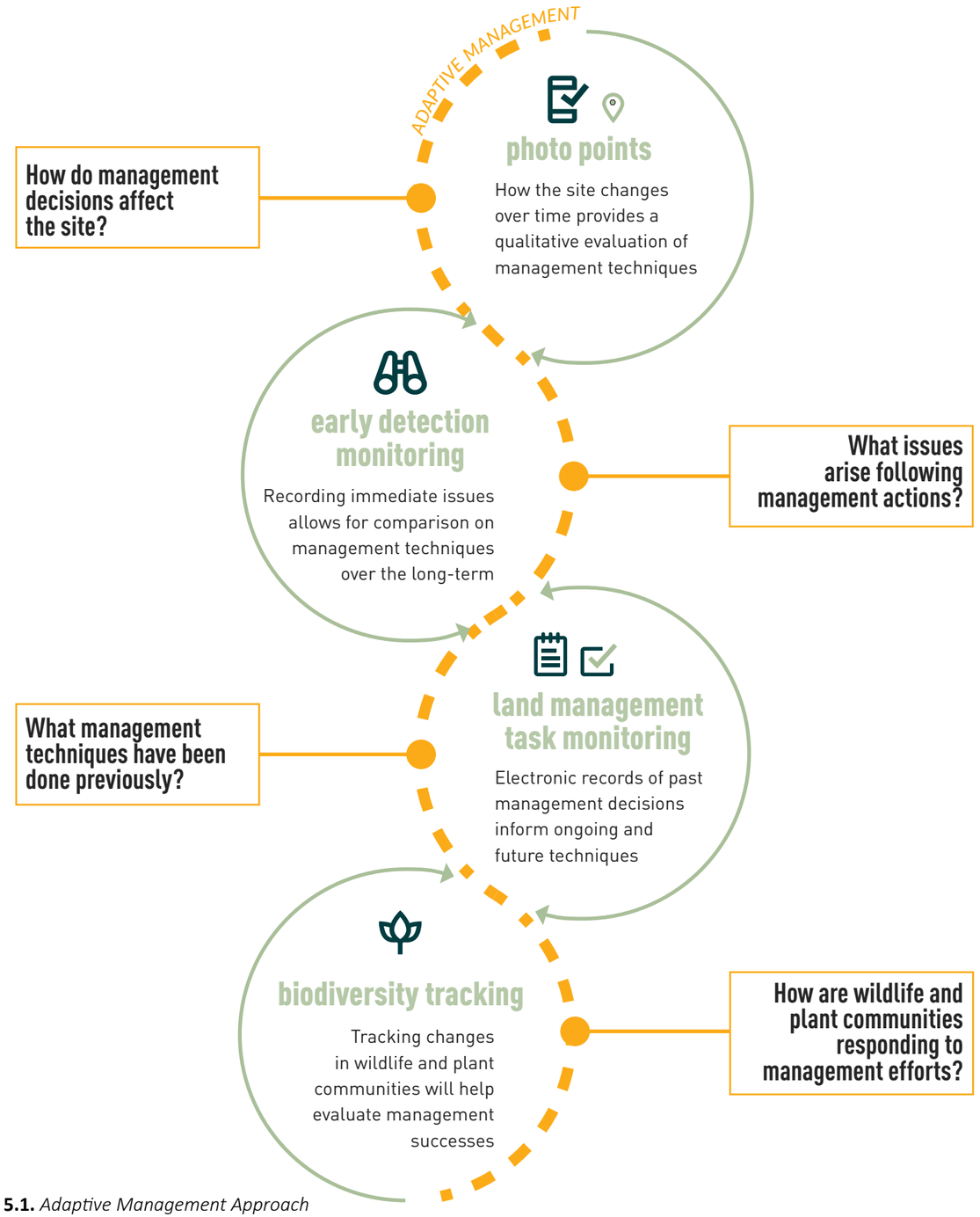

Figure 5.1. *Adaptive Management Approach*

PROTECTING SPRINGS AND ENDANGERED SPECIES

The springs and the endangered salamanders they support are a core motivator for better infrastructure and management at Zilker Park. The Habitat Management Plan calls out specific strategies and actions for managing the endangered species habitat in the park, in compliance with the Endangered Species Act (Figure 5.2). [65,74,99] This management plan was created in 2014 and updated in 2016 and 2018. It was created to fulfill measure 6.1.1.1 of the Barton Springs Pool Habitat Conservation Plan (HCP) and condition I of the associated Incidental Take Permit TE 839031-1.

It should be noted that the Barton Springs Pool HCP was prepared by the City of Austin Watershed Protection Department,[99] and is distinct from the HCP for managed groundwater withdrawals, which was created by Barton Springs/Edwards Aquifer Conservation District.[32] The Barton Springs Pool HCP addresses direct care of the endangered salamander species and their habitat.[99] The conservation district's HCP addresses pumping and maintaining adequate water levels for the salamander's survival within the Barton Springs Segment of the Edwards Aquifer.[32] These HCP's do not conflict, but rather, complement each other. In fact, there is an interlocal agreement between the City of Austin and the Barton Springs/ Edwards Aquifer Conservation District that coordinates management activities for the protection of the Barton Springs and Austin Blind Salamanders.[116]The actions required by the Endangered Species Act are complemented by spring and water quality buffers required by the City's development code—described in the Ecology chapter. Additional actions recommended in this document that support the springs and salamanders include green stormwater infrastructure, enhanced plant communities, and enhanced canopy. All three will increase water infiltration, reduce stormwater runoff, and improve water quality within Zilker Park.

Three primary goals of the Habitat Management Plan for the Barton Springs: [2]

1. Provide and maintain **non-embedded cover objects in epigean habitat** to maximize availability of interstices for salamanders and macroinvertebrates.
2. Restore and maintain **shallow, flowing water near springs** to provide less embedded cover, more vegetation, and fewer predators.
3. **Reduce habitat disturbance** from humans.

Planned management actions for all springs based on these goals:

- Flush sediment periodically by hand to prevent the upper 2–3 inches of cover from becoming embedded
- Maintain native vegetation both in within the springs and within the riparian zone.
- Periodic removal of predatory fish and crayfish in the springs.

Planned management actions for Eliza Springs:

- Prevent destruction of the amphitheater by removing woody plants growing out of the concrete.

Planned management actions for Barton (Parthenia) Springs:

- Remove accumulated flood debris in salamander habitat at Parthenia Spring by hand as necessary to help reduce accumulation of flood debris over time.
- Investigate how modification of upstream and downstream dam can improve ecosystem integrity and flow regime of Barton Springs.

Planned management actions for Old Mill (Sunken Garden) Spring:

- Modify the Old Mill spring pool and stream to maintain the spring pool at a shallower depth and reduce water velocities in the stream.

Planned management actions for Upper Barton Spring:

- Discourage and provide remediation for habitat disruption and vandalism.

Figure 5.2. *Habitat Management Plan Strategies, from From the 2018 City of Austin Watershed Protection Department's Habitat Management Plan for the Barton Springs and Austin Blind Salamanders*

REPAIRING DEGRADATION AND PREPARING FOR RESTORATION

This section addresses the types of environmental degradation found within Zilker Park. To restore ecological health to the park, these issues must be addressed before or during restoration, or restoration efforts will be ineffective. Here, we look at stormwater management integration through:

Green Stormwater Infrastructure

Mitigation of Erosion Issues

Reducing User Impacts

Invasive Species Management

Repairing degradation adjacent to Lower Barton Creek will enhance user experience and enhance ecological processes.

GREEN INFRASTRUCTURE

GREEN STORMWATER INFRASTRUCTURE

Green stormwater infrastructure can address the root cause of erosion: fast-moving water often coming off roads, parking lots, and buildings. Rain gardens, swales, berms, and grading changes can slow water flowing across a landscape (Figure 5.3). When water moves more slowly, it has longer to soak into the soil, reducing erosion, preventing sediment and pollutants from entering streams and springs, and increasing groundwater supplies. Green infrastructure offers other benefits, including increased creek flow and wildlife habitat. At Zilker Park, green infrastructure has already been used to decrease stormwater flows into Barton Springs Pool and in the Disc Golf Course. Just over 14 acres have been identified as potential locations for improving and/or installing green stormwater infrastructure (Figure 5.4). These areas have standing water after heavy rain, periodically carry large volumes of stormwater, are open with no active recreation, have significant water-related erosion, and/or are near impervious surfaces that create runoff. In addition, a well-planned and designed green stormwater installation can heighten the aesthetics and quality of the user experience in these areas.

Low lying area in sports field south of Barton Springs pool area that floods during rain events.

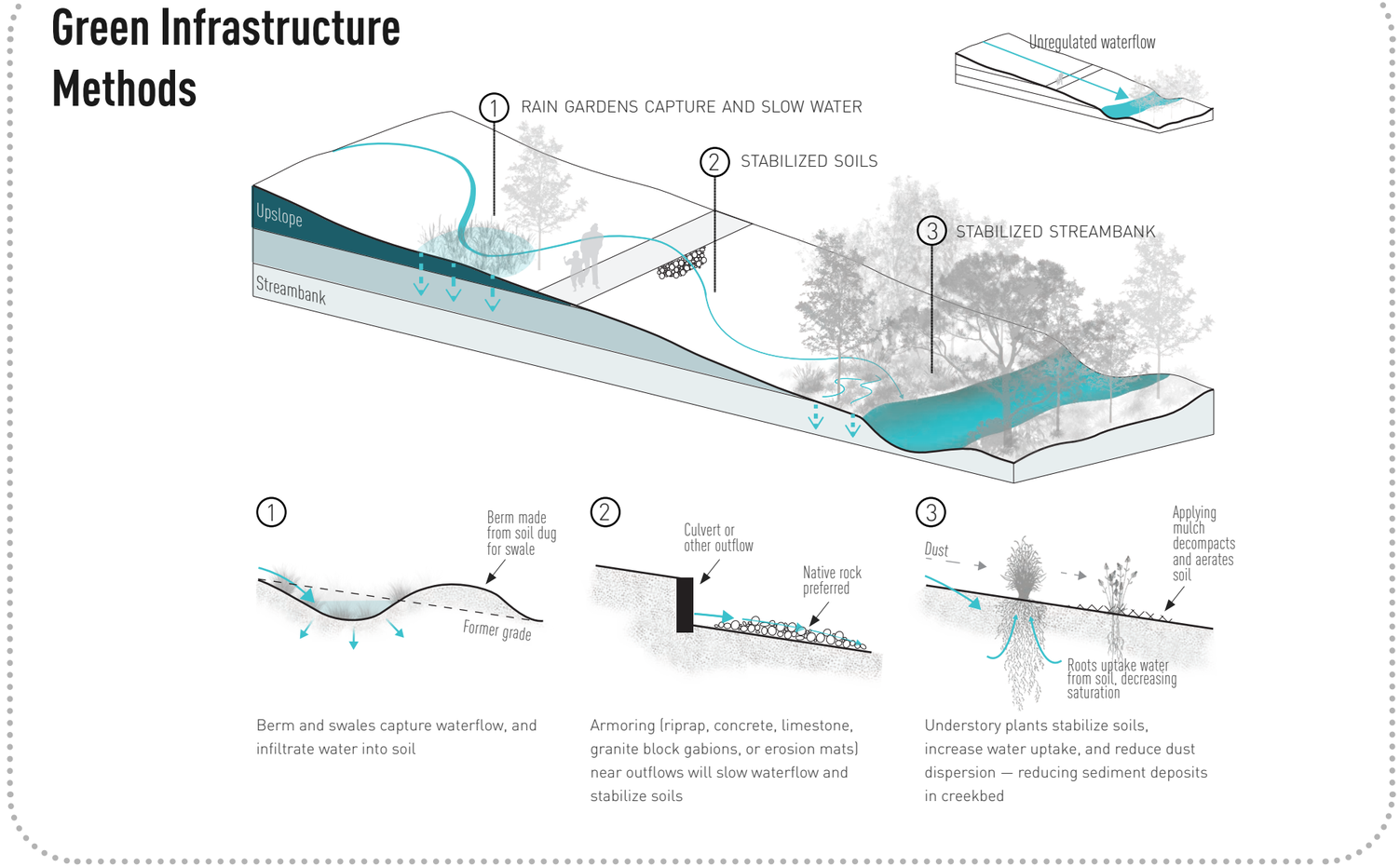

Figure 5.3. *Green Infrastructure Methods*

GREEN INFRASTRUCTURE

RAIN GARDENS, SWALES, AND BERMS

A rain garden is a depression where water can pond after rain and soak in gradually. Swales are linear rain gardens, sometimes with water flowing through them. Berms are earthen mounds that reduce downslope travel of water and allow for infiltration. Swales and Berms are often used together to create an effective chain of rain gardens. Swales can be created from existing erosion paths (unless the erosion is too severe) either by hardening the path and directing water to a depression, or by slowing and spreading water flow to allow it to soak in. Both rain gardens and swales work best over soils that absorb water quickly. They also require plants that can withstand repeated wet-dry cycles (Table 5.2). It should be noted that rain gardens and other types of water quality basins in the Barton Springs Zone may be required to have a liner to prevent infiltration of pollutant-laden stormwater and other contaminants (ECM 1.6.2.C).[117] The open, underutilized area just down slope of the Rugby Fields and associated parking before the slope increases substantially down to Barton Creek is a representative location of where green stormwater infrastructure can turn problems into amenities.

RAINWATER HARVESTING

Rainwater harvesting catches runoff from roofs and stores it for later use. While rainwater is not currently harvested at Zilker Park, new construction plans should consider adding harvesting systems.

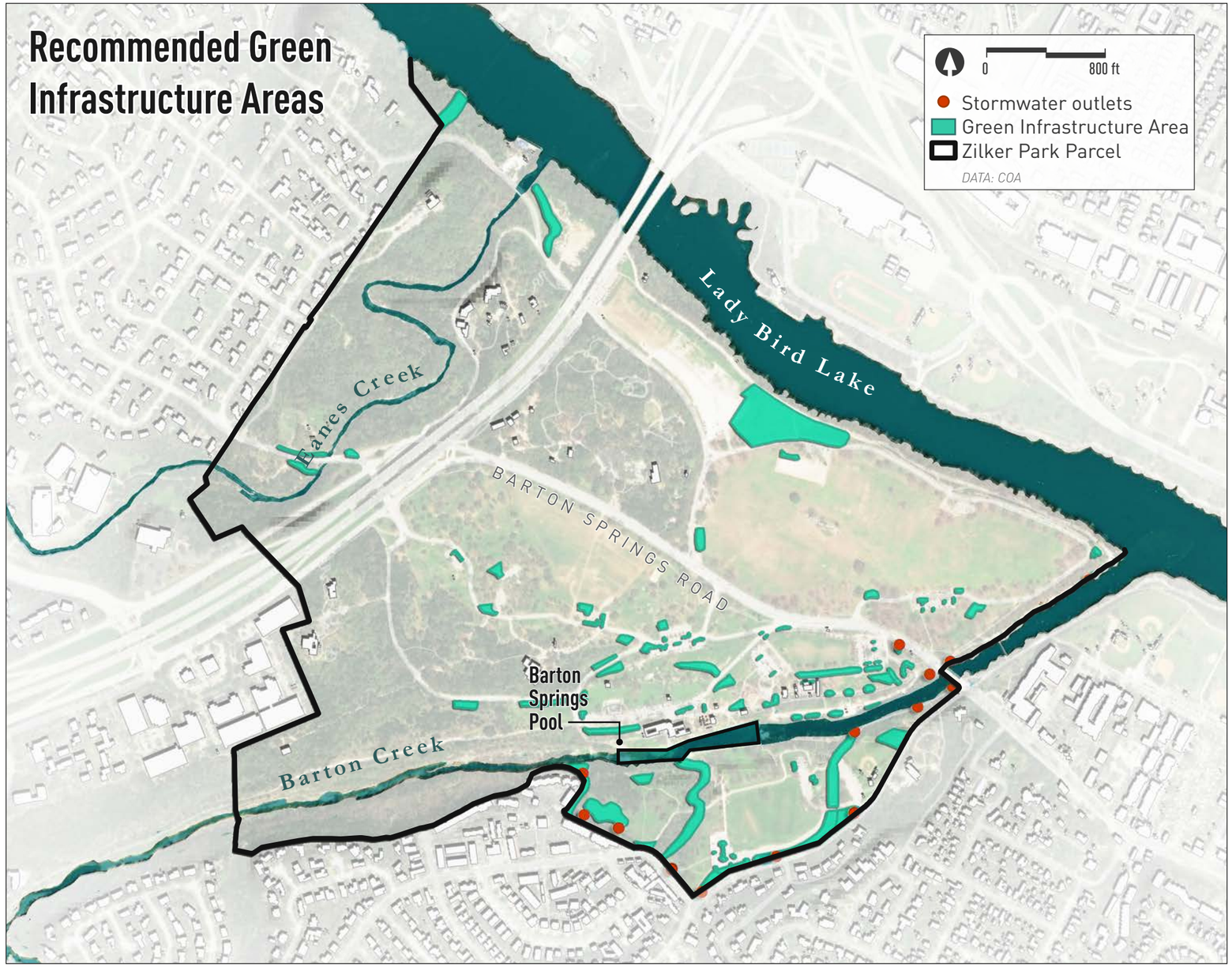

Figure 5.4. *Recommended Green Infrastructure Areas*

USER EXPERIENCE

USER IMPACTS

Unfortunately, Zilker Park is being degraded by the volume of users coming to enjoy the park without adequate infrastructure or design to support them. Off-trail recreation, water access, and trail conditions are impacting Zilker Park's natural areas. Many of these problems can be addressed by providing infrastructure that meets the needs and volume of park users. The upcoming Zilker Vision plan should address the following needs: trails, water access, gathering locations, trail size and maintenance, as well as physical barriers to environmentally sensitive areas. Here, these issues are addressed as they relate to natural area management and ecological degradation.

A note on homeless encampments: homelessness is an issue much larger than the scope of this project. Homeless camps were observed throughout the natural areas of Zilker Park. Along with these encampments comes informal trails, trash, trampling of native vegetation, and impacts on other park users. While this is a major issue that needs to be addressed for the health of the park and the people impacted by homelessness, it is beyond the scope of this project.

EROSION ON TRAILS

Erosion is wearing away several trails in Zilker Park. This includes decomposed granite running off the Butler Trail into the riparian woodland and the lake, erosion issues along both shores of Barton Creek below the pool, and numerous areas where the combination of stormwater and trail location have resulted in gullies that jeopardize the integrity of slopes. In these areas, additional grade dips and small culverts and/or stormwater spreaders (rip rap that disperses flow) should be installed to increase the number of locations where water moves across or under the trail and reduce the impact of water on a particular area. Where these solutions are not enough, green stormwater infrastructure should be considered upslope.

INFORMAL TRAILS AND TRAMPLING

Restoring heavily used natural areas will require decommissioning informal water access points and trails, as well as revegetating impacted areas. Going forward, informal trails should be identified and addressed as they are created.

Brushing is a simple, effective way to reclaim informal trails. Brushing uses cut vegetation from pruning or invasive species removal to block the trail. Cut vegetation should be placed over impacted areas for at least 30 ft from intersections with formal trails. The cut pieces do not need to be large but should be difficult to walk through. Densely branched invasive species such as Ligustrum are especially good for brushing informal trails as long as all fruits and seeds are removed first. Where the informal trail is in a relatively open area, the brush pieces should extend 3 to 5 ft beyond the trail edge to discourage visitors from widening the trail by walking beside the cut brush. Brushing may not be a good option in areas that flood regularly, because the loose material can wash into waterways.

While brushing can also be used for small, trampled areas, larger areas will need soil amendments, decompaction, and planting. In high-use areas, temporary fencing (at least knee high) and appropriate interpretive signage will discourage continued trampling while the area recovers.

Trash and erosion along Barton Creek has been accelerated by intense foot traffic.

USER EXPERIENCE

FORMALIZING TRAILS AND IMPROVING INFRASTRUCTURE

Some of the informal trails can be formalized and added to the regular trail system. This process directs the flow of users to formal areas, decreases informal use, and allows for decommissioning and restoring other informal trails. For example, this approach is recommended for select trails running from upland parking lots and paths to Barton Creek downstream of the pool.

Many formal areas, like the historic picnic tables in the Nature Preserve, have not been maintained regularly. Creating formalized access paths to these picnic areas offers the opportunity for design that fits into the surrounding area and historic features of the park. It also moves people away from informal use of the natural areas.

The Zilker Vision Plan process should consider which informal trails to formalize.

TRAIL DESIGN AND MAINTENANCE

Trails must be carefully designed to accommodate the number of users, eliminate erosion, eliminate washing away of trail material, reduce impact to adjacent natural areas, and create an amazing user experience. Trail design criteria should be an integral part of the Zilker Vision Process.

Ecological considerations for the trails include:

- Stabilize trails within 50 ft of the water's edge.
- Stabilize trails with a downslope side of 15% or greater within 2 ft of the trail.
- Stabilize trails in low-lying or frequently flooded areas.
- Where feasible, keep trails 50 ft from the water's edge.
- Add a combination of knee-high fencing and hardscape to create a physical boundary in high use areas to protect adjacent natural areas.

Trails can be stabilized in several ways, including paving, geocell systems, spraying a polymer on the crushed granite, or edging on the downslope side of the trail. The measure of success should be the reduction or elimination of trail material washing into natural areas.

These criteria are aligned with the City of Austin Environmental Criteria Manual, would considerably improve the trail system's function, and would substantially reduce the trail's impacts on Zilker Park's natural areas.

ACCESS TO THE WATER

To protect the fragile ribbon of habitat along the water's edge, creating criteria for the establishment of formal water access points should be a part of the Zilker Vision Plan process. The following can be considered:

- Install formal water access points along Barton Creek downstream of the Pool and along Lady Bird Lake with a greater footprint along Barton Creek to match volume of users.
- Upgrade established access points where possible.
- Redirect traffic to formalized access points to reduce damage to the shoreline and prevent erosion.
- In areas where access is undesired, create physical barriers to reduce access such as knee-high fencing, split rail fencing, and hardscape.
- Consider flooding.
- Ensure access complements natural areas and allows them to thrive adjacent to the watershed edge.

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Simple, knee high fencing can discourage off trail activity.

SOIL & EROSION

MITIGATING EROSION

Soils are the foundation of a well-functioning landscape. Human actions, infrastructure, and stormwater flows all impact Zilker Park's ability to support stable, healthy soils. While green stormwater infrastructure can reduce water flow, the localized effects of previous erosion must still be addressed using the recommendations below.

SHEET EROSION

Sheet erosion can be addressed by upslope solutions that reduce or slow water flow and by establishing native plants. Upslope solutions include grading changes, adding swales, and incorporating rain capture areas. Planting and seeding understory plants helps to stabilize the soil and increase water infiltration. Planting can be supplemented by organic material (like mulch) to cover exposed roots.

Compaction from human trampling is aggravated by stormwater runoff from impervious cover.

RILL & GULLY EROSION

As with sheet erosion, upslope solutions should be considered first. Where those can be installed, minor cases of rill and gully erosion may be treated like sheet erosion. Where upslope solutions are not feasible, erosion mats can temporarily hold the soil until new plants are established. Where this is still not enough, water flows can be slowed or spread using rock and/or gabions.

Gully plugs can be used for larger gullies. These consist of rock dams at several points along the gully that slows water long enough for the sediment to settle out and gradually fill the gully.[118] Gully plugs where rock is supplemented with coir log on the upslope portion of the plug increases the particle capture and allows soil buildup more effectively. Some gullies are caused by outflows from culverts or impervious cover onto steep slopes. Examples include the network of gullies on the north slope of Barton Creek between the pool and Barton Springs Road, as well as the slope leading down to the lake just east of Mopac. In both cases, upslope solutions that include green stormwater infrastructure should focus on slowing the water and increasing water infiltration on the flatter terrain. Within the gullies, hardening erosion points with riprap or gabions followed by planting can move towards ecological repair.

Where large culverts are causing erosion adjacent to the lake and the water cannot be dispersed because of the slope below or the volume of water, the most effective solution is to extend the culvert into the lake. Such extensions should be planned carefully to blend in with the natural landscape.

Gully erosion located between Stratford Drive and Lady Bird Lake.

SOIL & EROSION

STREAMBANK EROSION

The City of Austin has employed numerous stream stabilization techniques over the years, evolving from flood-focused concrete and gabion designs to more naturalistic channel designs meant to restore stream function.[119] Simply reducing stormwater runoff over the lake and creek banks and maintaining healthy vegetation can address much of the bank erosion seen in the study area. For parts of Eanes Creek near Stratford Drive, a more intensive effort will be needed. A widely used approach by the City uses limestone boulders from below the scour depth to the bank full height to stabilize the eroding bank. The upper slopes are stabilized using geogrid reinforced soil lifts and planted with native vegetation. This approach will stop ongoing bank erosion and tree mortality and improve water quality during major rain events.

Heavy use near Bark'n Springs causes shoreline erosion

SUPPORTING SOIL HEALTH

The recommendations here help build back soils where they have been depleted by previous land use practices. Increasing soil health will reduce the likelihood of erosion, increase water infiltration, and create the opportunity for more robust plant growth. It should be noted that salt-based fertilizers harm the biology that builds soil structure, cycles nutrients, and sequesters carbon. This is why feeding the microbes via organic amendments is suggested as a healthier and more sustainable method of adding nutrients to any area.

For degraded woodland areas and formal areas under tree canopy, mulch application is the easiest, most straightforward practice to increase organic material, prevent compaction, and increase soil fauna. In addition, it increases water infiltration and stabilizes bare soil. For formal areas under a tree canopy, a three-inch layer of native mulch or mulch from the site will maintain soil moisture and reduce weeds. In natural areas, mulch can be used where the soil has been compacted by foot traffic and in bare areas created by erosion and invasive species removal. Mulching around new plantings will also increase their survival by reducing competition and increasing water availability. However, mulch should not be used in areas that have been seeded or will be seeded within the year, because the mulch will reduce germination and establishment.

High-quality, weed-free compost can be used in areas where topsoil has been lost to erosion or the area is highly compacted or degraded, such as the Polo Field. In these cases, compost can be applied at 1 to 2 inches and raked gently in with existing topsoil. When seeding, the seed can be mixed with a small amount of compost to improve the contact between seeds and the soil. Seeds should not be more than 1/8 inch deep in the soil/compost as any deeper will inhibit germination.

Aeration and inoculation should be used in highly compacted soils such as the Polo Field. Aeration creates channels that help water soak into the soil. Aeration is best accomplished with a core aeration tool that removes soil plugs. Aeration is most effective when the soil is moist after a heavy rain or irrigation. Aeration should be complemented by the application of a liquid inoculant that feeds soil organisms.

In all cases, soil amendments should only be applied where they will not be washed away by rain or where they can be stabilized with erosion blankets. Applying amendments when the soil is already moist from rain or irrigation will help lock in the moisture. Keeping soil moist after adding amendments will help those amendments break down and feed the soil faster but is not required.

INVASIVES

INVASIVE SPECIES

Managing invasive species is critical for maintaining and restoring Zilker Park's ecological function. A list of 20 high-priority invasive species found in Zilker Park is presented in the Ecology chapter (Table 3.5). Each of these species has a set of best management practices as recommended by the City of Austin, Siglo Group, and others. (Table 5.1). The most problematic species at Zilker Park, according to Siglo Group, include Arundo, bamboo, bastard cabbage, Bermudagrass, catclaw vine, Chinaberry, Chinese parasol tree, Chinese pistache, Chinese tallow, Nandina, hedge parsley, Japanese honeysuckle, Johnsongrass, King Ranch bluestem, Ligustrum, Malta star thistle, paper mulberry, sweet autumn clematis, and tree of heaven. Controlling invasive species is a long-term process that requires repeated treatments.[120] The City of Austin's Invasive Species Management Plan lists the top 24 invasive species (shown in Table 3.5 of the Ecology chapter) and stipulates that each department should prioritize this list according to their mission.[102]

The ideal defense against invasive species is robust native plant communities that prevent invasive species from establishing. Minimizing bare ground and increasing the number of native species reduces opportunities for invasive plants to take advantage of gaps. Therefore, open space created in a natural area by thinning, invasive species removal, or other management actions should be planted or seeded as soon as possible. Invasive species that require full sun can also be reduced by expanding woodlands that create more shaded conditions.

When using herbicides, applications should follow all state, city, and federal laws, as well as manufacturer recommendations and requirements under the supervision of a commercially licensed herbicide applicator. Herbicide control should only use approved methods in the Austin Parks and Recreation Grounds Maintenance Division Integrated Pest Management (IPM) Plan and each proposed use requires approval of the Zilker Grounds Manager.[121] This is detailed in the IPM Plan—"Before an applicator uses a pesticide of any type, the treatment must be approved by the supervisor and documented in the work order system."[121] When treating plants near water, the City of Austin Watershed Protection Department should be consulted. In all cases, minimizing the use of herbicides while getting the desired effect, will reduce impacts on surrounding plant material.

Table 5.1 *Invasive Removal Best Practices*

Invasive Removal Best Practices

Arundo, *Arundo donax*

FOLIAR SPRAY	Apply foliar spray with imazamox solution. If not mixed with desirable vegetation, a combination of glyphosate and imazomox can be used. When stems die, cut and remove vegetation. Repeat as necessary. Erosion control efforts such as silt fences or erosion control fabric should be used and restoration plantings should be installed as soon as possible.	Where Appropriate: Mature patches with no other vegetation that can be killed with the herbicide. Optimal Time of Year: Mid- to late summer Plant/Patch Size: Plants < 6ft tall Effectiveness: Moderate Applicator Required: Yes Labor Intensity: Moderate
DIGGING AND ROOT REMOVAL	Cut and remove tops of plants. Dig and remove as much of the roots as possible to minimize resprouting and dispose of all plant material off site. Wait for new sprouts to show and dig a second time. Digging will cause massive soil disturbance and open the area to erosion. Erosion control efforts such as silt fences or erosion control fabric should be used and restoration plantings should be installed as soon as possible.	Where Appropriate: Small patches Optimal Time of Year: Any time Plant/Patch Size: Mature plants Effectiveness: Low Applicator Required: No Labor Intensity: High
WICK CHEMICAL APPLICATION OR CUT AND SQUIRT	Use wick applicator to wipe the leaves with glyphosate/surfactant mix, allowing for application without harming nearby restoration plantings. Alternatively, cut individual stems and squirt a glyphosate solution into the stem cavity. Erosion control efforts such as silt fences or erosion control fabric should be used and restoration plantings should be installed as soon as possible.	Where Appropriate: Mowed/dug areas. Non-monocultures Optimal Time of Year: Summer Plant/Patch Size: Medium-sized patches Effectiveness: Uncertain Applicator Required: Yes Labor Intensity: High
CHANGING SITE CONDITIONS	Increase tree canopy cover to shade out and weaken the establishment of giant cane. This can be accomplished by planting riparian tree species directly around a treated area of giant cane, with particular focus on fast-growing trees such as box elder, hackberry, and black willow.	Where Appropriate: Treated areas Optimal Time of Year: Fall Plant/Patch Size: N/A Effectiveness: Uncertain Applicator Required: No Labor Intensity: High

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Invasive Removal Best Practices (continued...)

Bamboo, *Phyllostachys aurea*

MECHANICAL

Starve the plant's rhizomes by continuously mowing, pulling, and disposing of sprouts. Rhizomes can sometimes be dug up, but even a small piece of it left in the ground will generate more stalks of bamboo. It may take 2-3 years to achieve control.

Where Appropriate:	Mature patches with no other vegetation that can be killed with the herbicide.
Optimal Time of Year:	Mid- to late summer
Plant/Patch Size:	Plants < 6ft tall
Effectiveness:	Moderate
Applicator Required:	No
Labor Intensity:	Moderate

CHEMICAL CONTROL

Use a foliar spray with an appropriate herbicide on the younger, resprouting leaves after a first round of mechanical control.

Where Appropriate:	Where bamboo is growing among desirable plants
Optimal Time of Year:	Growing season
Plant/Patch Size:	Any
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	Moderate

CHEMICAL CONTROL

Cut the stalks of the bamboo plant and pour an appropriate herbicide down into the cut stalk. The intention is for the herbicide to spread into the roots and rhizomes. Repeated treatments are likely necessary and it may take 2-3 years to control the stand.

Where Appropriate:	Where bamboo is growing among desirable plants
Optimal Time of Year:	Growing season
Plant/Patch Size:	Any
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	Moderate

Bastard cabbage, *Rapistrum rugosum*
Malta Star thistle, *Centaurea melitensis*

MECHANICAL

Hand pull plants, including taproot, before they go to seed. Mowing will reduce amount of seed in soil bank. Planting native seeds (especially Indian blanket) reduces bastard cabbage populations.

Where Appropriate:	Anywhere
Optimal Time of Year:	Winter/spring
Plant/Patch Size:	Smaller patches
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	Moderate

CHEMICAL CONTROL

Spot spray with glyphosate solution, avoiding direct contact with or drift onto desirable plants. Herbicide is most effective in the rosette stage (before plants begin to flower). Bastard cabbbage can become resistant to many herbicides, so mechanical control is preferred.

Where Appropriate:	Where desirable plants won't be affected by herbicide
Optimal Time of Year:	Fall-early spring
Plant/Patch Size:	Larger patches
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	High

Invasive Removal Best Practices (continued...)

Bermudagrass, *Cynodon dactylon*
Johnsongrass, *Sorghum halapense*
King ranch bluestem, *Bothriochloa ischaemum var. songarica*

MECHANICAL

Remove existing plant material with topsoil removal from the site. Spot treat as new plants emerge after soil is reintroduced to the site.

Where Appropriate :	Areas where there aren't any other desirable species
Optimal Time of Year:	Any
Plant/Patch Size:	Varies
Effectiveness:	High
Applicator Required:	No, but other considerations exist
Labor Intensity:	High

COMBINED CONTROL

Where monocultures occur (can be as little as a 4' by 4' patch with 80% or greater domination by invasive species) mow/ weed whack to ground early spring to early summer (ensure this happens before seeds mature). Follow-up with foliar spray (OutriderC is fairly specific to Johnsongrass) on resprouting material in summer. Use an herbicide appropriate for the species and with consideration for vicinity to water. Avoid using glyphosate on Johnsongrass because it can become resistant (and already has in some areas). Well timed follow-up treatments are essential to successfully minimize re-establishment from the seed bank or root sprouts.

Where Appropriate :	Monocultures
Optimal Time of Year:	Spring to early Summer
Plant/Patch Size:	Dense patches
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	High

Catclaw vine, *Dolichandra unguis-cati*

MECHANICAL

Use shovel to remove the entire root system of catclaw vine and remove as much of the plant as possible. Dispose of plant remnants in compost pile.

Where Appropriate:	Anywhere
Optimal Time of Year:	Year-round
Plant/Patch Size:	Smaller plants
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	High

CHEMICAL CONTROL

Cut each vine stem close to the ground and treat freshly cut surfaces (preferably within 5 minutes) with an herbicide and water mixture.

Where Appropriate:	Anywhere
Optimal Time of Year:	Fall
Plant/Patch Size:	Larger plants
Effectiveness:	Moderate
Applicator Required:	Yes
Labor Intensity:	Moderate

CHEMICAL CONTROL

Apply foliar spray to monoculture stands. Step 1: Cut catclaw vine that is growing into trees at head height. Step 2: Spray with appropriate herbicide solution (note that this may vary based on vicinity to water). Take care to avoid herbicide contact or drift onto desirable vegetation.

Where Appropriate:	Where desirable plants won't be harmed by herbicide
Optimal Time of Year:	Fall
Plant/Patch Size:	Large patches
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	Moderate

Invasive Removal Best Practices (continued...)

Chinaberry, *Melia azedarach*
Chinese parasol tree, *Firmiana simplex*
Chinese pistache, *Pistacia chinensis*
Chinese tallow, *Triadica sebifera*
Ligustrum sp.
Paper mulberry, *Broussonetia papyrifera*

MECHANICAL — Remove plants 2" or less in basal diameter using a Weed Wrench or other mechanical device. Hand pulling of new seedlings is required for multiple years until the seed bed is diminished and other plants can fill the niches. Provide for erosion control as needed. Leave as much of the pulled material as possible on site in low-use woodlands, taking care to remove any seed material, and leaving roots without soil contact. Haul off cut material or chip for use as mulch on site.

Where Appropriate:	Area with slopes <3:1
Optimal Time of Year:	Any time
Plant/Patch Size:	⩽ 2" diameter
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	High

CUT STUMP — Cut tree down, providing for safety first. Paint the top of the stump with an appropriate herbicide for woody species immediately, taking care to cover edges. When applying the herbicide, follow manufacturer's labeled instructions and consider vicinity to water. Leave as much of the downed material as possible on site in low-use woodlands, taking care to remove any seed material. Haul off cut material or chip for use as mulch on site. Provide for erosion control if on steep slope or in riparian zone. Hand pulling of new seedlings will be required in subsequent years.

Where Appropriate:	Anywhere
Optimal Time of Year:	Fall
Plant/Patch Size:	Larger plants
Effectiveness:	Moderate
Applicator Required:	Yes
Labor Intensity:	Moderate

BASAL SPRAY — Spray the bottom 12-15" of the tree with an appropriate herbicide solution. The standing dead snag will be excellent habitat for many insects and birds. Only use when tree height is shorter than the distance to the nearest trail or recreational use areas. Will not be as effective if bark is thick, a species dependent condition.

Where Appropriate:	Away from trail
Optimal Time of Year:	Slight fall preference
Plant/Patch Size:	>2" diameter
Effectiveness:	Moderate
Applicator Required:	Yes
Labor Intensity:	Low

Nandina, *Nandina domestica*

MECHANICAL — Remove material less than 2" diameter with weed wrench. Pull new seedlings and saplings when soil is moist to ensure removal of entire root system.

Where Appropriate:	Anywhere, easiest with deeper soils
Optimal Time of Year:	Any
Plant/Patch Size:	Seedlings and saplings
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	High

CHEMICAL CONTROL — The most effective method is to cut plants and apply herbicide to the stumps. Use a basal bark treatment (15% Garlon is effective); remove any fruit on treated plants. Repeated treatments will be necessary to kill root sprouts. Foliar sprays are less effective.

Where Appropriate:	Any
Optimal Time of Year:	Summer-fall (growing season)
Plant/Patch Size:	Mature plants
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	High

Invasive Removal Best Practices (continued...)

Hedge parsley, *Torilis arvensis*

MECHANICAL

For small sites, hand pull plants, including taproot, before they go to seed. For larger sites, mowing shortly after inflorescences emerge may be effective in reducing the amount of seed in soil bank. Mowing/haying that removes the cut biomass would also reduce litter cover and decrease future germination.

Where Appropriate:	Small areas
Optimal Time of Year:	Early Spring
Plant/Patch Size:	Small
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	High

CHEMICAL CONTROL

Spot spray with an appropriate herbicide solution, avoiding direct contact with or drift onto desirable plants. Treating hedge parsley about one week after the inflorescences emerge reduces subsequent regrowth the most.

Where Appropriate:	Monocultures
Optimal Time of Year:	Early Spring
Plant/Patch Size:	Varies
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	Low

Japanese honeysuckle, *Lonicera japonica*

PRESCRIBED FIRE

In fire-adapted communities, spring prescribed burns greatly reduced Japanese honeysuckle coverage and crown volume. Repeated fires reduced honeysuckle by as much as 50 percent over a single burn. A previously burned population of honeysuckle will recover after several years if fire is excluded during this time. By reducing honeysuckle coverage with fire, refined herbicide treatments may be applied, if considered necessary, using less chemical.

Where Appropriate:	Small areas
Optimal Time of Year:	Early Spring
Plant/Patch Size:	Small
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	High

FOLIAR SPRAY

Cutting followed by foliar spray in non-monoculture stands: Step 1: Cut vine at ground level and remove above ground biomass from the site. Where the vine is tangled in overstory trees and cannot be pulled down without damaging native tree branches, cut it at head height and allow the vine in the upper branches to desiccate and fall. Step 2: Allow vine to re-sprout from roots. Step 3: When it is 2 feet in height/spread, use foliar spray with herbicide solution that contains aquatic safe glyphosate.

Where Appropriate:	Treated Areas
Optimal Time of Year:	Cut winter/spray spring
Plant/Patch Size:	All
Effectiveness:	Moderate
Applicator Required:	Yes
Labor Intensity:	Moderate

Invasive Removal Best Practices (continued...)

Sweet autumn clematis, *Clematis terniflora*

MECHANICAL

Clematis can be hand-pulled if the root can be removed. In more open areas, it can also be mowed.

Where Appropriate:	Anywhere
Optimal Time of Year:	Any time
Plant/Patch Size:	Small patches
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	High

CHEMICAL CONTROL

Foliar Spray in monoculture stands: Step 1: Cut vine that is growing into trees at head height. Step 2: Spray with glyphosate solution. Take care to avoid herbicide contact or drift onto desirable vegetation. Repeated applications may be necessary.

Where Appropriate:	Monocultures
Optimal Time of Year:	Late Fall to Winter
Plant/Patch Size:	large patches
Effectiveness:	High
Applicator Required:	Yes
Labor Intensity:	Low to Moderate

CHEMICAL CONTROL

Basal bark application or cutting followed by stump treatment in non-monoculture stands. Find where plants are rooted, cut the stem and apply triclopyr. Triclopyr can also be applied as a basal bark treatment.

Where Appropriate:	Anywhere
Optimal Time of Year:	Any time
Plant/Patch Size:	Large plants
Effectiveness:	high
Applicator Required:	yes
Labor Intensity:	high

CHEMICAL CONTROL

Cutting followed by foliar spray in non-monoculture stands: Step 1: Cut vine at ground level and remove above ground biomass from the site. Where the vine is tangled in overstory trees and cannot be pulled down without damaging native tree branches, cut it at head height and allow the vine in the upper branches to desiccate and fall. Step 2: Allow vine to re-sprout from roots. Step 3: When it is 2 feet in height/spread, use foliar spray with herbicide solution that contains aquatic safe glyphosate.

Where Appropriate:	Anywhere
Optimal Time of Year:	Any time
Plant/Patch Size:	Large plants
Effectiveness:	high
Applicator Required:	yes
Labor Intensity:	high

Tree of heaven, *Ailanthus altissima*

MECHANICAL

Remove plants 2" or less in basal diameter using a Weed Wrench or other mechanical device. Hand pulling of new seedlings is required for multiple years until the seed bed is diminished and other plants can fill the niches. Provide for erosion control as needed. Leave as much of the pulled material as possible on site in low-use woodlands, taking care to remove any seed material, and leaving roots without soil contact. Slash from higher-use areas can be moved for use elsewhere on the site or removed altogether.

Where Appropriate:	Area with slopes <3:1
Optimal Time of Year:	Any time
Plant/Patch Size:	⩽ 2" diameter
Effectiveness:	High
Applicator Required:	No
Labor Intensity:	High

HACK AND SQUIRT

Tree of heaven will aggressively root sprout if cut completely. Instead, use a hatchet or girdling tool to create several wounds around the base of the tree. Do not completely girdle stem. Wound approximately 50% of diameter, with each wound 1 to 2" in height. Spray triclopyr-based solution onto wounds. This treatment is most suitable when tree height is shorter than the distance to the nearest rail or recreation areas. For trees closer to trails or recreational areas, a follow up removal of the tree should occur 6 months after the initial hack and spray treatment.

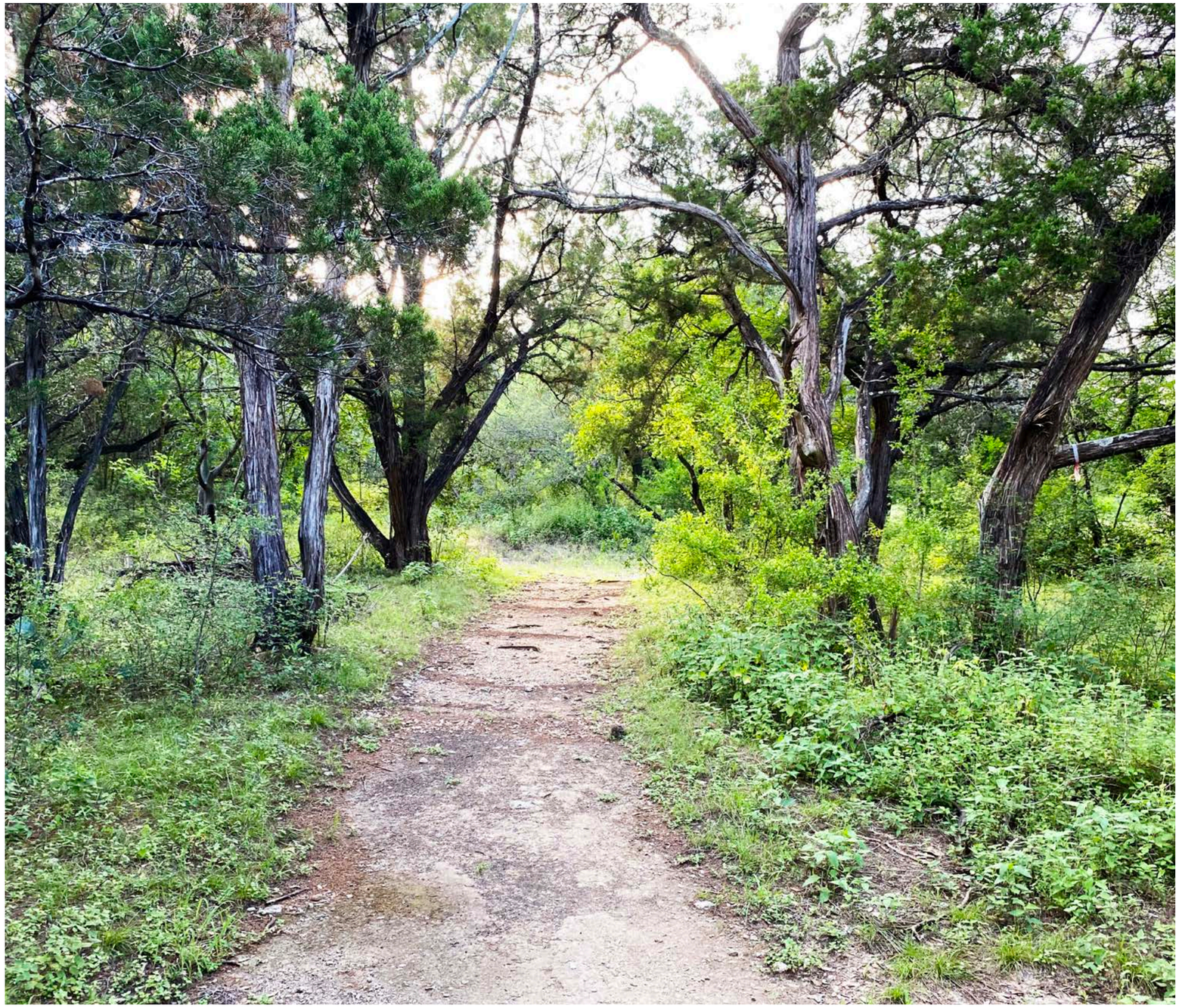
Where Appropriate:	Away from trail
Optimal Time of Year:	Slight fall preference
Plant/Patch Size:	>2" diameter
Effectiveness:	Moderate
Applicator Required:	Yes
Labor Intensity:	Medium

ENHANCING AND RESTORING PLANT COMMUNITIES AND HABITAT

Once degradation in an area has been addressed, native vegetation can be restored or enhanced to create healthy plant communities and habitat for wildlife, as well as a beautiful setting for human enjoyment. First, we provide basic guidelines for establishing and caring for native plants. Then we detail methods for:

Enhancing the Existing Canopy

Restoring Plant Communities



Restoration in the Oak/Juniper/Elm Recommended Plant community will decrease invasives, add age class diversity, address erosion, and increase species diversity.

ESTABLISHING NATIVE PLANTS

Native plants can be established actively or passively. Passive restoration can be used where existing native plants can spread through seeds, runners, or roots. In these sites, addressing erosion, trampling, soil quality, and/or invasive species can be enough to begin ecological repair. In sites with more ecological damage or high visibility, active restoration (seeding or planting) is often needed to create success and catalyze recovery. Seeds and plants sourced from Texas (preferably Central Texas) will be best adapted to conditions at Zilker Park and should be used whenever possible.

Active planting and seeding can speed repair of ecological damage by quickly stabilizing soils, increasing diversity, shading out invasive plants, and better defining the user experience. Factors to consider when deciding between planting and seeding include availability of irrigation, moisture in soils, visibility of the site, presence of invasive species, cost of labor and resources, and whether natural recovery is a realistic option. Planting approaches for trees, shrubs, and forbs range from larger container trees that need substantial irrigation and establishment support to small bare root seedlings that require fewer resources but will have a higher mortality rate. For woody species, in most cases, smaller container plants will be the most efficient use of resources. Planted and seeded sites should be monitored and adaptively managed by experienced professionals or volunteers for 3 years or until plants are fully established. During this time, access via foot traffic and mowing should be restricted from seeded/planted areas to protect the developing seedlings and saplings.-

A full list of recommended plants can be found in Table 5.2. This list was created based on healthy plant communities in the study area. The plants on the list meet the following criteria:

- Native to Central Texas—historically occurring without introduction in the Edwards Plateau and Blackland Prairie ecoregions, with plants found in surrounding ecoregions considered on a case-by-case basis;
- Plant material should be grown within 250 miles of Zilker Park;
- Available through the local nursery trade or Native Plant Society groups;
- Successfully used in restoration projects within Central Texas;
- Add diversity to Zilker Park's current plant communities;
- Included in the Texas Parks and Wildlife Department's Wildscapes list of plants;122
- Listed in the Texas Parks and Wildlife Department's descriptions of the vegetation types found in the study area; and/or
- Recommended for this or similar projects by arborists, ecologists, or land management professionals.

PLANTING

Live plantings help to stabilize soils, increase diversity, shade out invasive species, and better define the user experience. Live plantings can consist of trees, understory, groundcover, or any combination of the three. In all cases, the following guidelines are critical:

- Prepare for success: Prepare the area for planting and address any issues (such as invasive species, erosion, or soil compaction) before planting. The plant palette must be determined with careful consideration of the typical site conditions (i.e., soil moisture and light).
- Establish oversight: Planting should be overseen by a trained individual who will ensure that the plants are handled properly and that the right species and number of plants are installed using appropriate planting techniques.
- Check plant quality: Plants should be inspected when they are delivered to the site and again before going into the ground to ensure that they meet growth specifications, are healthy, and have no weeds growing in the pots.
- Match plant material to use patterns: Where new plantings occur along trails or other high-use areas, ensure that plantings are protected or can withstand expected use. Where formal access to the water's edge is planned, ensure plantings will discourage informal pathways. Tall growing bunchgrasses such as eastern gamma grass, Lindheimer's muhly, and switchgrass can both stabilize the shoreline edge and discourage individuals from trespassing.
- Plant the right size: Plants should be the smallest size

Live plantings of understory and herbaceous material work to stabilize soils and better define the user experience. The size of plantings affect the success rate depending on the conditions of the site.

suitable for the circumstances. Small caliper trees and smaller potted plants establish faster and are less expensive,123 while larger plants are ideal for areas where trampling or aesthetics are of immediate concern.

• Plant in the right place: The recommended plant list found in Table 5.2 includes appropriate locations for each species. Ensure riparian trees are planted along the shoreline and upland trees are planted outside of the floodplain, keeping in mind that some species may be appropriate for a variety of settings. Take advantage of microtopography and high moisture areas to increase plant species diversity. Beyond the distinctions in the recommended plant list, an experienced professional and/or volunteer should facilitate decisions about where particular plants are placed. This will be particularly true for any potential rain gardens, swales, or wetlands. Planting trees in clumps or mottes rather than evenly spaced creates a more natural aesthetic. These trees will grow up to form groves, mimicking how trees grow naturally in Central Texas. Spacing between trunks can range in riparian and woodland areas from 10 to 30 ft with smaller spacing recommended for smaller species.

• Plant at the right time of year: Most planting should occur from October to March to allow plants to establish before the heat of the summer.

• Determine irrigation needs: While irrigation increases costs and the ecological footprint of projects, it also increases survivability, and is often necessary in highly visible, highly used areas, but less necessary in more remote parts of the park. Temporary irrigation can be critical during the first three years of establishment, especially during the dry summer months. Irrigation should be designed with a focus on water conservation to reduce the overall amount of irrigation, including reducing potable water use. In addition, irrigation systems should recognize topography and stormwater flows of the site.

• Continue care: Whether trees, understory, or groundcover, planting is only the first step. Long-term success requires that the new plants have sufficient water, are not being outcompeted by invasive species, and are not impacted by erosion issues.

SEEDING

Seeding can be used independently or as a complement to live plantings. Seeding should be used in areas where trampling is unlikely, where the seed will not be washed away, and where live planting is not practical. When seeding, it is critical to properly prepare the seeding area, ensure invasive species are not a major issue, control for erosion, establish good seed to soil contact, and ensure sufficient irrigation and/or rain. When successfully implemented, seeding offers a cost-effective way to restore or enhance an area.

While restoring or increasing the number of plant species is recommended in all plant communities in Zilker Park, seeding such a large area may not be realistic due to costs, labor, access, or time. Seed islands can be used to reduce labor and seeding costs. A seed island is a small area that has been planted or seeded with the intent of the plant material spreading to surrounding, unimproved areas. The area can be quite small (as small as 8 ft by 8 ft). The area should have invasive species removed, soil supplemented if needed (see Supporting Soil Health section), and erosion controlled. The seed island concept can be used in any of the restoration areas and all planting and seeding efforts should be thought of as seed islands for the surrounding areas.

Most of the practices outlined above for live plantings also apply to seeding. Important factors for seeding include:

• Source the Seeds: Seeds should come from a reputable seed distributor that specializes in native seed and can verify seed purity through testing—seed must be weed free.

• Prepare the Soil: Prepare the soil to support good seed-to-soil contact and a healthy growing medium. Remove weeds that can potentially outcompete seed material.

Seeding can create diverse and showy cover within urban areas, as seen here at Dell Medican Center near downtown Austin, and makes the most sense where trampling is unlikely to occur.

• Seed at the Right Time: 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 to early spring.

• Use Proper Seeding Rates: Rates will vary based on seed type and whether the seeding is adding diversity to an area with existing vegetation, complementing live plantings, or establishing vegetation in an area prepped specifically for seeding. Higher seeding rates help the new plants crowd out weeds more quickly.

• Spread the Seed: Seed can be casts using broadcast techniques or by incorporating seed into the soil or using techniques like seedballs (a popular technique for outreach and appropriate for children). Seed to soil contact is one of the main drivers of germination success and thus, no-till seed drills, raking seed into soil, and seedballs are all techniques that can substantially improve establishment.

• Determine irrigation needs: Temporary irrigation ensures germinating seedlings do not dry out and that there is soil moisture during establishment. This is more critical in high use, high visibility areas.

RESTORING PLANT COMMUNITIES

The site has been grouped into 10 proposed plant communities with 6 driven by ecological considerations, 3 by land use, and 1 by water (Figure 5.5). These communities were derived from the 12 existing plant communities described in the Ecology chapter and from an evaluation of topography, existing and likely use, soils, infrastructure constraints, proximity to water, likely response to different management, and the likelihood of restoration success. The recommendations here focus on the six terrestrial plant communities: Oak/Juniper/Elm Woodland, Riparian Woodland-Permanent Water, Riparian Woodland-Intermittent Water, Forested Wetland, Savanna, and Meadow. In addition, planting recommendations are given for the open water areas. To a lesser extent, ecological management practices, such as canopy enhancement, are recommended for the formal parkland area and the rights-of-way, recognizing that land use needs and formal park uses will drive management in these areas.

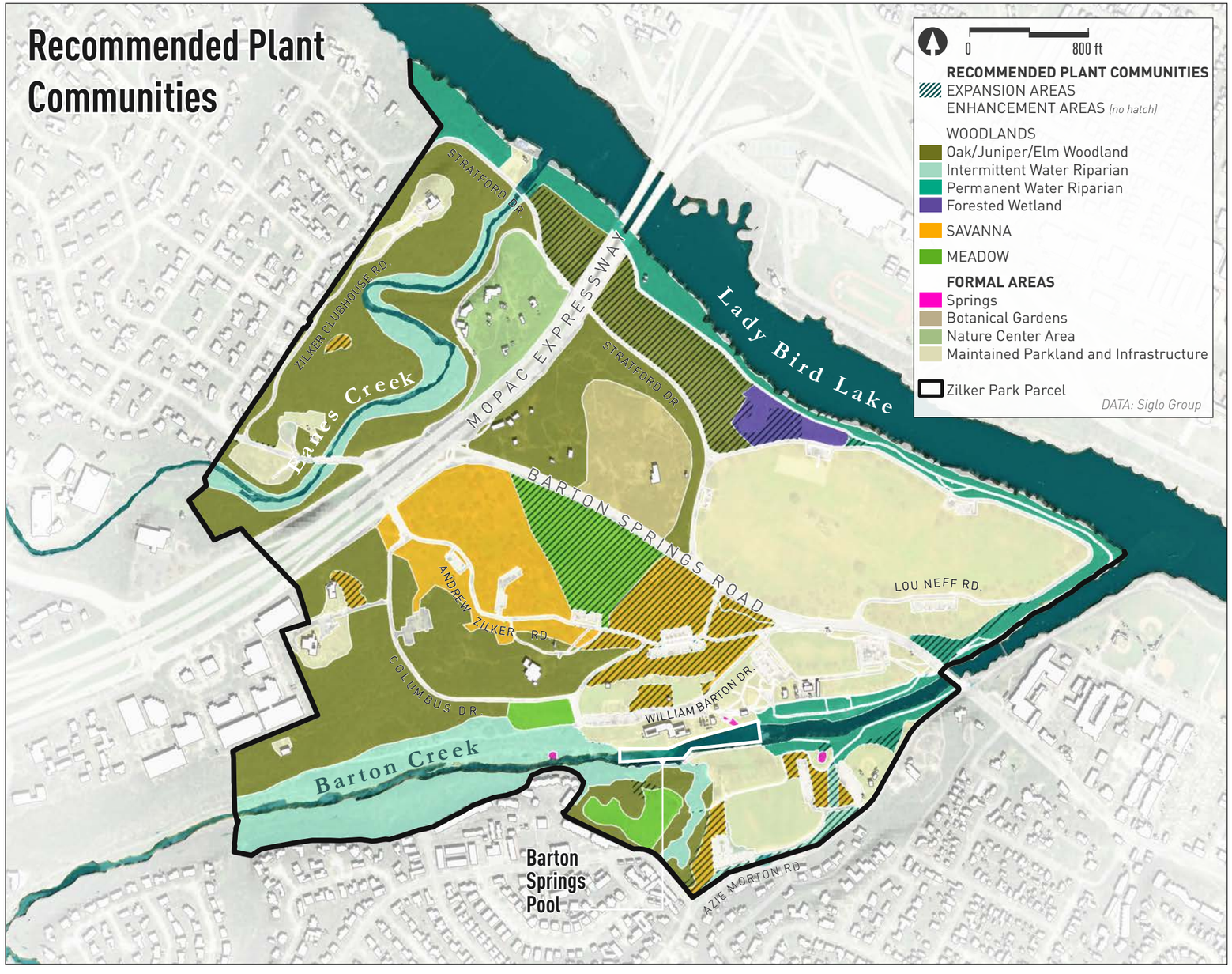


Figure 5.5. *Recommended Plant Communities*

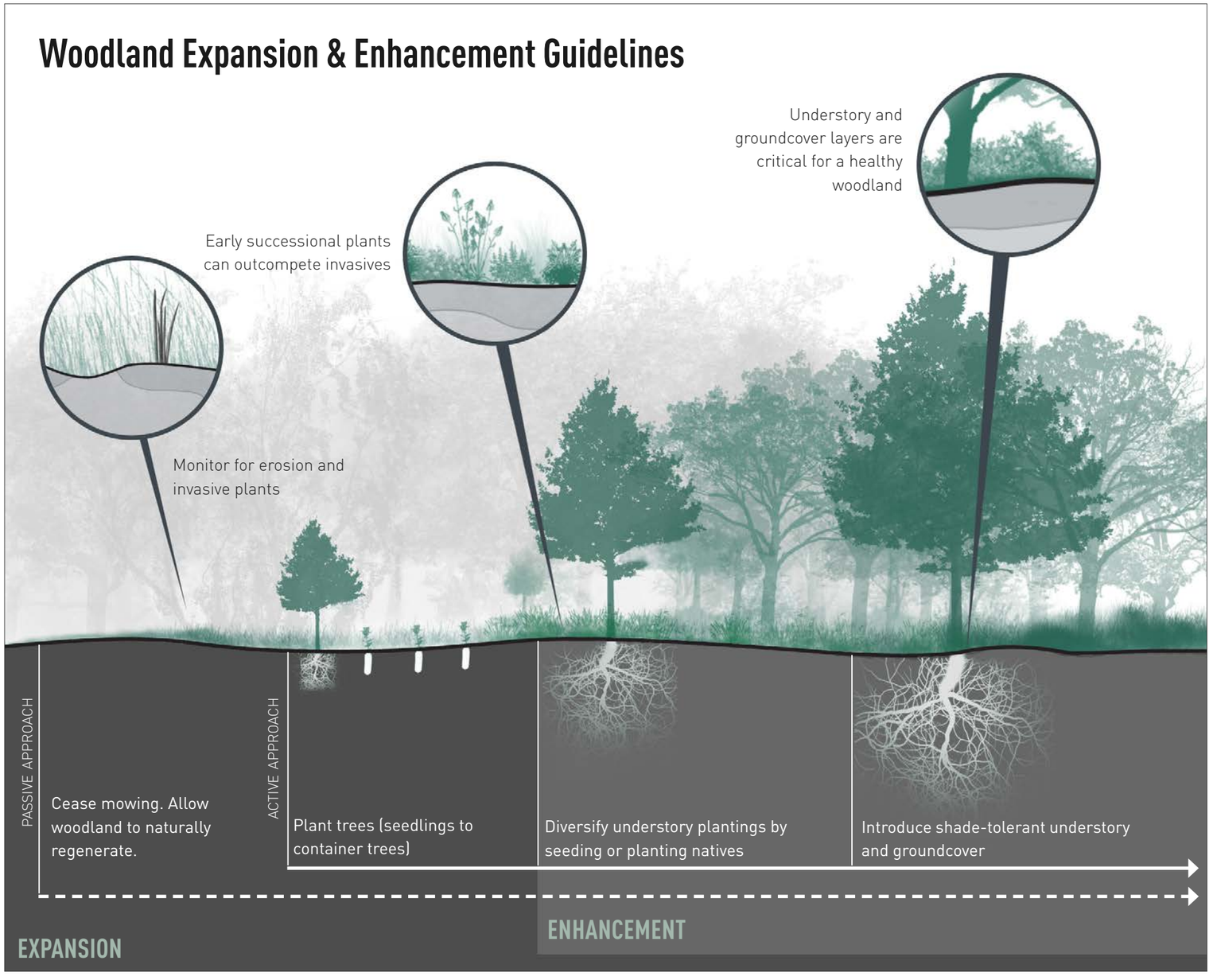
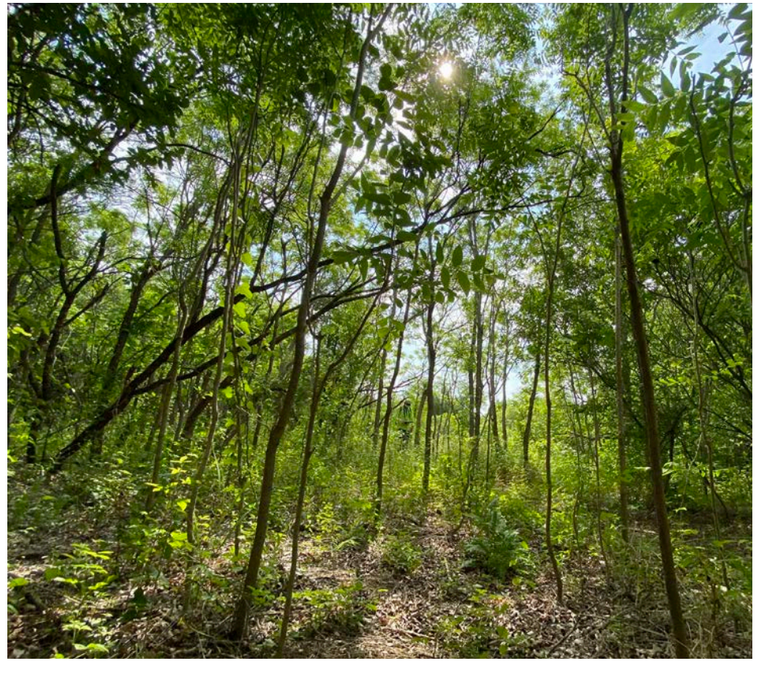


Figure 5.6. *Woodland Expansion & Enhancement Guidelines*

Here we describe restoration actions for specific plant communities. Recommended actions fit into two categories: enhancement and expansion (Figure 5.6). Enhancements are improvements to an existing plant community that ensure the park is providing the best quality habitat, recreational value, and ecosystem benefits. Expansions are areas currently underutilized that would benefit from an ecological approach. Specific guidance on enhancement and expansion is included for woodlands, savannas, and meadows. As described earlier in this chapter, management in the spring areas is defined by the Habitat Management Plan.[65] No action suggested here should conflict with the Habitat Management Plan and if it does, the directives of the Habitat Management plan should be followed.

For each area, existing plants and invasive species are listed in Table 3.1. Recommended plant species are listed in Table 5.2 and techniques for managing invasive species can be found in Table 5.1.



Restoration activities call for either the enhancement or expansion of communities. Woodlands with poor diversity or invasive plant infestations, as seen above, can be enhanced with a higher diversity of the canopy, understory, and herbaceous layer.

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CANOPY

CANOPY ENHANCEMENT

Canopy enhancement adds shade trees in the formal park areas where that expansion does not interfere with park use and improves the user experience. It is recommended where additional tree cover will provide shade, improve water quality, and reduce the impacts of impervious cover on localized heating. There are 66 acres of recommended canopy enhancement along the edges of roads, parking lots, and walkways (Figure 5.7). Canopy enhancement should use live plantings whenever feasible with irrigation during establishment. Where possible, trees should be planted at the same time as green stormwater infrastructure is installed, because the additional water in the soil will create healthier trees. By adding more shade trees, Zilker Park will increase in comfort, contribute to climate change mitigation and adaptation, and create a more naturalistic park aesthetic.

Figure 5.7. *Recommended Canopy Enhancement*

RESTORATION

WOODLANDS: OAK/JUNIPER/ELM, RIPARIAN, AND WETLAND

Woodlands are plant communities where trees are the dominant plant form. At Zilker Park, there are four proposed woodland plant communities that require enhancement and/or expansion (Figure 5.8).

- Oak/Juniper/Elm Woodland (96 acres enhancement, 15 acres expansion, 28% of study area): Restoration efforts in this area aim to decrease invasives, add age class diversity, address erosion, and increase species diversity.

- Riparian Woodland-Intermittent Water (43 acres enhancement, 2 acres expansion, 11% of study area): These areas are impacted by regular flooding that brings invasive species seeds and can cause acute erosion issues. Riparian woodlands also offer unique opportunities for restoration due to greater water availability along the waterways.

- Riparian Woodland-Permanent Water (23 acres enhancement, 2 acres expansion, 6% of study area): These areas have even more water available than intermittent areas, creating opportunities for wetland plantings along the edge. Trees have sufficient resources to grow extremely large. These areas suffer from invasive species and have the most substantial erosion issues in the park.

- Forested Wetland (2 acres enhancement, 2 acres expansion, 1% of study area): The existing Wetland plant community is being enhanced and expanded by adding more canopy cover and species diversity with a focus on facultative wetland species.

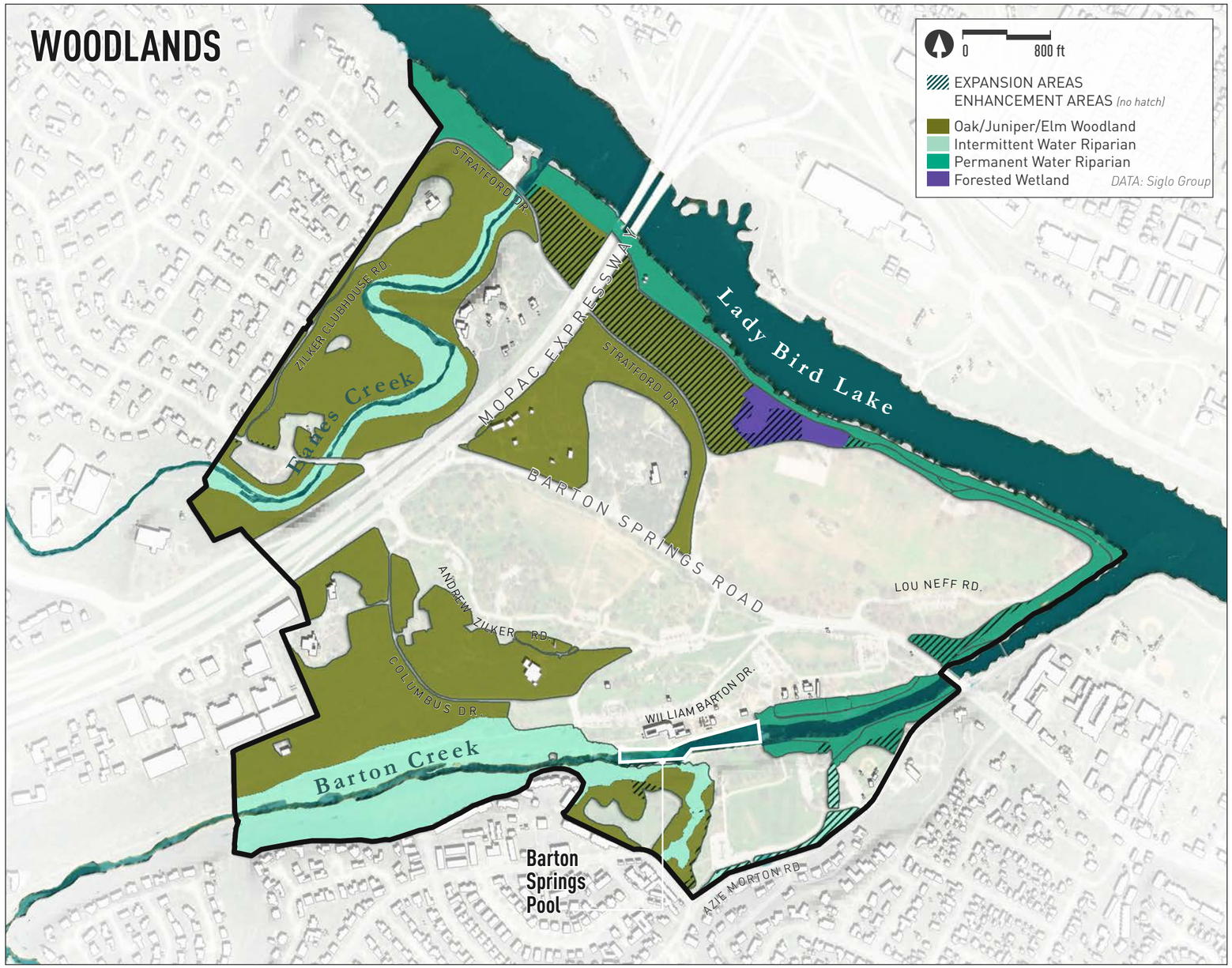


Figure 5.8. *Recommended Canopy Enhancement*

RESTORATION

WOODLAND ENHANCEMENT (160 ACRES, 39.7% OF PARK)

Woodland enhancement includes managing invasive species, addressing erosion, increasing age class diversity through woodland thinning, and increasing structural and plant diversity. The actions here are similar for Oak/Juniper/Elm and riparian woodlands with adjustments along water ways to improve the user experience. The recommended plant list notes which species are best suited for upland sites or wetter soils (Table 5.2).

Woodland expansion & species diversity is recommended near the existing wetland.

Actions:

1. Control invasives with a focus on Ligustrum, Nandina, catclaw, sweet autumn clematis, Chinaberry, Japanese honeysuckle, and paper mulberry. Invasive control is especially important in riparian woodlands because flood waters regularly bring in new seeds.
2. Address acute erosion issues with solutions that include green stormwater infrastructure.
3. Create formal user infrastructure in high use areas, particularly along waterways to direct the user experience, reduce trampling, reduce erosion, and protect plant material.
4. Use knee-high fencing, split rail fencing, and/or hardscaping to create a physical barrier between natural areas and formal use areas.
5. Increased age class diversity by thinning small diameter saplings in areas with homogeneous age structure. Thinning will reduce competition among potential canopy trees and make space for added structural diversity in the understory and groundcover layers.
6. In areas with active sheet erosion, areas that were historically cleared (reference 1940 and 1984 aerials in the Historic & Cultural Use chapter), and areas being thinned, use mulch to increase organic content, soil fauna, and water infiltration.
7. Once the steps above have been completed over a three-year period, evaluate understory species. Where shrub and small tree layers have not volunteered, plant. Where available, use irrigation.
8. Once the steps above have been completed over a three-year period, evaluate herbaceous layer for diversity. In areas where more diversity or biomass is desired, prepare site by lightly disturbing surface and disperse shade tolerant species by seed with a dusting of compost to increase seed to soil contact. Irrigate where possible.
9. Increase the diversity of canopy trees throughout the woodlands and plant where desired for next generation of canopy trees. Irrigate where feasible.
10. Repeat steps 1 and 2 annually. Repeat steps 5, 6, 7, 8, and 9 every three years

RESTORATION

WOODLAND EXPANSION (23 ACRES, 5.7% OF PARK)

Woodland expansion areas include the Butler Landfill, the Bone Yard, and select locations in the upslope areas adjacent to Barton Creek. Historically, many of these areas would have been part of a floodplain terrace woodland with a nearly continuous, cathedral-like canopy along with thriving understory and herbaceous layers. The purpose of expansion in these areas is to return more of the park to a natural state and to increase ecological function, diversity, shade, visual interest, carbon sequestration, and wildlife habitat, while helping to mitigate urban heat island temperatures. These areas were carefully chosen to minimize impacts on recreation and infrastructure. Establishing woodlands in underutilized areas is one of the most effective ways to enhance the user experience and increase the ecological functionality and diversity of the natural areas, while reducing overall management needs. Many of these areas are currently maintained as invasive grasslands that are regularly mowed. In woodland expansion areas, actions include soil enhancement, woody species planting, invasive management, and eventual herbaceous layer seeding.

A note on the Butler Landfill: As discussed in the Historic and Cultural Use Chapter, approximately 100,000 cubic yards of refuse from an old landfill is under the ground in this area. While the costs of excavating that material and returning the area to a restored natural state would be substantial, considering the significance of the location adjacent to a lake in the most used park in one of the fastest growing cities in the country, it is within the realm of possibilities. In addition, as this report focusses on best ecological outcomes, returning this area to a wooded area adjacent to Lady Bird Lake would result in the greatest ecological uplift while creating a large new area for park users to enjoy. To accomplish woodland expansion in this area additional studies, planning, and actions not covered below will be needed.

Actions:

1. Plant and establish woody species using a tree motte planting design that focusses on close planting distances in groups of trees. This design creates more naturalistic results, reduces weed issues, reduces overall costs of infrastructure, and minimizes the size of area disturbed. A representative motte is shown in Figure 5.9 with a planting plan for canopy, understory, and herbaceous species. The mottes should be dispersed throughout the woodland expansion area and cover 50% of the area. In areas outside of the floodplain, compost should be distributed to a depth of 2 inches in portions of the motte to be planted prior to planting and the area should be mulched to a depth of 3 to 4 inches after planting to reduce weed competition in the entire area and build soil fertility.
2. After two years of growth, increases in canopy, and breaking down of mulch layer, seed the mottes with shade tolerant species where native plant layer is not present.
3. Manage invasive two seasons before planting or seeding.
4. After two years, allow passive restoration (no mowing) to occur within the expansion areas not previously planted or expand the motte areas as desired.
5. Annually, look for opportunities to increase species diversity.
6. Follow actions outlined in woodland enhancement.
7. Follow actions outlined in woodland enhancement.

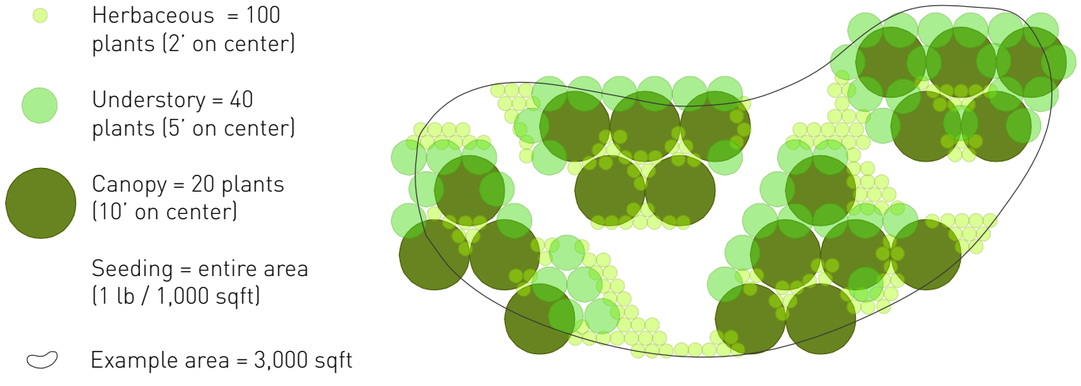


Figure 5.9. *Motte planting diagram*

RESTORATION

MEADOWS

Meadows are open expanses of grasses and wildflowers that represent the swaths of prairies that would be found on rich soils outside the floodplains in the Blackland Prairie. These areas are generally without trees. They were maintained for eons by a combination of large herbivores and fire. While the ideal management practices for this area would aim for a mid to tall grass prairie, because of the dominance of invasive grasses (Bermuda grass, King Ranch Bluestem, Johnsongrass, etc.), the intent of meadow management is to build on current wildflower meadow management practices used by PARD and increase native plant diversity over time. Along with wildflowers, native grasses should be a major component of any seed mix. Appropriate species (see Table 5.2 for a full list) include: Engelmann's daisy, beebalm, golden wave, bluebonnets, Indian blanket, basket flower, coreopsis, coneflower, silver bluestem, blue grama, buffalograss, curly mesquite, sideoats grama, little bluestem, big bluestem, and Indiangrass.

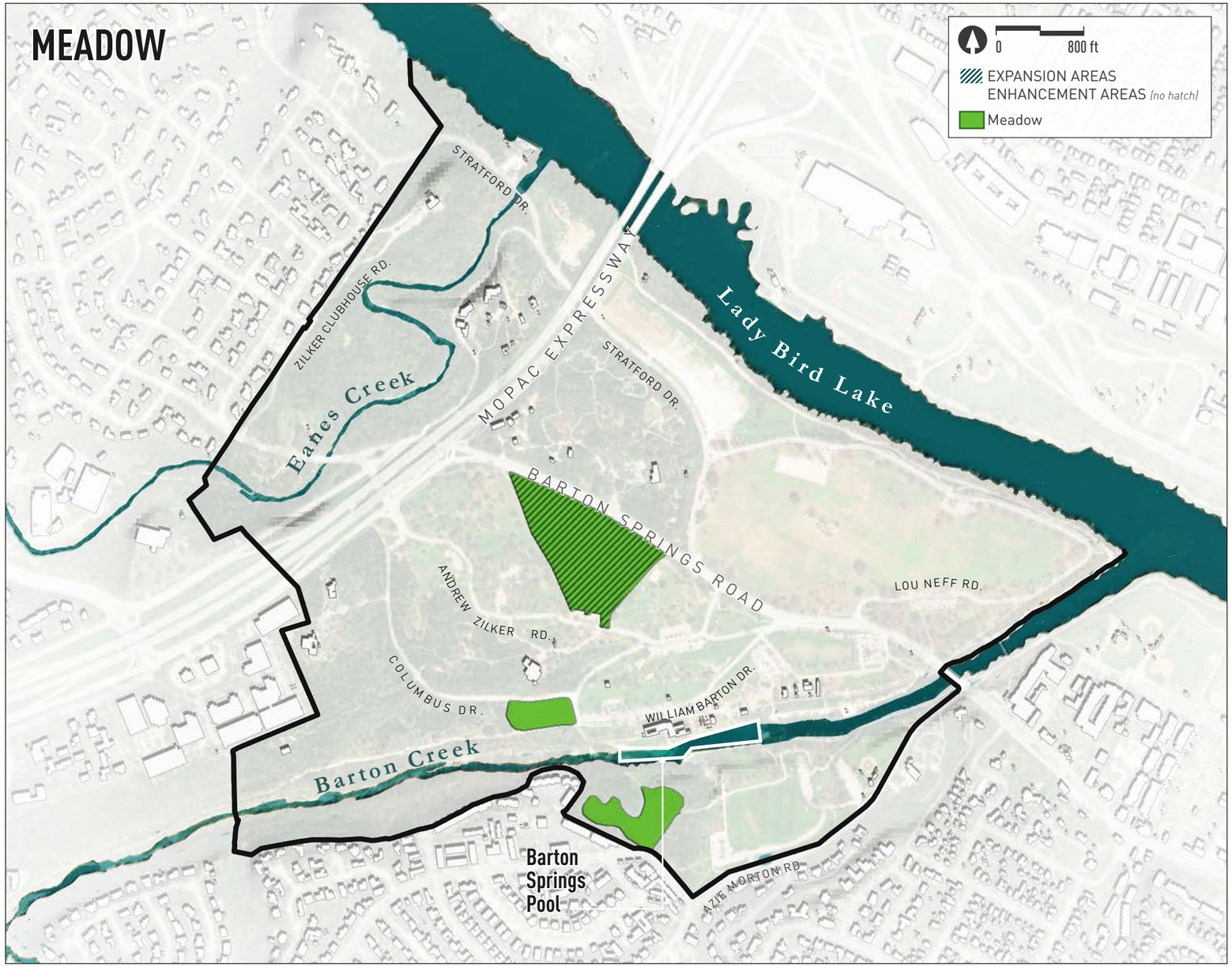


Figure 5.10. *Meadow Enhancement & Expansion*

RESTORATION

MEADOW ENHANCEMENT (5 ACRES, 1.2% OF PARK)

There are 5 acres of meadow enhancement found at the southern entrance of Barton Springs Pool and at the Violet Crown Trailhead (Figure 5.10). Key elements of meadow enhancement include reducing mowing frequency and increasing height of mowing; spot treating invasives; managing woody encroachment; and seeding areas for increased diversity.

Actions:

1. Reduce mowing to no more than two times a year and mow at no less than 6 inches. Mowing lower than 6 inches results in damage to the growth of bunch grasses. Mow in late February and late July. Mowing can also be timed to reduce/inhibit nuisance vegetation (i.e., before the ragweed goes to seed, around mid-October).
2. Seed entire area after mowing with pollinator species and native grasses to increase overall habitat value. Seed from Oct 15 to Dec 1 and again March 15 to April 15. Ensure good seed to soil contact. Where feasible use temporary irrigation.
3. Spot treatment King Ranch bluestem, Bermuda grass, and Johnsongrass in areas where the invasive patch is greater than 16 sq ft and the invasive covers more than 80% of the area. Treat these grasses by 1) cutting invasive to the ground before seed matures (May to June); 2) after six weeks of regrowth spot treating area with appropriate herbicide; 3) seeding in fall (Oct 15 to Dec 1) with 1/8 inch of compost at a rate of 24 lbs per acre; 4) reseeding in areas without germination from March 15 to April 15.
4. Create temporary barriers around seeded areas to reduce trampling and increase potential of establishment.
5. Consider the use of fire as a management tool.
6. Repeat process annually.

MEADOW EXPANSION (11 ACRES, 2.8% OF PARK)

Eleven acres of meadow expansion are possible in the Polo Field. Establishing meadows here will increase diversity in low-use zones, add pollinator habitat and support unique bird species. In addition to the actions mentioned for meadow enhancement, meadow expansion requires soil treatment.

Actions:

1. Follow guidance in "Supporting Soil Health" section to aerate, inoculate, and amend the soil.
2. Follow steps for meadow enhancement.

Meadows can be enhanced by increasing species diversity via plantings, in the form of plug planting seedling

RESTORATION

SAVANNAS

Savannas are grasslands with groupings of trees found throughout the Edwards Plateau and in flatter areas outside of the floodplain. They represent a mix of woodland and meadow. Like meadows they were maintained by a combination of large herbivores and fire. At Zilker, savannas can be found in the Disc Golf Course, areas around the pool parking lots, south of Barton Creek between the parking lots, and in small pockets within the Oak/Juniper/Elm woodland. In open urban areas like Zilker Park, savannas are invaded by aggressive invasive species. In their wooded component they are often mowed and manicured due to social norms associated with land management, as we see at Zilker Park. To both expand and enhance these areas, primary actions will be reducing mowing, reducing user impacts, increasing understory, and increasing diversity over time, while pushing back invasives.

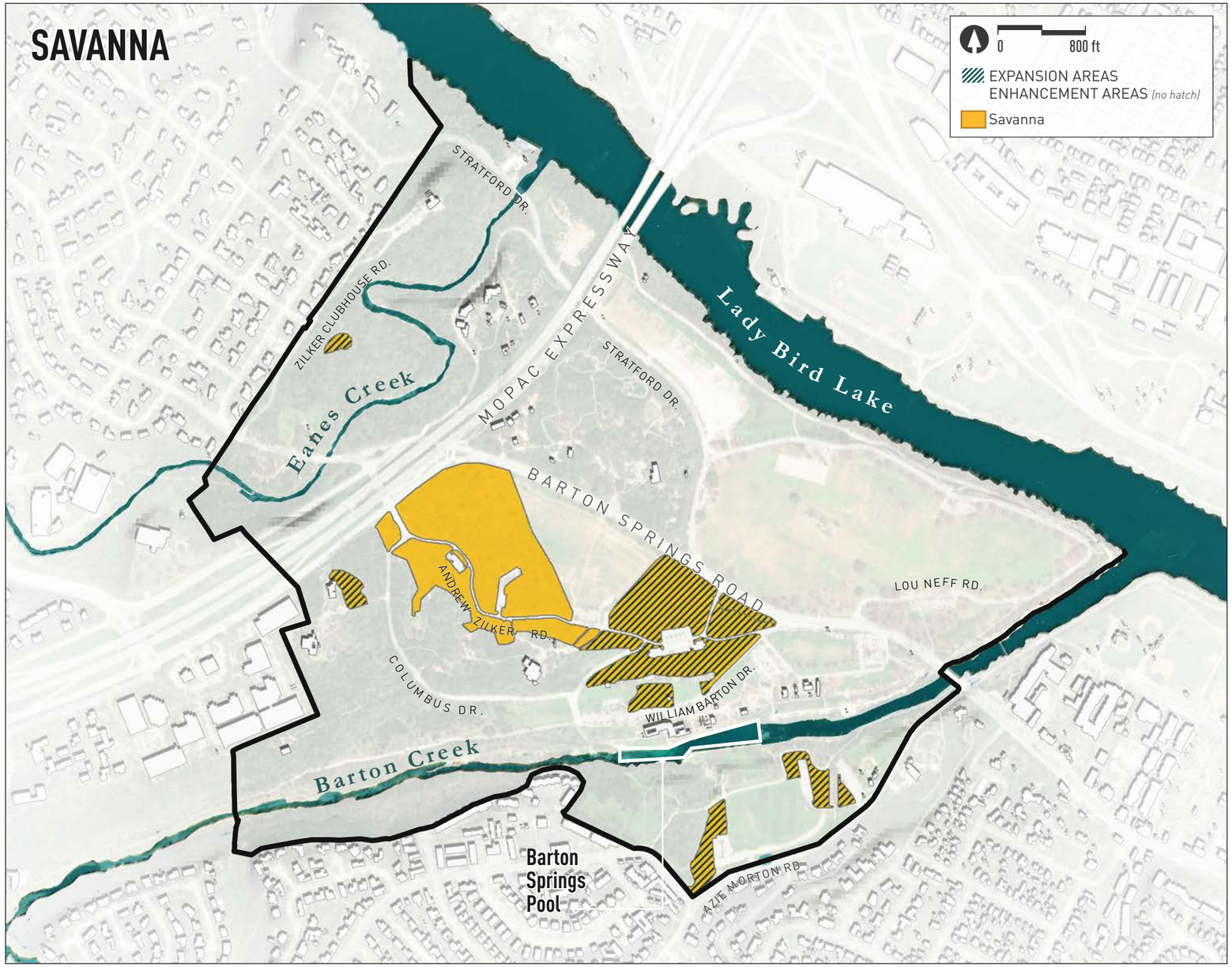


Figure 5.11. *Savanna Enhancement & Expansion*

RESTORATION

SAVANNA ENHANCEMENT (20 ACRES, 4.9% OF PARK) AND EXPANSION (17 ACRES, 4.3% OF PARK)

The purpose of savanna enhancement and expansion is to improve the health of existing grassland and understory native plant assemblages and support better wildlife habitat. The difference between the two areas is that savanna expansion areas are currently being maintained as lawns with frequent mowing, whereas enhancement areas are being mowed less regularly (Figure 5.11).

Actions (for both expansion and enhancement):

1. Reduce mowing in open areas to no more than two times a year and mow at no less than 6 inches. Under the tree canopy and outside of active recreation areas, stop mowing where understory is being established and mow herbaceous layer no more than once a year at no less than 6 inches. Mowing lower than 6 inches results in damage to the growth of bunch grasses. Mow in late February and late July.
2. Follow seeding actions described in meadows for open areas.
3. Spot treatment of invasives in open areas as described in the meadows section above.
4. Ensure human use through the area, even if diffuse, is directed to allow for some areas to be maintained in a natural state—for instance, in the Disc Golf Course, it is likely that some fairways should be mulched to reduce erosion and direct formal use. In addition, plantings around the tee boxes should have knee-high fencing, split rail fencing, or hardscaping that creates a boundary between users and naturally maintained areas.
5. Maintain canopy cover in the area between 15 and 50% with planting or other means following above planting procedures. Use irrigation where feasible.
6. Increase soil health in understory through a combination of mulching (where there is active human use and lack of vegetation) and compost where herbaceous and understory growth is planned.
7. Create understory layer currently lacking in most areas that covers ~10% of the understory through planting of woody species, with irrigation where feasible.
8. Seed shade tolerant species under canopy to maintain 40% of the understory in a native herbaceous layer. In high use areas seeding must be accompanied by knee-high fencing, split rail fencing, and/or hardscaping that directs users out of the area and reduces trampling.
9. Control woody invasive species in the canopy and understory.
10. Mowing in the savanna should be timed to reduce/inhibit nuisance vegetation (i.e., before the ragweed goes to seed).
11. Consider the use of fire as a management tool.
12. Repeat steps 1, 2, 3, 6, 8, and 9 annually. Repeat steps 5 and 7 every three years.

AQUATIC & WETLAND PLANTINGS

Within Lady Bird Lake and the Forested Wetland there are opportunities to increase aquatic and wetland plant diversity that increases the quality of wildlife habitat and reduces the likelihood of invasive plant establishment. The Forested Wetland, Riparian Woodland, and Springs & Permanent Waters columns in the recommended plant list (Table 5.2) include over 25 species appropriate for wetter parts of the study area. These can be planted in the Forested Wetland directly, along the shoreline of Lady Bird Lake to enhance the wetland fringe, particularly around the two habitat islands, as well as in the lake with the use of an exclosure that protects the plants from herbivores.

Wetland fringe and islands along Lady Bird Lake.

Table 5.2 *Recommended Plant Species correspond with Recommended Plant Communities in Figure 5.5*

Recommended Plants

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Agarita	*Mahonia trifoliolata*	SHRUBS	*	*	*		*	*			*	*
American basketflower	*Centaurea americana*	HERB	*	*	*	*	*		*		*	
American beautyberry	*Callicarpa americana*	SHRUBS	*	*	*		*	*				*
American elderberry	*Sambucus canadensis*	SHRUBS		*		*	*					
American elm	*Ulmus americana*	LARGE TREE		*	*		*					*
American germander	*Teucrium canadense*	HERB		*		*	*					
American Pokeberry	*Phytolacca americana*	SHRUBS	*	*	*	*	*		*			
American water-willow	*Justicia americana*	HERB		*			*					
Anacacha orchid tree	*Bauhinia lunarioides*	TREES		*	*		*	*				*
Anacua	*Ehretia anacua*	LARGE TREE	*	*	*		*	*				*
Annual fimbry	*Fimbristylis annua*	GRASS/SEDGE				*						
Annual winecup	*Callirhoe leiocarpa*	HERB		*	*		*		*			
Antelope horns	*Asclepias asperula*	HERB	*	*	*		*		*			
Arrowheads	*Sagittaria spp.*	HERB		*			*					
Arrowroot	*Sagittaria platyphylla*	HERB								*		
Bald cypress	*Taxodium distichum*	LARGE TREE	*	*		*	*					*
Bear grass	*Nolina texana*	GRASS/SEDGE	*	*	*			*			*	*
Beardtounge	*Penstemon laxiflorus*	HERB		*	*				*			
Beebalm	*Monarda fistulosa*	HERB		*	*				*		*	*
Big bluestem	*Andropogon gerardii*	GRASS/SEDGE		*	*		*	*				
Black walnut	*Juglans nigra*	LARGE TREE	*	*		*	*					*
Black willow	*Salix nigra*	TREES		*		*	*					
Black-eyed Susan	*Rudbeckia hirta*	HERB		*	*	*	*		*		*	*
Blackfoot daisy	*Melampodium leucanthum*	HERB	*	*	*							*
Blue curls	*Phacelia congesta*	HERB		*	*	*	*		*		*	
Blue grama	*Bouteloua gracilis*	GRASS/SEDGE		*		*	*		*		*	

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Blue sage	*Salvia ballotifolia*	SHRUBS	*	*	*				*		*	*
Blue water hyssop	*Bacopa caroliniana*	HERB					*			*		
Blue waterleaf	*Hydrolea ovata*	HERB		*			*					
Blue-eyed grass	*Sisyrinchium scabrum*	HERB		*	*				*			
Bois d'arc	*Maclura pomifera*	LARGE TREE	*	*	*	*	*				*	*
Box elder maple	*Acer negundo*	LARGE TREE		*		*	*					
Britton's sedge	*Carex tetrastachya*	GRASS/SEDGE		*		*	*				*	
Brookweed	*Samolus parviflorus*	HERB					*			*		
Buffalograss	*Bouteloua dactyloides*	GRASS/SEDGE		*	*	*	*	*	*		*	*
Burr oak	*Quercus macrocarpa*	LARGE TREE		*	*	*	*					*
Bush sunflower	*Simsia calva*	HERB		*	*				*		*	
Bushy bluestem	*Andropogon glomeratus*	GRASS/SEDGE		*		*	*					
Butterfly weed	*Asclepias tuberosa*	HERB	*	*	*	*	*					*
Buttonbush	*Cephalanthus occidentalis*	SHRUBS	*	*		*	*					*
Cabomba	*Cabomba caroliniana*	HERB								*		
California bulrush	*Schoenoplectus californicus*	HERB		*			*					
Camphorweed	*Pluchea camphorata*	HERB		*			*					
Canada wildrye	*Elymus canadensis*	GRASS/SEDGE	*	*	*	*	*	*	*		*	
Cane bluestem	*Bothriochloa barbinodis*	GRASS/SEDGE		*	*	*	*	*	*		*	
Capitate spikerush	*Eleocharis geniculata*	HERB				*	*					
Cardinal flower	*Lobelia cardinalis*	HERB	*	*		*	*					*
Carolina basswood	*Tilia caroliniana*	TREES	*	*	*	*	*					
Carolina buckthorn	*Frangula caroliniana*	SHRUBS	*	*	*		*					*
Carolina canarygrass	*Phalaris caroliniana*	GRASS/SEDGE				*	*				*	
Carolina joint-tail	*Coelorachis cylindrica*	GRASS/SEDGE			*		*	*	*		*	
Carolina larkspur	*"Delphinium carolinianum subsp. Virescens"*	HERB	*	*	*	*		*	*			

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Catclaw acacia	*Acacia greggii var. wrightii*	SHRUBS			*							
Cedar	*Juniperus ashei*	TREES	-	*	*		*					*
Cedar elm	*Ulmus crassifolia*	LARGE TREE		*	*	*	*	*			*	*
Cedar sage	*Salvia roemeriana*	SHRUBS	*	*	*		*	*				*
Cenizo	*Leucophyllum fructescens*	SHRUBS	*	*	*				*		*	*
Cherokee sedge	*Carex cherokeensis*	GRASS/SEDGE	*	*	*	*	*				*	*
Chile piquín	*Capsicum annuum*	HERB		*	*	*	*					
Chinquapin oak	*Quercus muhlenbergia*	LARGE TREE	*	*	*			*				*
Clammyweed	*Polanisia dodecandra subsp. Trachysperma*	HERB			*				*		*	
Clasping coneflower	*Dracopis amplexicaulis*	HERB	*	*		*	*					
Climbing hempvine	*Mikania scandens*	VINE				*	*					
Clover fern	*Marsilea macropoda*	HERB	*	*			*					*
Common hackberry	*Celtis occidentalis*	LARGE TREE	-	*	*		*	*				
Coralbean	*Erythrina herbacea*	HERB	*	*	*				*			*
Coralberry	*Symphoricarpos orbiculatus*	SHRUBS	*	*	*		*					
Cowpen daisy	*Verbesina encelioides*	HERB	*	*	*	*	*	*	*		*	
Creek plum	*Prunus rivularis*	TREES		*	*		*				*	*
Crossvine	*Bignonia capreolata*	VINE	*	*			*					*
Curly mesquite	*Hilaria belangeri*	GRASS/SEDGE	*	*	*			*	*		*	
Cutleaf evening primrose	*Oenothera laciniata*	HERB		*	*			*	*		*	
Damianita	*Chrysactinia mexicana*	SHRUBS		*					*			*
Deer muhly	*Muhlenbergia rigens*	GRASS/SEDGE	*	*							*	*
Desert willow	*Chilopsis linearis ssp. linearis*	TREES	*	*			*				*	*
Dewberry	*Rubus trivialis*	SHRUB			*	*	*					
Ditch rabbit-foot grass	*Polypogon interruptus*	GRASS/SEDGE				*	*					
Drummond phlox	*Phlox drummondii*	HERB	*	*	*			*	*		*	*
Durand oak	*Quercus durandii*	LARGE TREE			*		*					

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Eastern cottonwood	*Populus deltoides*	LARGE TREE	*	*		*	*					*
Eastern gamagrass	*Tripsacum dactyloides*	GRASS/SEDGE	*	*		*	*					
Eastern red cedar	*Juniperus virginiana*	TREES		*	*				*			*
Eastern red columbine	*Aquilegia canadensis*	HERB		*	*		*					*
Eel grass	*Vallisneria americana*	HERB	*							*		
Elbow bush	*Forestiera pubescens*	SHRUBS	*	*	*	*	*		*		*	*
Emory sedge	*Carex emoryi*	GRASS/SEDGE		*		*	*					
Engelmann's daisy	*Engelmannia peristenia*	HERB	*	*	*	*		*	*		*	*
Engelmann's sage	*Salvia engelmannii*	HERB		*	*			*	*			*
Escarpment black cherry	*Prunus serotina var. eximia*	TREES	*	*	*	*	*					*
Eve's necklace	*Styphnolobium affine*	TREES	*	*	*		*	*			*	*
Evergreen sumac	*Rhus virens*	SHRUBS	*	*	*		*	*			*	*
Fall aster	*Symphyotrichum oblongifolium*	SHRUBS	*	*	*		*	*				*
Fall obedient plant	*Physostegia virginiana*	HERB	*	*			*					
False day flower	*Tinantia anomala*	HERB		*	*		*					
False indigo	*Amorpha fruticosa*	SHRUBS	*	*		*	*					*
False nettle	*Boehmeria cylindrica*	HERB				*	*					
Feather windmillgrass	*Chloris virgata*	GRASS/SEDGE					*	*				
Flame acanthus	*Anisacanthus quadrifidus var. wrightii*	SHRUBS	*	*							*	*
Flameleaf sumac	*Rhus lanceolata*	SHRUBS	*	*	*			*			*	*
Flat-tem spikerush	*Eleocharis compressa*	HERB				*						
Four nerve daisy	*Tetraneuris scaposa*	HERB	*	*	*			*	*		*	*
Four o'clock	*Mirabilis albida*	HERB			*	*	*		*			
Fragrant sumac	*Rhus aromatica*	SHRUBS	*	*	*		*	*				*
Frogfruit (phyla incisa)	*Phyla nodiflora*	GROUND COVER	*	*		*	*					
Gaura	*Gaura lindheimeri*	HERB	*	*	*		*	*	*		*	*

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Gayfeather	*Liatris mucronata*	HERB	*	*	*			*	*		*	*
Giant bulrush	*Schoenoplectus validus*	GRASS/SEDGE		*			*					
Giant goldenrod	*Solidago gigantea*	HERB	*	*		*	*		*		*	
Globe mallow	*Sphaeralcea angustifolia*	HERB	*	*	*			*	*			
Golden groundsel	*Packera obovata*	HERB		*	*		*	*				
Golden wave coreopsis	*Coreopsis basalis*	HERB	*	*	*			*	*		*	*
Goldenball lead tree	*Leucaena retusa*	TREES	*	*	*		*	*			*	*
Goldeneye daisy	*Viguiera dentata*	HERB	*	*	*	*	*	*	*			
Goldenrod	*Solidago altissima*	HERB		*		*	*		*			
Green ash	*Fraxinus pennsylvanica*	LARGE TREE	*	*		*	*					
Green comet milkweed	*Asclepias viridiflora*	HERB			*			*	*			
Green dragon	*Arisaema dracontium*	HERB		*		*	*					
Green milkweed	*Asclepias viridris*	HERB			*			*	*			
Green sprangletop	*Leptochloa dubia*	GRASS/SEDGE	*	*	*	*		*	*		*	
Gregg's dalea	*Dalea greggii*	Herb		*				*	*		*	*
Gregg's mistflower	*Conoclinium greggii*	HERB	*	*	*	*	*	*	*		*	*
Gregg's salvia	*Salvia greggii*	SHRUBS	*	*	*			*	*		*	*
Greybark grape	*Vitis cinerea*	SHRUB			*	*	*					
Guajillo	*Senegalia berlandieri*	SHRUBS	*	*	*						*	*
Gum bumelia	*Sideroxylon lanuginosum*	LARGE TREE		*	*		*	*				*
Hall's panicum	*Panicum hallii*	GRASS/SEDGE		*				*	*		*	
Hardy spineless prickly pear	*Opuntia ellisiana*	SHRUBS		*							*	*
Heath aster	*Symphyotrichum ericoides*	HERB	*	*	*	*	*	*	*			
Heller's marbleseed	*Lithospermum helleri*	HERB			*		*					
Honey locust	*Gleditsia triacanthos*	LARGE TREE		*	*		*					
Hornwort	*Ceratophyllum demersum*	HERB	*							*		

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Horsetail	*Equisetum laevigatum*	HERB	*	*		*	*					*
Huisache	*Vachellia farnesiana*	TREES		*			*	*				*
Huisache daisy	*Amblyolepis setigera*	HERB		*	*			*	*			
Illinois bundleflower	*Desmanthus illinoensis*	HERB	*	*	*			*	*		*	
Indian blanket	*Gaillardia pulchella*	HERB	*	*	*	*	*	*	*		*	*
Indian paintbrush	*Castilleja indivisa*	HERB	*	*	*			*	*			
Indiangrass	*Sorghastrum nutans*	HERB	*	*	*			*	*		*	
Inland rush	*Juncus marginatus*	HERB				*	*					
Inland sea oats	*Chasmanthium latifolium*	GRASS/SEDGE	*	*	*	*	*					*
Ironweed	*Vernonia baldwinii*	Herb	*	*	*	*	*				*	*
Kidneywood	*Eysenhardtia texana*	TREES	*	*	*			*			*	*
Lacey oak	*Quercus laceyi*	LARGE TREE	*	*	*			*				*
Lanceleaf coreopsis	*Coreopsis lanceolata*	HERB	*						*			*
Lance-leaf frog fruit	*Phyla lanceolata*	GROUND COVER		*		*	*					
Late boneset	*Eupatorium serotinum*	HERB	*	*	*	*	*					*
Lazy daisy	*Aphanostephus sp.*	HERB		*			*	*	*			
Lemon beebalm	*Monarda citriodora*	HERB	*	*	*	*		*	*		*	
Lindheimer's muhly	*Muhlenbergia lindheimeri*	GRASS/SEDGE	*	*		*	*				*	*
Lindheimer's senna	*Senna lindheimeriana*	HERB	*	*	*			*	*		*	*
Lindheimer's silktassel	*Garrya ovata ssp. Lindheimeri*	SHRUBS	*	*	*	*	*				*	*
Lindheimer's daisy	*Lindheimera texana*	HERB		*	*			*	*		*	
Little barley	*Hordeum pusillum*	GRASS/SEDGE			*			*	*			
Little bluestem	*Schizachyrium scoparium*	GRASS/SEDGE	*	*	*	*		*	*		*	*
Little walnut	*Juglans microcarpa*	TREES		*			*				*	*
Live oak	*Quercus fusiformis*	LARGE TREE	*	*	*	*	*	*				*
Live oak	*Quercus virginiana*	LARGE TREE	*	*	*	*	*	*				*

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Lovegrass	*Eragrostis intermedia*	GRASS/SEDGE	*	*				*	*		*	
Manyflower marsh-pennywort	*Hydrocotyle umbellata*	HERB					*			*		
Marbleseed	*Lithospermum molle*	HERB	*		*	*	*	*	*			*
Marsh fleabane	*Pluchea odorata*	HERB	*	*			*					
Marsh obedient plant	*Physostegia intermedia*	HERB		*			*					
Maximillian sunflower	*Helianthus maximiliani*	HERB	*	*		*	*		*		*	*
Meadow sedge	*Carex perdentata*	GRASS/SEDGE		*				*	*		*	*
Mealy blue sage	*Salvia farinacea*	SHRUBS	*	*	*	*		*	*		*	*
Mesquite	*Prosopis glandulosa*	TREES	*	*	*			*			*	*
Mexican buckeye	*Ungnadia speciosa*	TREES	*	*	*		*	*			*	*
Mexican olive	*Cordia boissieri*	SHRUBS		*				*				*
Mexican plum	*Prunus mexicana*	TREES	*	*	*	*	*	*			*	*
Missouri primrose	*Oenothera missouriensis*	HERB	*	*				*	*		*	*
Mistflower	*Conoclinium coelestinum*	HERB	*	*	*	*	*				*	
Monterrey oak	*Quercus polymorpha*	LARGE TREE	*	*				*				*
Morning glory	*Ipomoea lindeimeri*	VINE	*	*	*	*	*	*				*
Mustang grape	*Vitis mustangensis*	SHRUB	*			*						
Netted milkvine	*Matelea reticulata*	HERB	*	*	*	*	*	*				
Nodding smartweed	*Polygonum lapathifolium*	HERB				*	*					
Nolina	*Nolina lindheimeri*	SHRUBS	*	*	*							*
Northern spicebush	*Lindera benzoin*	SHRUBS		*	*		*					*
Nutsedges	*Cyperus spp (wet soils)*	GRASS/SEDGE								*		
Obedient plant	*Physostegia angustifolia*	HERB		*		*	*					
Old man's beard	*Clematis drummondii*	VINE		*	*	*	*					
Old plainsman	*Hymenopappus scabiosaeus var. corymbosus*	HERB		*	*			*	*			
Open water flatsedge	*Cyperus ochraceus*	GRASS/SEDGE				*						

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Orange zexmenia	*Wedelia texana*	SHRUBS	*	*	*			*	*		*	*
Paleleaf yucca	*Yucca pallida*	SHRUBS		*				*	*		*	*
Partridge pea	*Chamaecrista fasciculata*	HERB		*	*		*	*	*		*	
Passion vine	*Passiflora incarnata*	VINE		*			*					
Pecan	*Carya illinoensis*	LARGE TREE	*	*		*	*					*
Pickerelweed	*Pontederia cordata*	HERB	*	*		*	*					*
Pigeonberry	*Rivina humilis*	SHRUBS		*	*	*	*	*				*
Pine muhly	*Muhlenbergia dubia*	GRASS/SEDGE		*	*			*				*
Pink evening primrose	*Oenothera speciosa*	HERB	*	*	*	*		*	*		*	*
Plains coreopsis	*Coreopsis tinctoria*	HERB	*	*	*	*		*	*		*	*
Pondweed	*Potamogeton spp. (native/local species)*	HERB	*							*		
Ponyfoot	*Dichondra recurvata*	HERB				*						
Possumhaw holly	*Ilex decidua*	TREES	*	*	*	*	*	*			*	*
Poverty dropseed	*Sporobolus vaginiflorus*	GRASS/SEDGE			*							
Powdery thalia	*Thalia dealbata*	HERB		*			*					*
Prairie coneflower	*Ratibida columnifera*	HERB	*	*	*	*	*	*	*		*	
Prairie fleabane	*Erigeron modestus*	HERB		*	*			*	*		*	
Prairie foxglove	*Penstemon cobaea*	HERB		*	*			*	*			*
Prairie gaillardia	*Gaillardia aestivalis*	HERB		*	*			*	*		*	
Prairie nymph	*Herbertia lahue*	HERB		*	*			*	*		*	
Prairie parsley	*Polytaenia nuttallii*	HERB	*	*	*			*	*		*	
Prairie verbena	*Glandularia bipinnatifida var. bipinnatifida*	HERB	*	*	*			*	*		*	
Purple coneflower narrow leaf	*Echinacea angustifolia*	HERB		*					*			*
Purple leatherflower	*Clematis pitcheri*	VINE	*	*	*	*	*	*				*
Purple lovegrass	*Eragrostis spectabilis*	GRASS/SEDGE	*	*	*			*	*			
Purple prairie clover	*Dalea purpurea var. purpurea*	HERB		*	*	*			*		*	*
Purple three-awn	*Aristida purpurea*	GRASS/SEDGE	*	*	*		*	*	*			

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Purpletop	*Tridens flavus*	GRASS/SEDGE		*	*			*	*		*	
Red buckeye	*Aesculus pavia*	SHRUBS	*	*	*	*	*	*				*
Red lovegrass	*Eragrostis secundiflora*	GRASS/SEDGE	*	*	*			*	*			
Red mulberry	*Morus rubra*	TREES	*	*		*	*				*	*
Red yucca	*Hesperaloe parviflora*	SHRUBS	*	*				*	*			*
Retama	*Parkinsonia aculeata*	TREES	*	*			*				*	*
Riverfern	*Thelypteris ovata var. lindheimeri*	HERB		*			*					*
Rock penstemon	*Penstemon baccharifolius*	HERB		*	*							*
Rock rose	*Pavonia lasiopetala*	SHRUBS	*	*	*		*	*	*		*	*
Roughleaf dogwood	*Cornus drummondii*	TREES	*	*	*	*	*				*	*
Rusty blackhaw viburnum	*Viburnum rufidulum*	TREES		*	*		*				*	*
Sacred datura	*Datura wrightii*	HERB		*					*			*
Sago pondweed	*Stuckenia pectinata*	HERB								*		
Sand dropseed	*Sporobolus cryptandrus*	GRASS/SEDGE		*	*	*		*	*		*	*
Sand lovegrass	*Eragrostis trichodes*	GRASS/SEDGE		*		*		*	*			
Sand spikerush	*Eleocharis montevidensis*	HERB				*	*					
Sawgrass	*Cladium mariscus*	GRASS/SEDGE	*				*					
Scarlet clematis	*Clematis texensis*	VINE	*	*	*		*	*				*
Scarlet sage	*Salvia coccinea*	HERB	*	*	*	*	*	*	*		*	*
Scott's turf	*Carex retroflexa texensis*	GRASS/SEDGE		*			*					*
Scrambled eggs	*Corydalis curvisiliqua*	HERB		*	*			*	*		*	
Sedge	*Schoenoplectus sp.*	GRASS/SEDGE				*	*					
Sedges	*Eleocharis spp*	GRASS/SEDGE					*					
Seep muhly	*Muhlenbergia reverchonii*	GRASS/SEDGE		*			*		*			*
Shin oak	*Quercus sinuata var. breviloba*	LARGE TREE		*	*			*				*
Shiny goldenrod	*Solidago nitida*	HERB		*	*	*	*				*	*

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Shrubby boneset	*Ageratina havanensis*	SHRUBS	*	*	*	*	*	*				*
Sideoats grama	*Bouteloua curtipendula*	GRASS/SEDGE	*	*	*	*	*	*	*		*	*
Silver bluestem	*Bothriochloa laguroides*	GRASS/SEDGE	*	*	*	*	*	*	*		*	
Skelton leaf goldeneye	*Viguiera stenoloba*	SHRUBS	*	*	*			*			*	*
Slender greenthread	*Thelesperma filifolium*	HERB	*	*	*	*	*	*	*		*	
Slenderlobe passionflower	*Passiflora tenuiloba*	VINE		*	*				*			
Small head sneezeweed	*Helenium microcephalum*	HERB					*					
Smoke tree	*Cotinus obovatus*	TREES	*	*	*		*					*
Snailseed vine	*Cocculus carolinus*	VINE			*	*	*					
Snapdragon vine	*Maurandya antirrhiniflora*	VINE	*	*	*	*	*	*				
Sneezeweed	*Helenium elegans*	HERB	*	*	*	*	*	*	*			
Soft rush	*Juncus effusus*	HERB	*	*			*					
Sotol	*Dasylirion texana*	SHRUBS		*				*	*			*
Southern cattail	*Typha domingensis*	HERB					*					
Southern mainden hair fern	*Adiatum capillus-veneris*	FERN					*					
Southern shield fern	*Thelypteris kunthii*	HERB	*	*	*	*	*					*
Southwestern bristlegrass	*Setaria scheelei*	GRASS/SEDGE			*		*	*				
Spanish oak	*Quercus buckleyi*	LARGE TREE	*	*	*		*	*			*	*
Spiderwort	*Tradescantia spp.*	HERB	*	*	*	*	*	*	*		*	
Spineless prickly pear cactus	*Opuntia gomei*	SHRUBS		*					*		*	*
Standing cypress	*Ipomopsis rubra*	HERB	*	*	*	*	*	*	*		*	
Starbrush white-top sedge	*Dichromena colorata*	GRASS/SEDGE		*		*	*					
Starry rosinweed	*Silphium asteriscus*	HERB	*	*			*					
Sticky flatsedge	*Cyperus elegans*	GRASS/SEDGE				*	*					
Straggler daisy	*Calyptocarpus vialis*	HERB	*	*	*	*	*				*	*
Sugar hackberry	*Celtis laevigata*	LARGE TREE	-	*	*		*	*				

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Swamp smartweed	*Polygonum hydropiperoides*	HERB					*					
Swamp sunflower	*Helenium autumnale*	HERB	*	*		*	*					*
Switchgrass	*Panicum capillare*	GRASS/SEDGE							*			
Switchgrass	*Panicum virgatum*	GRASS/SEDGE	*	*		*	*				*	*
Tall dropseed	*Sporobolus compositus var. compositus*	GRASS/SEDGE	*	*	*			*	*		*	
Texas ash	*Fraxinus texana*	LARGE TREE	*	*			*	*				
Texas aster	*Symphyotrichum drummondii*	HERB			*		*					
Texas bluebonnet	*Lupinus texensis*	HERB	*	*	*	*		*	*		*	
Texas cupgrass	*Eriochloa sericea*	GRASS/SEDGE		*				*	*			
Texas dwarf palmetto	*Sabal minor*	TREES	*	*		*	*					*
Texas green-eyes	*Berlandiera betonicifolia*	HERB			*		*	*				
Texas lantana	*Lantana urticoides*	SHRUBS		*	*						*	*
Texas milkweed	*Asclepias texana*	HERB	*	*	*		*	*				*
Texas mountain laurel	*Sophora secundiflora*	TREES	*	*	*		*	*			*	*
Texas persimmon	*Diospyros texana*	TREES	*	*	*		*	*			*	*
Texas red oak	*Quercus texana*	TREES						*				
Texas redbud	*Cercis canadensis var. texensis*	TREES	*	*	*		*	*			*	*
Texas rush	*Juncus texanus*	HERB					*					
Texas skeletonplant	*Lygodesmia texana*	HERB		*	*			*	*		*	
Texas sycamore	*Platanus occidentalis*	LARGE TREE	*	*		*	*					*
Texas thistle	*Cirsium texanum*	HERB	*		*	*	*	*	*			
Texas vervain	*Verbena halei*	SHRUBS		*	*			*	*		*	*
Texas wintergrass	*Nassella leucotricha*	GRASS/SEDGE		*				*			*	*
Three-square rush	*Schoenoplectus pungens*	HERB		*			*					
Torrey's rush	*Juncus torreyi*	HERB		*		*	*					
Turk's cap	*Malvaviscus arboreus var. drummondii*	SHRUBS	*	*	*	*	*					*

Recommended Plants (continued...)

					PLANT COMMUNITIES							
Common Name	**Botanical Name**	**Type**	**Priority**	**Availability**	**Oak/Juniper/ Elm Woodland**	**Forested Wetland**	**Riparian Woodlands**	**Savanna**	**Meadow**	**Spring & Permanent Waters**	**Rain Garden**	**Formal Areas**
Twistleaf yucca	*Yucca rupicola*	SHRUBS	*	*	*			*	*		*	*
Virginia creeper	*Parthenocissus quinquefolia*	VINE		*	*	*	*					*
Virginia frostweed	*Verbesina virginica*	SHRUBS	*	*	*		*	*				*
Virginia wildrye	*Elymus virginicus*	GRASS/SEDGE	*	*	*	*	*	*	*		*	*
Wafer ash	*Ptelea trifoliata*	TREES	*	*	*	*	*				*	*
Water primrose	*Ludwigia repens*	HERB	*	*			*					
Wax myrtle	*Morella cerifera*	SHRUBS	*	*	*		*				*	*
Western soapberry	*Sapindus drummondii*	TREES	*	*	*		*					
Western umbrella sedge	*Fuirena simplex*	GRASS/SEDGE					*					
Western wheatgrass	*Pascopyrum smithii*	GRASS/SEDGE		*	*			*	*		*	
White avens	*Geum canadense*	HERB	*	*	*	*	*					
White honeysuckle	*Lonicera albiflora*	VINE	*	*	*	*	*					*
White prairie clover	*Dalea candida var. candida*	HERB	*	*	*			*	*		*	*
White tridens	*Tridens albescens*	GRASS/SEDGE		*	*				*		*	
White water-lily	*Nymphaea odorata*	HERB								*		
Winecup	*Callirhoe involucrata*	HERB	*	*	*			*	*		*	*
Wright's purple skullcap	*Scutellaria wrightii*	HERB		*	*			*	*			
Yaupon holly	*Ilex vomitoria*	TREES	*	*	*	*	*	*				*
Yellow cow-lily	*Nuphar lutea*	HERB								*		
Yellow passionflower	*Passiflora lutea*	VINE	*	*	*	*	*	*				*
Yerba de tajo	*Eclipta alba*	HERB				*	*					
Yucca	*Yucca torreyi*	SHRUBS		*	*			*				*

Bird Habitat Enhancement & Expansion

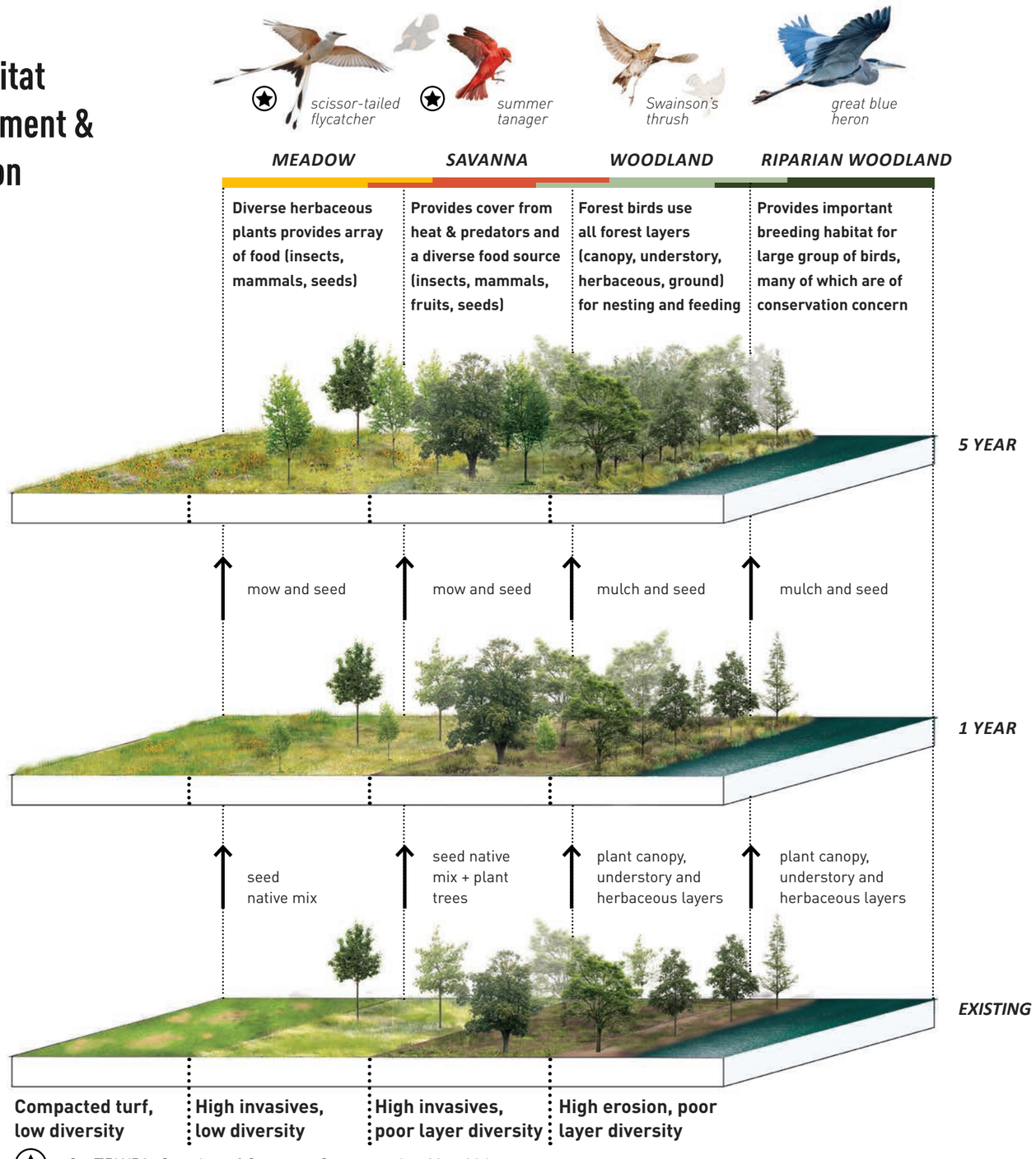


Figure 5.12. *Bird Habitat Enhancement & Expansion*

WILDLIFE HABITAT FEATURES & ENHANCEMENT

Zilker Park serves as a refuge and migration corridor for wildlife in the highly developed Austin area. More than 260 wildlife species have been observed in the park, including 6 amphibians (2 of which are endangered salamanders), 2 fish, 1 mollusk, 224 birds, 9 mammals, and 20 reptiles (Tables 3.3 & 3.4).

These natural area management guidelines will increase the amount and quality of wildlife habitat in Zilker Park by:

- Protecting salamander habitat by reducing stormwater runoff and increasing water quality within the park;
- Recommending over 150 native plant species that support a greater diversity of wildlife visiting and breeding in the park;
- Adding 54 acres of meadow and savannas that provide adequate food and nesting habitat for grassland birds;
- Adding 70 acres of proposed tree canopy that increases habitat connectivity; and
- Repairing the sensitive riparian shoreline that serves as nesting habitat for waterfowl, supports amphibious species, and allows for fish spawning areas.

The proposed plant communities described in the Restoring Plant Communities section have habitat features that support a variety of wildlife (Figure 5.12). For example, the 16 acres of enhanced and expanded meadows feature native grasses and wildflowers to attract pollinators. The meadows will create prime conditions for the Scissor-tailed Flycatcher and Eastern Meadowlark, both of which are classified as Species of Greatest Conservation Need (SGCN) by the Texas Department of Parks & Wildlife (TPWD). For the Scissor-tailed Flycatcher, the trees around the edges of the meadows will provide places to nest, while the meadows will provide open space for feeding.[124] For the Eastern Meadowlark, the meadows are large enough to accommodate their

required territory needs of at least 6 acres.[125] The wildflowers in the meadows will attract butterflies and other pollinators. These insects will also serve as food for grassland birds, many of which require insects to feed to their nestlings. In fact, caterpillars can make up 60% of the Yellow Warbler's diet, another species known to visit the site.[126]

Zilker Park's savannas offer a transitional plant community, with more canopy cover than meadows and more open space than woodlands. In addition, their position within and near to the park's woodlands gives them the added benefit of increasing the overall habitat size for wildlife that require canopy cover. These transitional zones serve as habitat for species like the Summer Tanager—another TPWD SGCN—which breed near gaps and edges of open woodlands.[127] The herbaceous species diversity supported by these savannas, including berry-producing woody species like beautyberry and agarita, will support the diet of the Summer Tanager, which is predominately made up of insects and small fruits.[127] Moving through the transitional savannas deeper into the woodlands, species like Swainson's Thrush can be found both foraging and resting during its migration.[128] This species is representative of dozens of other bird species that utilize Zilker Park for similar purposes, including vireos and warblers. Berries and fruits can account for over a third of this species' summer diet, so summer fruit-bearing native species like Texas persimmon, Mexican plum, creek plum, and escarpment black cherry are all included in the recommended plant list for woodland plant communities (Table 5.2).

Zilker Park's riparian woodland and associated waterways also provide habitat for a variety of wildlife, including two endangered salamanders, fish, clams, frogs, toads, and waterbirds. These areas are of particular importance in the park because they provide important breeding grounds for woodland specialists along with stopover habitat for migratory songbirds and waterfowl. The Great Blue Heron is a conspicuous species that can be commonly seen in the still morning waters of Barton Creek. The Great Blue Heron hunts in the shallow waters of Barton Creek. Restoration of the creek banks will support healthy populations of prey for the Great Blue Heron, which includes frogs, fish, snakes, and crawfish. Waterfowl can generally be divided into divers and dabblers (Figure 5.13). Divers like Canvasback, American coot, and Redhead need and benefit from the habitat available in open water. Dabblers like Gadwall, Blue-winged Teal, and Green-winged Teal skim food from the water's surface or feed in shallow waters. Key plant species that are important for a wide variety of likely avian visitors include oaks, willows, box elder, cottonwood, pecan, elm, possumhaw, and sumac, all of which are included in the recommended plant list (Table 5.2). Cavity-nesting birds such as the Wood Duck require cavities in standing snags or trees situated near to or over water, which are already present throughout the park's waterways. Leaving these decomposing logs in place throughout the riparian area is critical, as Wood Ducks cannot make their own cavities and will travel up to 1.2 miles from water to find them.[129]

These habitat enhancement recommendations can be supplemented by adding native milkweed to formal gardens, meadows, and savannas to feed monarch butterfly caterpillars; including plants that attract hummingbirds into planting and seeding mixes; and confirming that all seed mixes include plants that support native bees and butterflies.

Management and restoration efforts will play a direct role in the enhancement of wildlife habitat. Aquatic plants will provide valuable food and cover for invertebrates, fish, and other wildlife. Tree canopy over water will increase shade to help regulate temperatures on hot summer days and provide important refuge for fish. Finally, large woodland patches will provide more cover and food, improving habitat for numerous animals. By maintaining these areas and fostering a diversely vegetated landscape, park managers will continue to attract wildlife at Zilker Park long into the future.

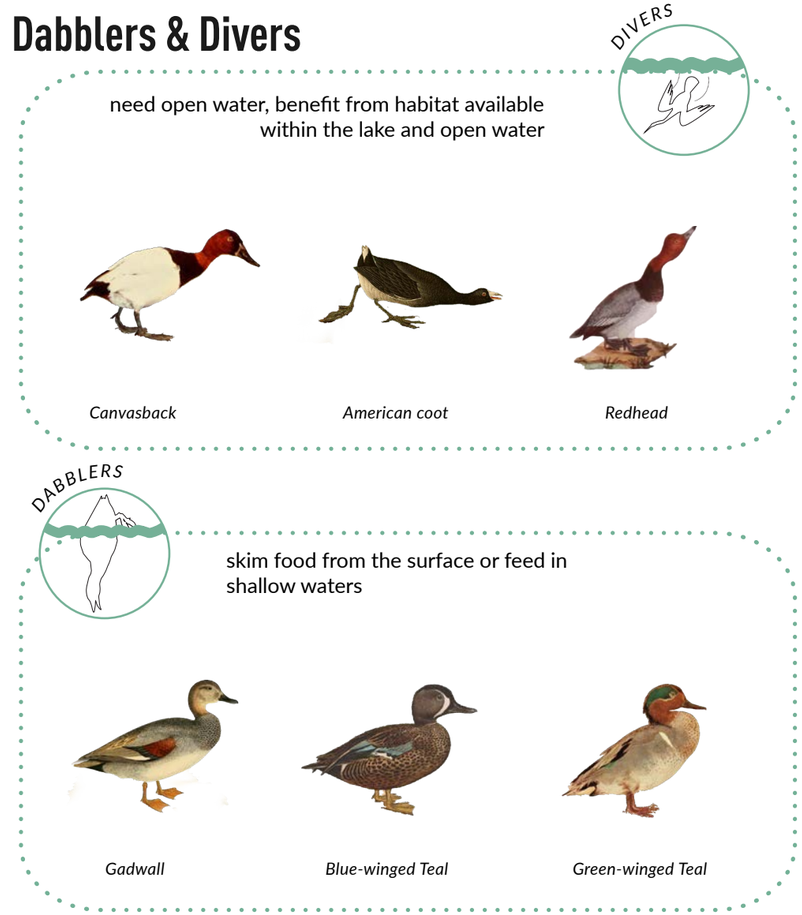


Figure 5.13. *Dabblers & Divers*

PART 6
MANAGEMENT UNITS

2021

The project area has been divided into 10 management units to discuss current conditions as well as management needs, priorities, and tasks (Figure 6.1). The unit boundaries are based on plant communities, anticipated activity level, and restoration/ maintenance needs. It is important to note that while these management units are a helpful way to understand the park, they may be modified in the future to support planning and implementation of the Zilker Vision Plan.

This chapter describes each unit's current ecological condition, management needs, and a prioritized list of management tasks. For each unit, work tasks are categorized into green infrastructure, soil & erosion, user experience, invasives, canopy, and restoration. When considering the task lists, managers should use an adaptive management framework and define upcoming work based on this document, as well as recent successes and challenges, new information from related projects, changes in weather patterns, the availability of resources, and/or changes in user preferences.

Management units including the Nature Preserve, Butler Landfill, and Ladybird Lake intersect with Zilker Park's official Nature Preserve Boundary. While these areas are separate management units because of their ecological character and usage patterns, all actions within the official Nature Preserve Boundary should adhere to the purpose of a preserve.

The boundary of the Butler Landfill extends between two management units—the Butler Landfill and Lady Bird Lake Shoreline. While these areas are separate management units, review and approval of any improvements over the landfill—like species selection or specifications for planting—may potentially need to be cleared with the City of Austin and Texas Commission on Environmental Quality (TCEQ).[71]

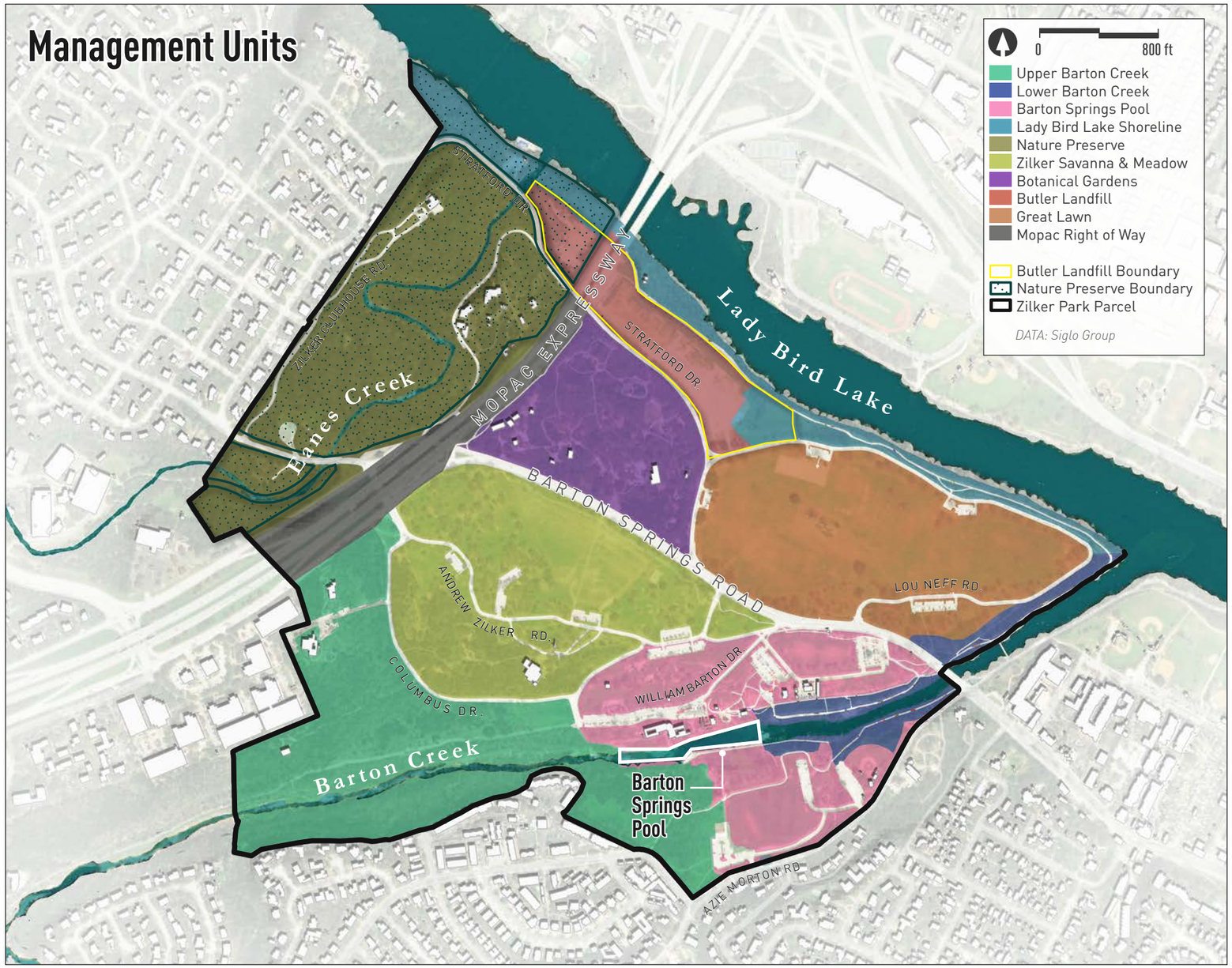


Figure 6.1. *Management Units*

UPPER BARTON CREEK MANAGEMENT UNIT

The 69-acre Upper Barton Creek unit includes Upper Barton Springs that is home to the Barton Springs Salamander, as well as approximately 2,600 linear ft of Barton Creek (Figure 6.1). This unit also borders the southwest corner of Barton Springs Pool. Management recommendations include woodland enhancement; riparian woodland expansion; and meadow enhancement. Recommendations are made for 66 acres (96%) of this 69-acre unit.

UPPER BARTON CREEK MANAGEMENT UNIT

ECOLOGY

Upper Barton Springs flows from the Barton Creek bed and creates habitat for the Barton Springs Salamander. Underground, this unit includes 18 acres of subsurface critical habitat for the Austin Blind Salamander. However, this range is largely inferred from ranges reported for other similar species according to the Barton Springs/Edwards Aquifer conservation district's habitat conservation plan. The presence of the Austin Blind Salamander has not yet been confirmed in this unit.

Vegetation consists of Oak/Juniper/Elm Woodland, Intermittent Creekbed, Barton Riparian Woodland, and Open Meadow. Barton Creek runs through the unit with the topography increasing in the southeast to just above the 100-year floodplain and flattening out into meadow. The elevation increases from the creek on the northwestern side to one the highest points in the park—at 554 ft elevation near the McBeth Recreation Center. Overstory trees include live oak, Ashe juniper, cedar elm, hackberry, pecan, and American elm in various states of maturity, with large swaths of the area previously cleared, according to the 1940 and 1984 aerials of the park (Figures 2.2 and 2.3). There are also substantial patches of mountain laurel and Texas persimmon both within the understory and creating a low canopy on southeastern facing slopes.

The woodlands contain substantial amounts of Ligustrum and Nandina throughout, with other problematic invasive species including Arundo, Bermudagrass, Chinaberry, Chinese tallow, Japanese honeysuckle, Johnsongrass, King Ranch bluestem, sweet autumn clematis, trailing lantana, and tree of heaven. Invasive material is carried into the unit through creek flows, as well as through various flows coming into the unit from adjacent subdivisions and office complexes. Erosion issues include sheet and gully erosion, due to offsite stormwater entering the unit. In addition, trampling and compaction along the Violet Crown Trail is leading to erosion along the trail. Use on the south side of the creek is intense from the Pool to Upper Barton Springs.

MANAGEMENT RECOMMENDATIONS

Management in this area calls for substantial woodland enhancement, riparian woodland expansion, savanna enhancement, as well as meadow enhancement. Efforts to define the user experience through formalization of trails and the creation of new trails in the northern portion of this unit will decrease pressure on the main Violet Crown Trail. Also, creating more formal water access points can work to drive user impact away from the area immediately surrounding Upper Barton Springs, thereby reducing the impacts of park users on the area. In select areas within the woodlands, soil amendments are recommended to replenish soils suffering from years of clearing. In these same areas, woodland thinning will relieve competition created by tightly spaced hackberries and cedar elms. Arundo around Upper Barton Springs, as well as Ligustrum, Nandina, Japanese honeysuckle, and sweet autumn clematis are priorities for treatment in the woodlands. King Ranch bluestem, Johnsongrass, and Bermudagrass are priorities for spot treatment in the meadows.

- *Plant trees next to the parking lot and along the Violet Crown Trail especially in the eastern section near the trailhead.*

- *Treat Nandina and Ligustrum throughout the unit, especially in the floodplain.*
- *Treat Arundo patches near Upper Barton Springs with a focus on techniques that do not endanger the salamander habitat and comply with the habitat management plan. Mechanical removal of root material (with proper disposal) would be one option. Successfully treating Arundo in this area will require repeated treatments over multiple years. Work should be completed in conjunction with the city's salamander specialist.*
- *As a part of savanna expansion and meadow enhancement, spot treat Bermudagrass, King Ranch bluestem, and Johnsongrass.*

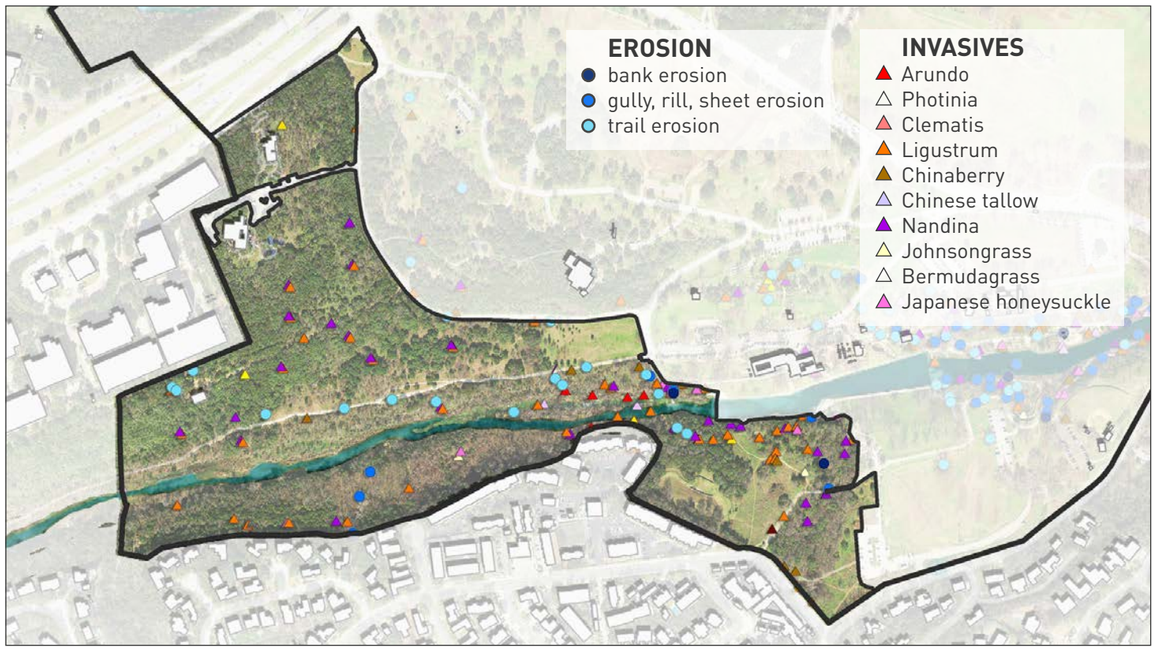
- *Prohibit dumping of landscaping debris in gully above the pool on north shore.*
- *Use plugs and/or riprap to mitigate gully issues.*
- *Use mulch in select areas moving from woodland to riparian woodland just upslope from the Violet Crown Trail to increase water infiltration and organic matter.*

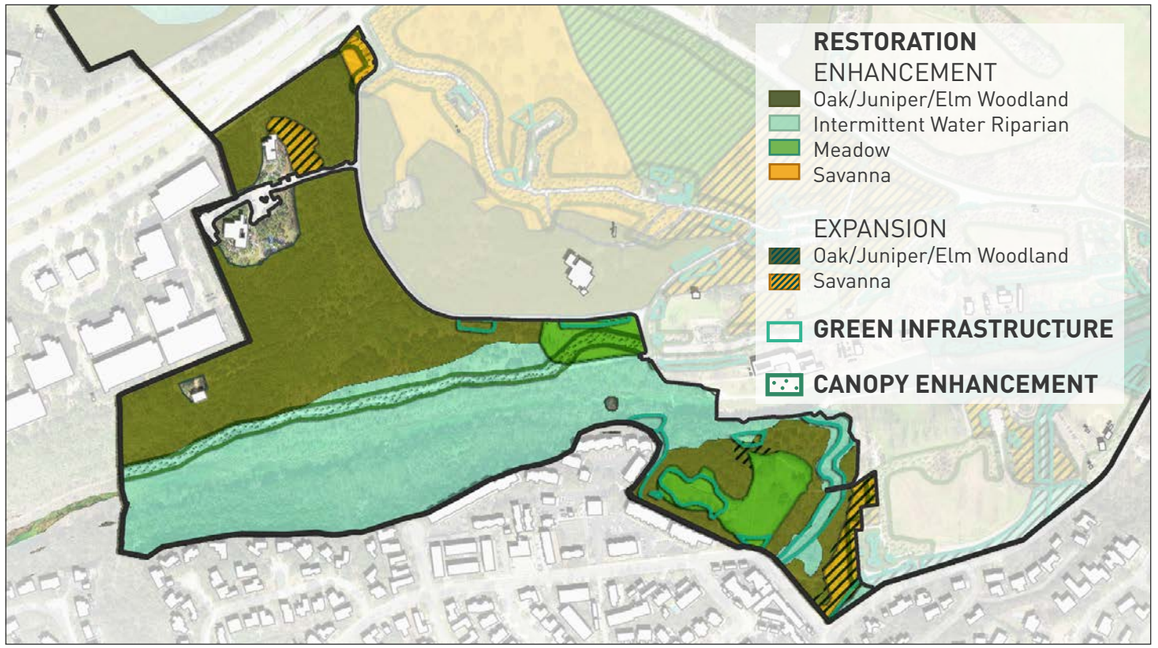
- *Retire and rehabilitate informal trails.*
- *Create up to three formal water access trails that run perpendicular from the main trail to the creek and reduce impacts on the creek bank and its vegetation.*
- *Create additional trails through the northern portions of this unit to alleviate pressure on the main stem of the Violet Crown Trail.*

- *Reduce mowing in meadow and savanna areas to no more than twice a year at a height of 6 inches or taller to allow native grasses and other desirable plants to establish.*
- *Stop mowing in woodlands.*
- *Thin tightly spaced hackberries and cedar elms just upslope of the Violet Crown Trail.*
- *Seed "pocket prairies" in woodland openings.*
- *Seed understory herbaceous species in woodland and savannas.*
- *Seed meadows and open areas of savanna with a focus on pollinator plants and native grasses.*
- *Seed natives after invasives are spot treated in open areas at two times the normal seeding rate.*

- *Install green infrastructure south of Barton Springs Pool to intercept water as it moves downhill toward the pool.*
- *Install green infrastructure south of Columbus Drive to capture and filter runoff from the roadway before it reaches the creek and pool.*

UPPER BARTON CREEK MANAGEMENT UNIT





TASK PRIORITIES

High

- ✓ *Reduce mowing and increase height.*
- ✓ *Treat Arundo, Nandina and Ligustrum in floodplain.*
- ✓ *Repair gully just upstream of pool on northern slope.*
- ✓ *Increase canopy.*

Medium

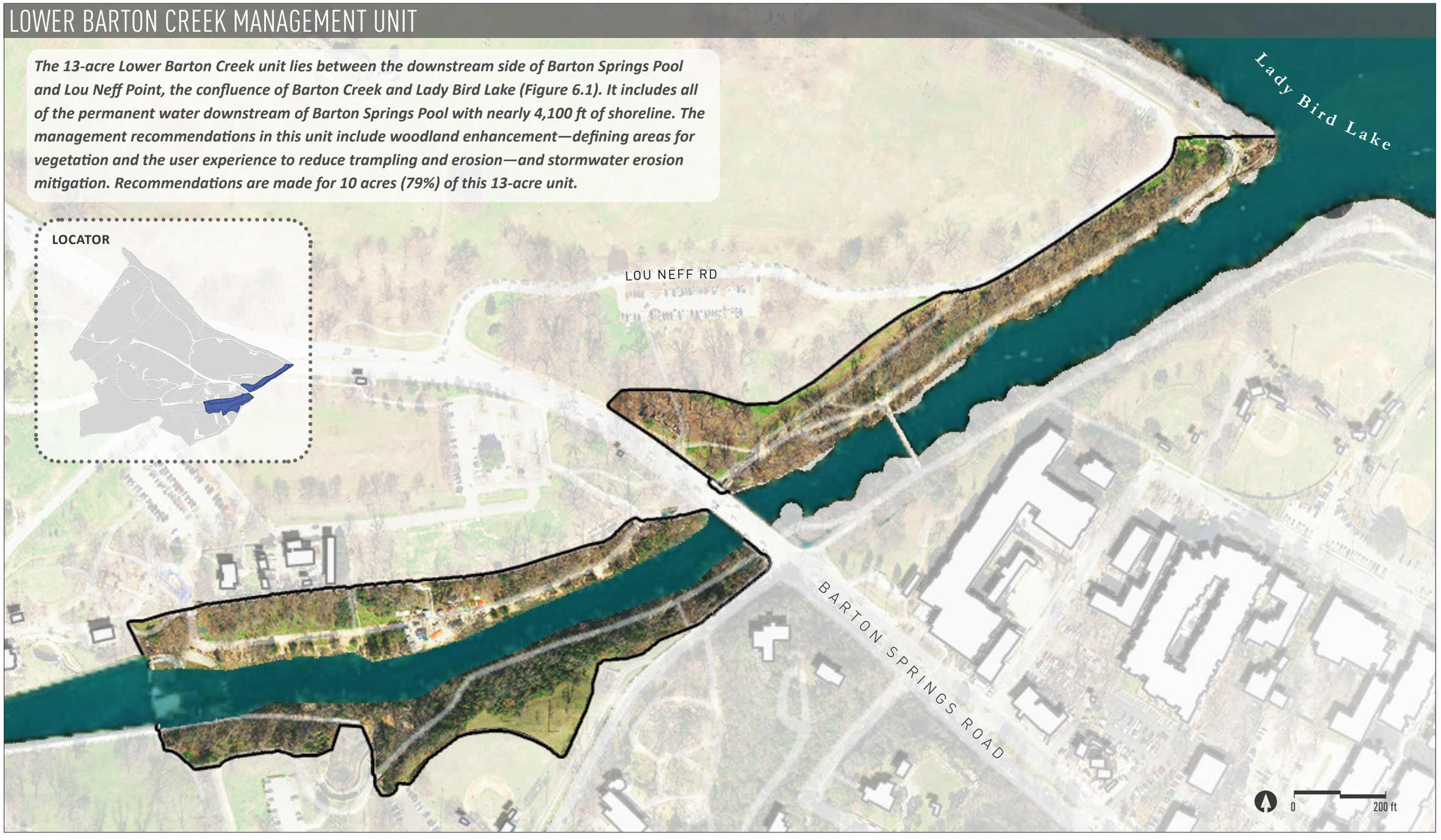
- ✓ *Create formal trails to creek.*
- ✓ *Seed for increased plant diversity in the savanna, meadow, and woodlands.*
- ✓ *Spot treat grass and herbaceous invasive species.*
- ✓ *Treat invasives throughout.*
- ✓ *Thin small caliper hackberry and cedar elm in designated areas.*
- ✓ *Amend soil in area moving to riparian woodland.*

Low

- ✓ *Install green infrastructure.*
- ✓ *Rehabilitate informal trails.*

LOWER BARTON CREEK MANAGEMENT UNIT

The 13-acre Lower Barton Creek unit lies between the downstream side of Barton Springs Pool and Lou Neff Point, the confluence of Barton Creek and Lady Bird Lake (Figure 6.1). It includes all of the permanent water downstream of Barton Springs Pool with nearly 4,100 ft of shoreline. The management recommendations in this unit include woodland enhancement—defining areas for vegetation and the user experience to reduce trampling and erosion—and stormwater erosion mitigation. Recommendations are made for 10 acres (79%) of this 13-acre unit.



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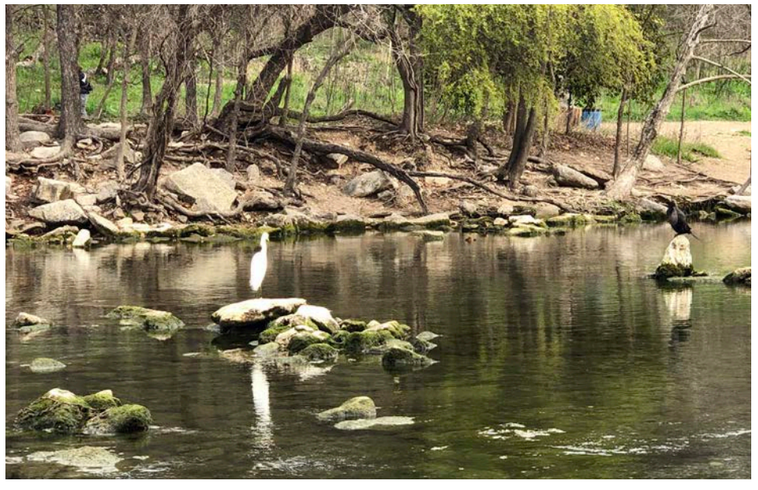
LOWER BARTON CREEK MANAGEMENT UNIT

ECOLOGY

This unit consists of Degraded Barton Riparian Shoreline and Degraded Barton Creek Riparian Woodland, along with a small area of Maintained Parkland. Trees in this area measure up to 59" dbh, with an average size of 10.6" dbh. Hackberry is by far the most abundant tree. Heritage and protected overstory trees in this management unit are predominately pecan with some bald cypress, sycamore, American elm, and box elder. The understory consists primarily of hackberry and Ligustrum in most areas, along with persimmon, red buckeye, and dogwood. There are also substantial patches of mountain laurel.

The area is one of the most ecologically sensitive and most degraded units in the site because of previous land clearing, flooding, stormwater coming off impervious cover upslope, and massive tramping issues due to park users creating informal trails to access the creek. Invasive species in this area include numerous large Ligustrum, as well as Arundo, Chinaberry, Chinese lacebark elm, Chinese tallow, Nandina, catclaw vine, and Japanese honeysuckle.



MANAGEMENT RECOMMENDATIONS

Riparian woodland enhancement is recommended for this entire area but should not be started until degrading factors including upslope stormwater and trampling are solved. Formal water access, formalizing the trail, and creating physical barriers to plantings in this area is critical. Once these issues are mitigated, invasive species control, woodland thinning of small caliper hackberries, and soil compaction remediation should proceed. This prepares the site for a combination of planting and seeding to enhance this very degraded, very used, and very ecologically significant piece of the park. A vignette for this area has been created to show a potential restoration path forward and its possible outcome (Figure 6.2).

GREEN INFRASTRUCTURE

- *Install rain gardens between the trail and the streambank on the north side of the creek, near Bark'n Springs, to filter stormwater flows from slope.*
- *Install green infrastructure upslope near Azie Morton Road.*

SOIL & EROSION

- *After installation of green infrastructure upslope of north shore, repair major gully erosion.*
- *Reduce soil compaction in shoreline areas before planting to increase aerobic soil activity.*

CANOPY

- *Plant trees on the north shore and trail to increase shade, stabilize the streambank, and provide riparian habitat.*

INVASIVES

- *Treat Arundo, Nandina, and Ligustrum, recognizing the need to consider slope stability when treating Arundo at the trail's edge and large Ligustrum on steep slopes.*
- *Treat invasives throughout unit.*

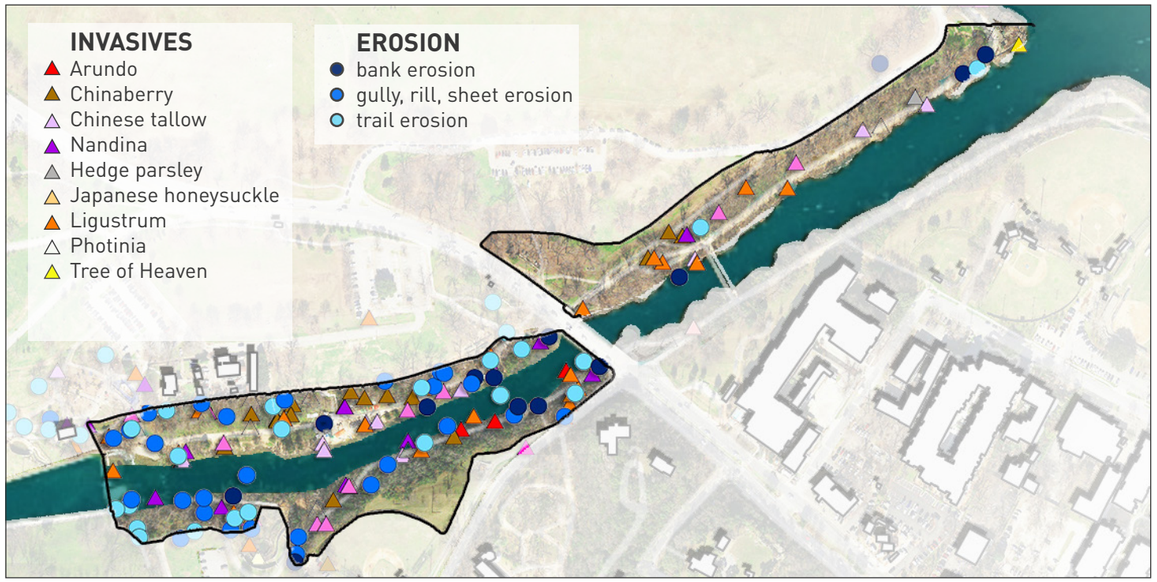
RESTORATION

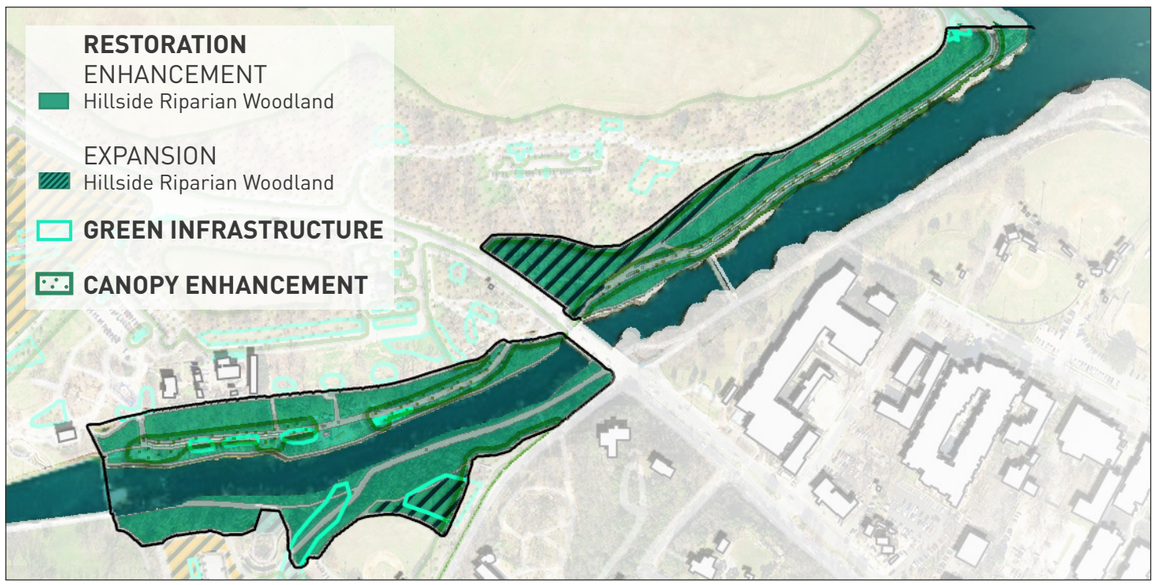
- *Thin small caliper, tightly spaced hackberries on northern slope.*
- *Plant moderate to large size canopy trees, understory trees and shrubs, groundcover and bunch grasses throughout area to repair ecological function in this area and increase water quality —planting is required due to high user volume and increased size is required to discourage trampling.*
- *Supplement planting with seeding throughout area.*

USER EXPERIENCE

- *Retire informal trails coming straight down northern slope.*
- *Create improved formal access to Bark'n Springs and Barton Creek throughout unit from upslope access points.*
- *Install knee-high cable fencing, split rail fencing, hardscaping, and/or other to create a physical barrier between formal areas and planting areas throughout area and reduce trampling, particularly along the water's edge.*
- *Create formal water access points throughout the unit to accommodate the volume of users.*

LOWER BARTON CREEK MANAGEMENT UNIT

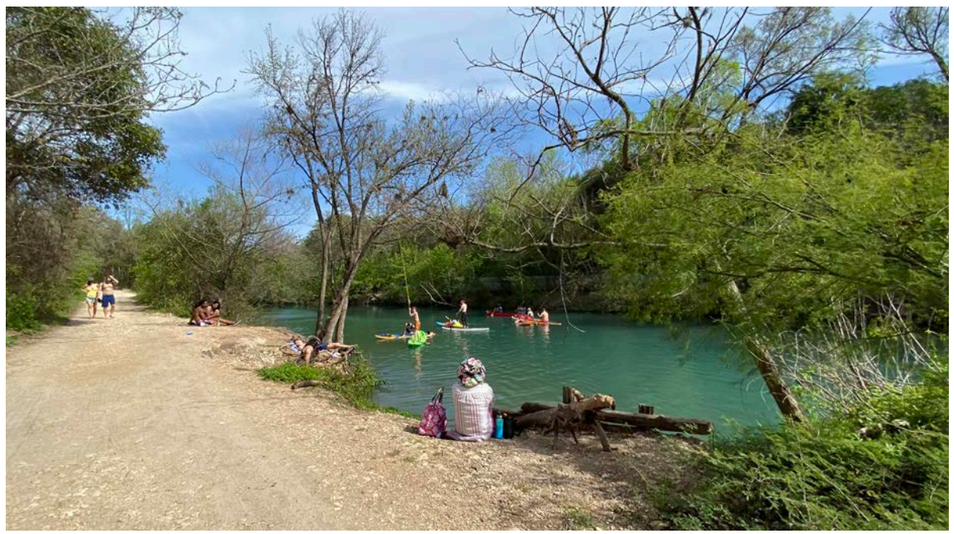




TASK PRIORITIES

High *All actions in this area are high priority due to the ecological sensitivity of the area, high use, substantial degradation, and opportunity for increase in ecological health.*

- ✓ *Formalize more water access points, with new points spaced more closely on the west side of this unit (near Bark'n Springs and Zilker Park Boat Rentals) and more dispersed towards the lake.*
- ✓ *Identify informal trails to formalize. Rehabilitate other informal trails by brushing, soil amendment and planting.*
- ✓ *Create physical barriers outside of formal use to protect plantings and natural areas particularly at shoreline.*
- ✓ *Create rain gardens between the trail and the streambank on the north side of the creek.*
- ✓ *Treat Arundo, Nandina, and Ligustrum.*
- ✓ *Mitigate compaction of soils.*
- ✓ *Thin small caliper hackberry.*
- ✓ *Plant area.*
- ✓ *Seed area.*



LOWER BARTON CREEK MANAGEMENT UNIT

Figure 6.2 visualizes the Lower Barton Creek transformation. The upper image shows degradation from lack of stormwater management upslope, trampling, and flooding that has resulted in compacted soils, erosion, an incomplete canopy, struggling vegetation, and a degraded user experience. The bottom image shows the ecological health and enhanced user experience that results by addressing upslope stormwater with green stormwater infrastructure, formalizing trails and water access, installing physical barriers to plantings, decompacting soils, and planting robust native canopy, understory, and groundcover vegetation.

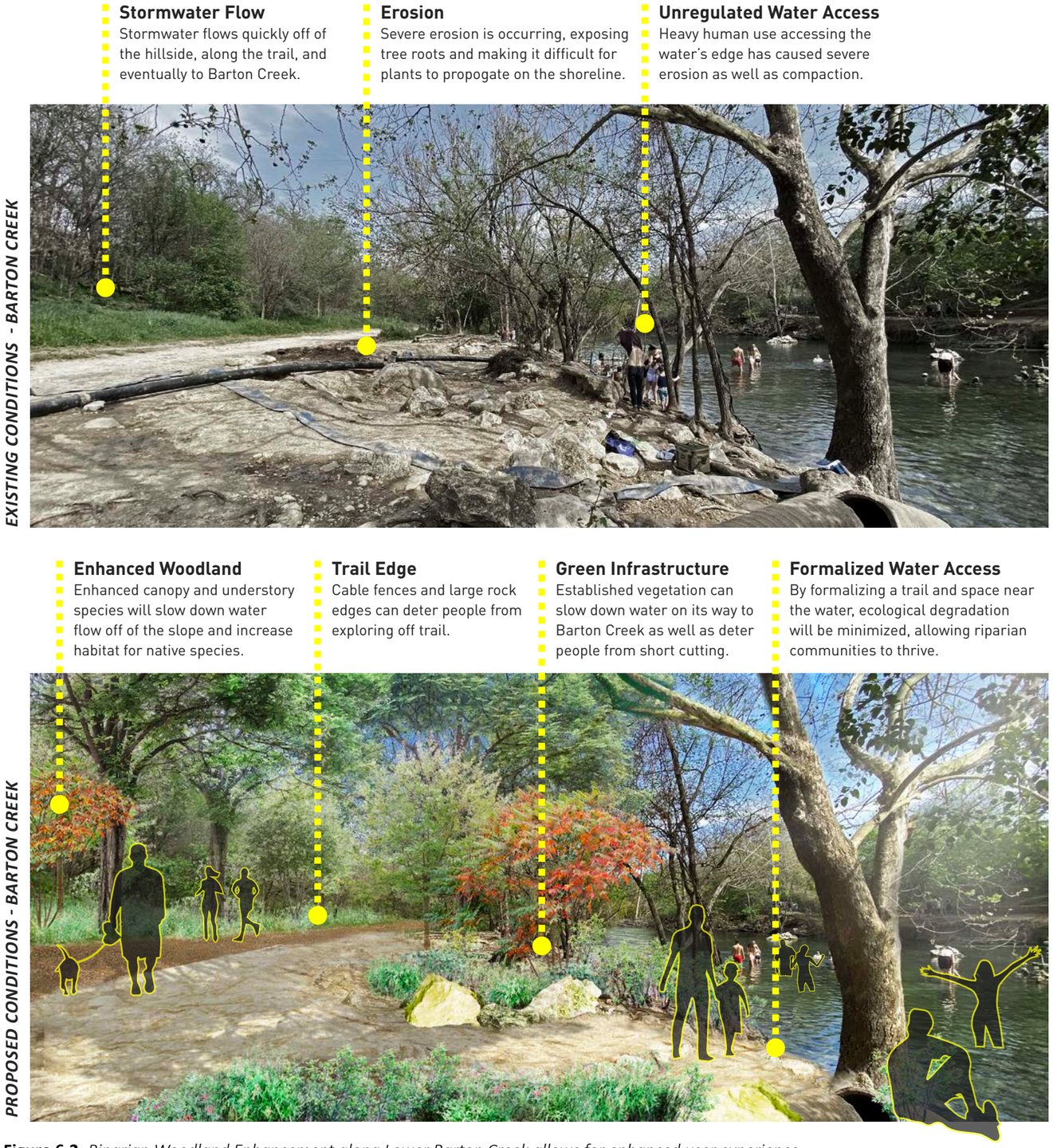


Figure 6.2. *Riparian Woodland Enhancement along Lower Barton Creek allows for enhanced user experience.*

BARTON SPRINGS POOL & ASSOCIATED MAINTAINED AREAS MANAGEMENT UNIT

The 38-acre Barton Springs Pool & Associated Maintained Areas unit includes Barton Springs Pool, Eliza Springs, Sunken Gardens (Old Mill) Spring, and all surrounding infrastructure and maintained open spaces such as the Ball Fields south of the pool and Hillside Theater north of the pool (Figure 6.1). It is bounded by Azie Morton Road, Barton Springs Road, Andrew Zilker Road, and William Barton Road. The management recommendations in this unit include savanna expansion, woodland expansion, canopy enhancement, and green infrastructure. Recommendations are made for 16.5 acres (44%) of this 38-acre unit. All recommendations are made to complement the experience of pool visitors who want to swim, sunbathe, and lay in the lawn, while maintaining the long-term health of the pool, springs, and park.

BARTON SPRINGS POOL & ASSOCIATED MAINTAINED AREAS MANAGEMENT UNIT

ECOLOGY

This management unit contains Barton Springs Pool and three of the four major springs that provide habitat for the Barton Springs and Austin Blind Salamanders—Eliza, Barton, and Sunken Gardens (Old Mill) Springs. In addition, the entire area (100%) consists of subsurface critical habitat for the Austin Blind Salamander. The unit has the highest impervious cover levels of any unit in the study area and includes seven parking areas, the Barton Springs Pool infrastructure, the Beverly S. Sheffield Education Center, the Hillside Theater, concessions, ball fields, a subdivision on its southern boundary, and Barton Springs Road on its northeastern boundary. The non-developed areas consist of mowed lawn with specimen trees. The trees in this area are mature with an average size of 20” dbh. There are 93 heritage trees, many of which are pecans and live oaks with the largest over 60” dbh.

Invasive species include Bermudagrass, Chinaberry, Chinese parasol tree, bamboo, Nandina, Ligustrum, catclaw vine, King Ranch bluestem, and Johnsongrass. Trampling, erosion, and informal trails are found throughout this unit on slopes with flows off of this area entering both the Pool and Barton Creek just below the Pool. The area includes the drainage areas adjacent to the southern border that drains portions of Azie Morton Road below the Pool. Before improvements, drainage from these areas flowed directly into the Pool.

MANAGEMENT RECOMMENDATIONS

Green stormwater infrastructure and canopy enhancement are the most pressing management needs in this highly utilized and developed area. The purpose of these recommendations is to reduce stormwater flows into the Pool and Barton Creek and to increase user comfort. Additional woodland and savanna enhancements will further increase ecological function, increase water infiltration, and increase water quality for a better user experience in Barton Springs Pool and Barton Creek. These practices complement efforts associated with the Habitat Conservation Plan to protect and enhance the habitat quality found in the spring areas for the Barton Springs and Austin Blind Salamanders.

- *In conjunction with green stormwater infrastructure installation, plant trees around parking lots, roads, buildings, and trails to increase shade and reduce local temperatures.*

- *Create formal trails that discourage trampling around the Rock Garden area.*
- *Create physical barriers to decrease trampling in savanna areas.*

- *Amend soils in savanna expansion areas.*

- *Substantial green stormwater infrastructure installations are needed in this area to capture stormwater runoff before it enters Barton Creek and reduces runoff from the seven parking areas in the unit.*
- *Installation of rainwater catchment systems on existing and new buildings will reduce runoff and create educational opportunities.*
- *Install rain gardens in the pool areas to reduce sheet flow into the pool and create a more aesthetically appealing user experience.*

- *Treat Ligustrum, Nandina, Chinese parasol tree, hedge parsley, and catclaw vine.*
- *As a part of savanna expansion, spot treat Bermudagrass, King Ranch bluestem, and Johnsongrass.*
- *Replacing the Nandina found at the entrance of Barton Springs Pool with native plantings may represent an easy lift for park planners and a straightforward project for volunteers.*

- *Reduce mowing in savanna areas to no more than twice a year at a height of 6 inches or taller to allow native grasses and other desirable plants to establish.*
- *Reduce mowing under tree canopy to no more than 50% of the understory area. Seed the remaining 40% of the understory with a hardy, shade-tolerant mix including Virginia wildrye, coralberry, straggler daisy, inland seaoats, Turk’s cap, and Virginia frostweed. Add shrubs and small trees to 10% of the understory.*
- *Seed natives after invasives are spot treated.*
- *Seed herbaceous understory in woodlands at southern border of unit.*
- *Where feasible, use fire in savanna areas to reduce understory and make carbon available for the soil.*

BARTON SPRINGS POOL & ASSOCIATED MAINTAINED AREAS MANAGEMENT UNIT

TASK PRIORITIES

High

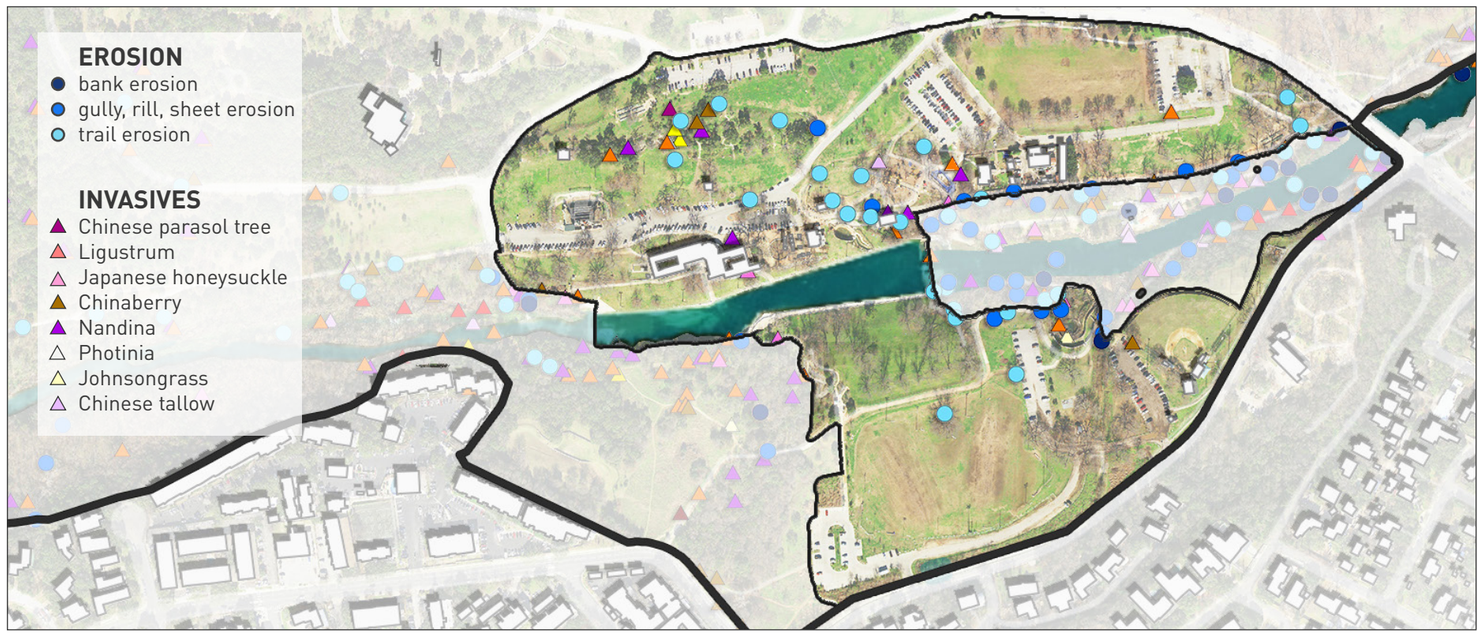
- ✓ *Install green infrastructure.*
- ✓ *Increase canopy.*
- ✓ *Reduce mowing.*

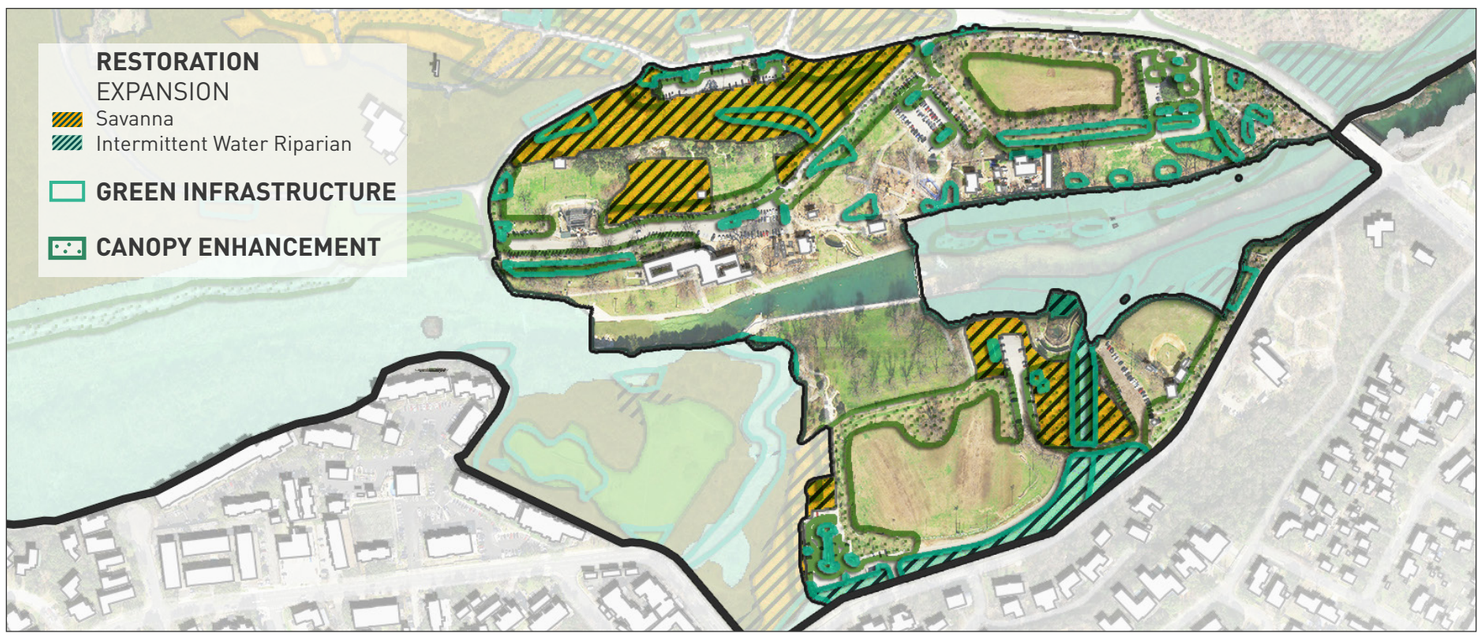
Medium

- ✓ *Treat woody and vine invasive species.*
- ✓ *Spot treat grass and herbaceous invasive species.*
- ✓ *Amend soil.*
- ✓ *Seed in open savanna areas.*
- ✓ *Seed herbaceous shade areas in savanna.*

Low

- ✓ *Seed to increase herbaceous understory in woodland areas.*





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LADY BIRD LAKE SHORELINE MANAGEMENT UNIT

The 20-acre Lady Bird Lake Shoreline unit is bounded by Lady Bird Lake to the north and the inland areas of Zilker's Great Lawn, Botanical Garden, and Nature Preserve (Figure 6.1). Land recommendations for this area include riparian woodland enhancement and green infrastructure opportunities. Recommendations are made for 19 acres (96%) of this 20-acre unit.

LADY BIRD LAKE SHORELINE MANAGEMENT UNIT

Produced by Siglo Group

LADY BIRD LAKE SHORELINE MANAGEMENT UNIT

ECOLOGY

This management unit contains 5,900 ft of shoreline. Much of the unit is composed of Lakeshore Riparian Woodland with the Wetland area between the lakeshore, Great Lawn, and Butler Landfill also included. The eastern half of the unit declines sharply to the water's edge—with a 32 ft drop from the top of slope downward—and a minimum width of 64 ft. The western half—while still having steep slopes in areas—begins to pull back from the water's edge with a maximum width of 376 ft west of Mopac. This management unit contains the broadest diversity of protected and heritage tree species in Zilker Park. Species include pecan, cottonwood, American elm, huisache, green ash, sycamore, black walnut, bald cypress, box elder, and juniper. Four of the ten largest trees in Austin occur in this management unit—all bald cypress. While there is a wealth of large mature trees, the unit is lacking next generation trees and understory in numerous areas, with Carolina laurel dominating in a few areas. The herbaceous layer in some areas is sparse due to shade and steepness of slope. It includes Virginia wild-rye, Turk's cap, and inland seaoats.

Wetland conditions occur within the Zilker Wetland (where wet ponds that detain stormwater from the Great Lawn and the Butler Landfill are channeled), the wetland fringe throughout the length of the unit, as well as the low-lying areas just east of Mopac and two small habitat islands just offshore.

Erosion is a major issue throughout the area with the biggest concern coming from trampling and informal trails on the steep eastern slopes—generally to access the large trees—and stormwater runoff from the Butler Landfill, Butler Trail, and impervious cover associated with Mopac further west. Invasive species are a concern throughout the area with Japanese honeysuckle, sweet autumn clematis, and catclaw being the largest concerns east of Mopac, and catclaw, Ligustrum, Arundo, and Nandina being the largest concerns west of Mopac.

MANAGEMENT RECOMMENDATIONS

Woodland enhancement is recommended for most of this area, with woodland expansion being recommended for part of the currently mowed area in the middle of the Wetland. Management and resource allocation should focus on reducing trampling; creating formal access points; retiring informal trails; repairing gully erosion; stabilizing the trail surface; creating a physical barrier to off trail use; installing green stormwater infrastructure to address runoff from impervious cover (likely upslope from this unit); and removing invasive species with a large focus on catclaw, Japanese honeysuckle, sweet autumn clematis, Ligustrum, Arundo, and Nandina west of Mopac. Plant canopy trees to support future canopy, while increasing shade on the trail and over Lou Neff Road. Increase groundcover species through seeding. Enhance wetland plants through planting around habitat islands.

- *Install green stormwater infrastructure to capture stormwater runoff from Mopac, parking lots, and overflow parking.*

- *Catclaw, Japanese honeysuckle, and sweet autumn clematis should be treated immediately with repeated treatment and a focus on catclaw.*
- *Treat other invasives throughout the area.*
- *Continue annual monitoring and treatment.*

- *Increase canopy plantings for the next generation of the urban forest.*
- *Increase diversity of species.*
- *Increase shade over trail.*
- *Increase shade over Lou Neff Drive.*

- *Repair gully erosion just east of Mopac (after green stormwater infrastructure installation). Because the road creates high runoff, repairs may need armoring. Once erosion is addressed, plant native species.*

- *Stabilize the trail to reduce erosion of crushed granite into natural areas.*
- *Where possible, bring the trail 2 ft inland to reduce slope on downhill side.*
- *Create formal water access points in at least two locations.*
- *Use a combination of cable fencing, split rail fence, and hardscaping along the trail and in restored areas to protect natural areas.*

- *Woodland expansion into middle of wetland area currently maintained as grass.*
- *Woodland enhancement throughout this unit, with a focus on increasing woodland diversity in age and species.*
- *Plant erosion repair areas.*
- *Increase biodiversity in the understory through planting—seeding may be more difficult due to steep slope, lack of irrigation, and competition from existing plants.*
- *Evaluate Zilker wetland for longer water retention. Longer wet periods would allow planting additional obligate and facultative wetland species.*
- *Enhance the wetland and increase plant diversity on small islands by planting 10+ species (at least 100 plants, gallon size, no more than 2 ft spacing) in each area respectively.*
- *Install one exclosure (>600 sq ft) against the shore and plant at least 5+ species (150 aquatic and emergent plants, gallon size, no more than 2 ft spacing).*

LADY BIRD LAKE SHORELINE MANAGEMENT UNIT

TASK PRIORITIES

High

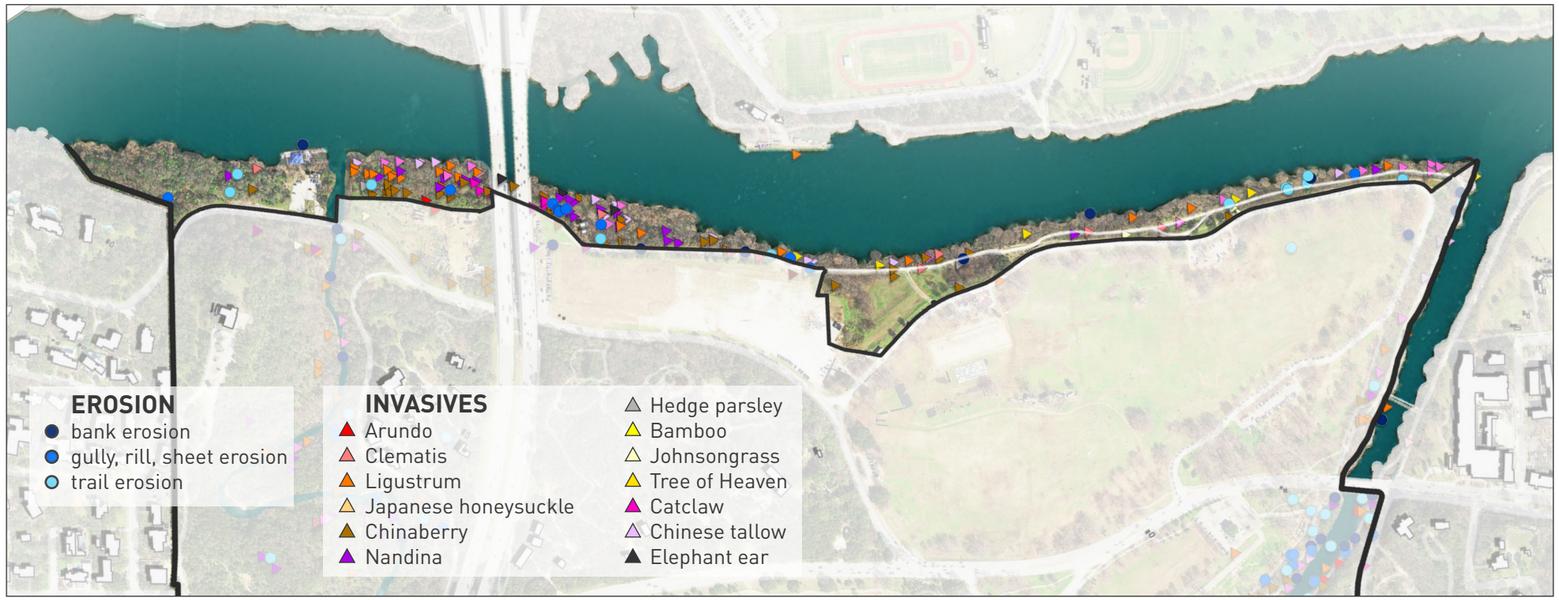
- ✓ *Treat catclaw vine, Arundo, sweet autumn clematis, Japanese honeysuckle, Ligustrum, Nandina, and tree of heaven.*
- ✓ *Evaluate the health and needs of large trees, preferably by an arborist.*
- ✓ *Stop all mowing except for a 2 ft buffer along the upslope portion of the trail.*
- ✓ *Install green stormwater infrastructure to control stormwater infrastructure from Mopac and overflow parking.*
- ✓ *Repair Mopac gully.*
- ✓ *Pull trail back 2 ft from edge of slope to reduce downhill slide.*
- ✓ *Stabilize the trail to reduce erosion of crushed granite into natural areas.*
- ✓ *Add fencing to formalized use areas.*

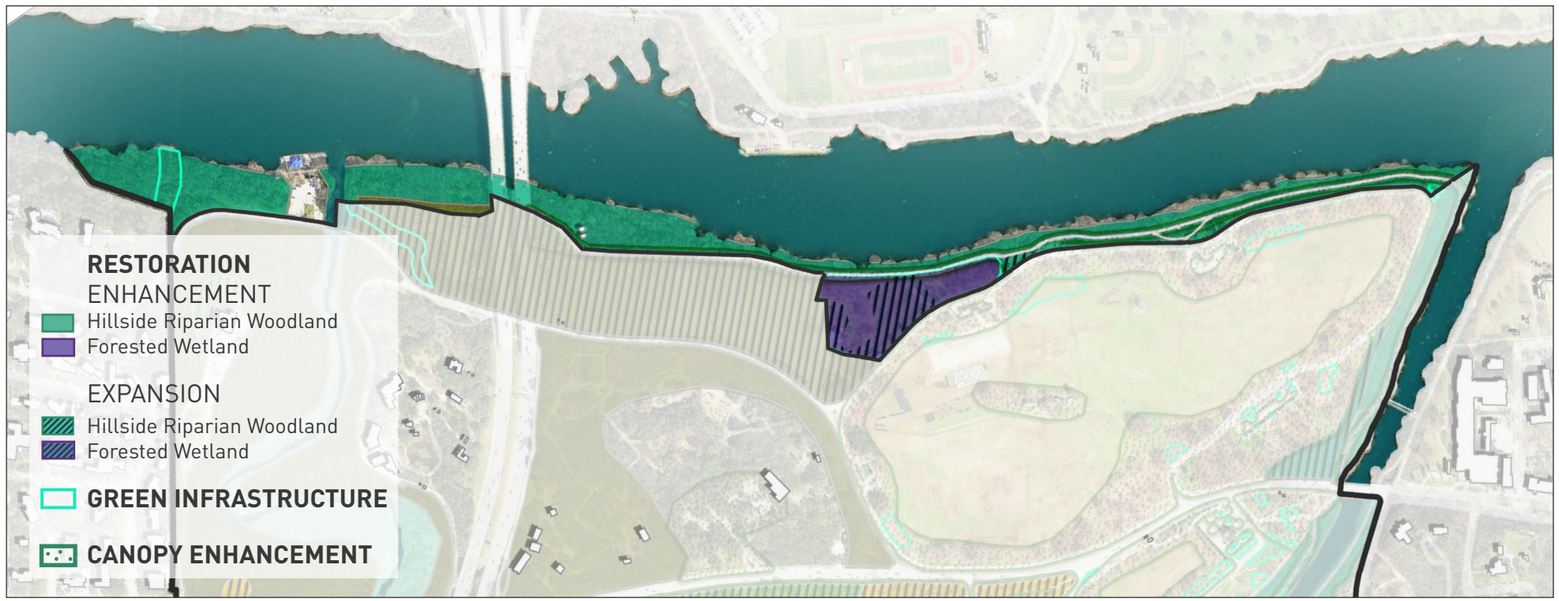
Medium

- ✓ *Plant herbaceous layer.*
- ✓ *Treat all remaining invasive species.*
- ✓ *Wetland plantings on lakeshore.*

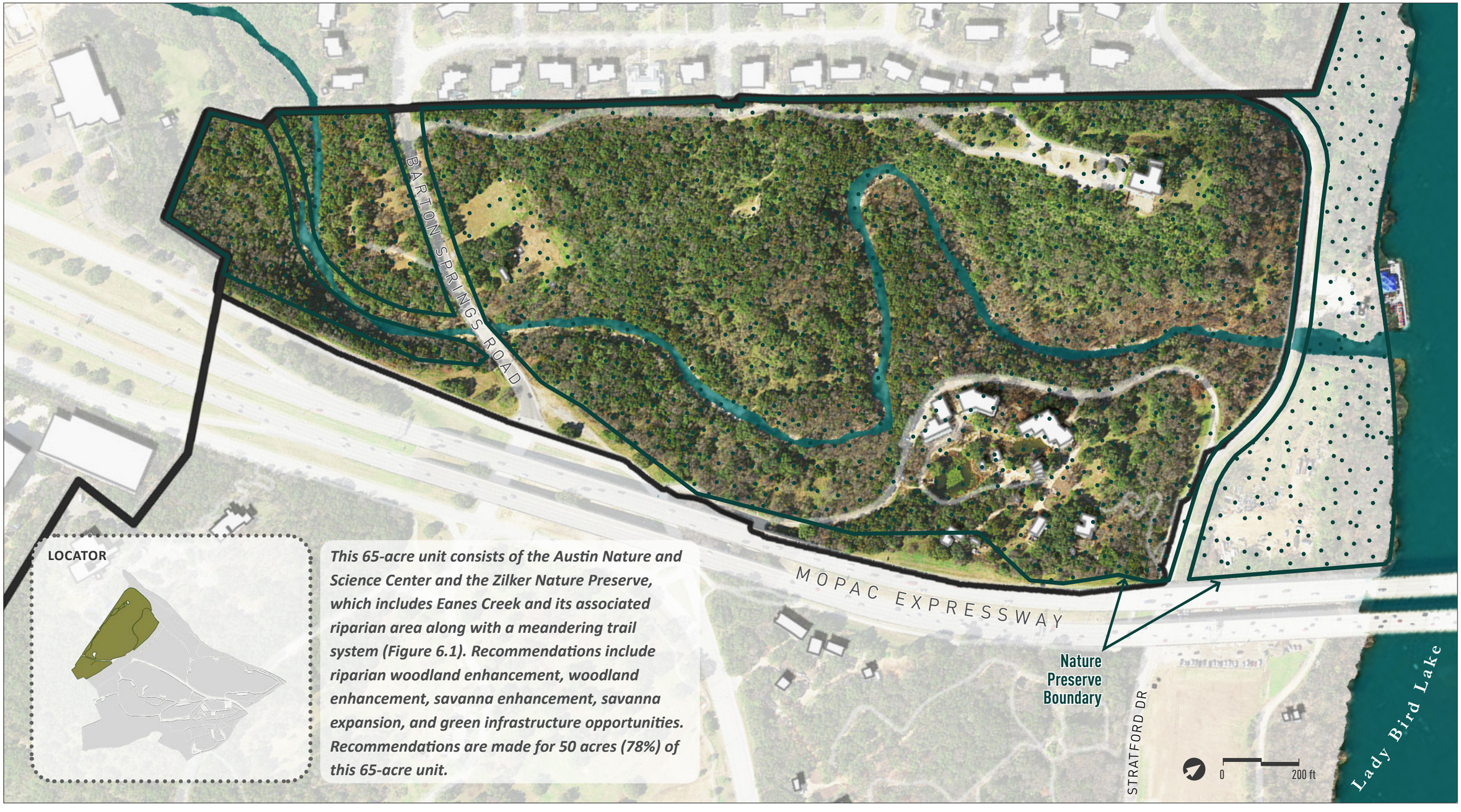
Low

- ✓ *Improve Zilker wetland and plants.*
- ✓ *Create and plant shoreline exclosure.*





NATURE PRESERVE MANAGEMENT UNIT



This 65-acre unit consists of the Austin Nature and Science Center and the Zilker Nature Preserve, which includes Eanes Creek and its associated riparian area along with a meandering trail system (Figure 6.1). Recommendations include riparian woodland enhancement, woodland enhancement, savanna enhancement, savanna expansion, and green infrastructure opportunities. Recommendations are made for 50 acres (78%) of this 65-acre unit.

NATURE PRESERVE MANAGEMENT UNIT

ECOLOGY

The Nature Preserve has the most topographic relief of anywhere in the study area, due to the Fredericksburg limestone and Eanes Creek cutting through the middle of the preserve. The limestone uplift that shoots up for the Colorado River floodplain gently falls to the west but is bisected by large cliffs and steep slopes on both sides of Eanes Creek. One of the highest points in the park is the Zilker Clubhouse—at approx. 552 ft elevation—with slopes dropping swiftly down to the mouth of Eanes Creek on Lady Bird Lake, which lies at 428 ft elevation.

The topographic shifts help give definition to the understory—with the cedar, oak, and juniper understory thinning out on the northern and eastern slopes and denser stands existing on the western and southern slopes. In most areas, there is a healthy understory that includes red buckeye, Mexican buckeye, silk tassel, mouse ears, gum bumelia, beebrush, Texas persimmon, and mountain laurel. On the steeper eastern-facing slopes, the mountain laurel and Texas persimmon form a low canopy with occasional cedar elm. This is similar to conditions in the Upper Barton Creek management unit on eastern facing slopes.

The funneling of water through the steeper areas is causing substantial bank erosion with active cut banks as high as 20 ft and trees recently felled into the creek bed or soon to be on their way. In addition to active erosion, some of the largest colonies of invasive species occur along the creek edge, as well as further inland in the 100-year floodplain where overflow happens during large rain events at a bend in the creek (near Mirror Pond). Dominant invasives in the area and along the creek include Ligustrum and Nandina. In upland areas, there are stands of Chinaberry and Johnsongrass, as well as Chinese parasol trees that are problematic. Invasives can be found sporadically and are not a major issue, but they are a larger problem at the northern entrance near Lady Bird Lake.

MANAGEMENT RECOMMENDATIONS

Recommended management actions include woodland enhancement, as well as meadow and savanna expansion and enhancement. Management and resource allocations should focus on invasive species treatment in the floodplain, studying solutions for bank erosion on the lower portions of Eanes Creek, maintaining the relatively high-quality habitat within the preserve, and directing the user experience.

- *Evaluate potential for green infrastructure to address water from Zilker Clubhouse Road and the Pistol & Skeet Range before it reaches Eanes Creek.*

- *Study solutions for bank stabilization in lower portion of Eanes Creek.*

- *Allow naturally occurring native seed to germinate and grow where invasives have been treated.*
- *Seed groundcover and herbaceous species in woodlands to increase species diversity.*
- *Enhance and expand meadows and savannas around the Zilker Clubhouse and in open areas in the woodlands through reduced mowing, spot treating invasives, amending soil, and seeding.*

- *Treat invasives in the floodplain with a focus on Ligustrum and Nandina.*
- *Treat invasives at the northern entrance to the preserve with a focus on Chinese parasol tree, Chinaberry, Johnsongrass, and Ligustrum.*
- *Treat invasives throughout.*

- *Rehabilitate at least 50% of the current informal trails and continue managing future trails as they are identified.*
- *Use wayfinding to direct users to formal trails and away from informal trails.*

NATURE PRESERVE MANAGEMENT UNIT

TASK PRIORITIES

High

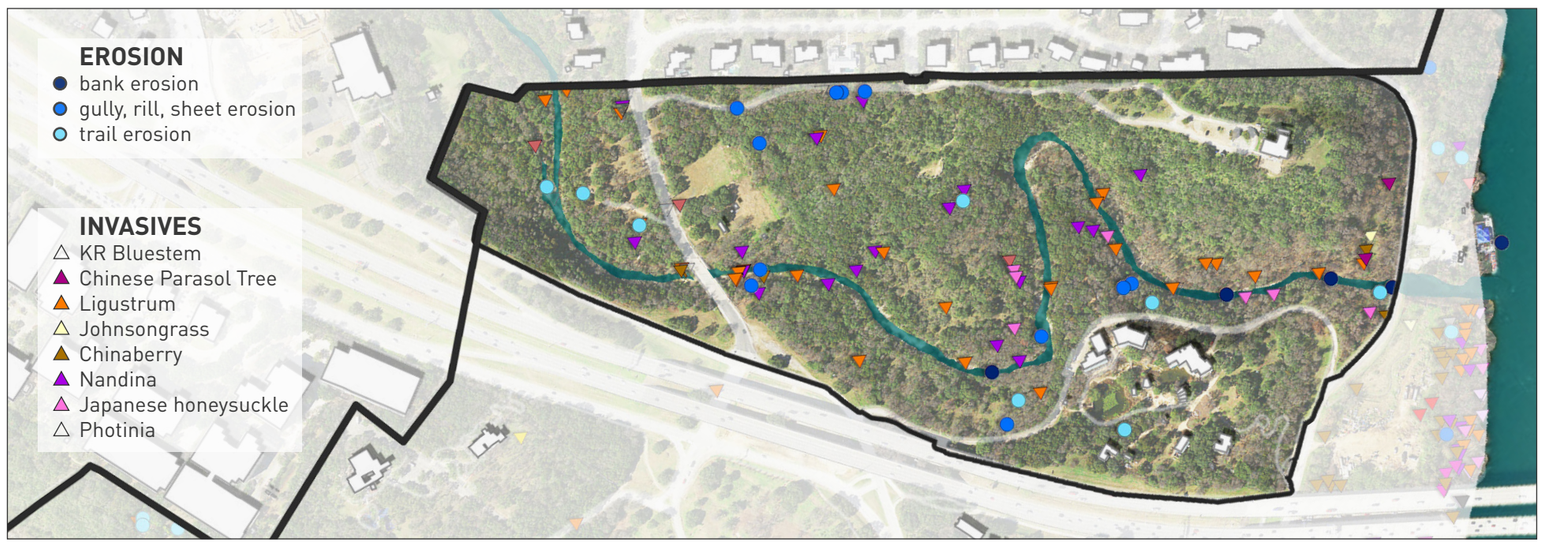
- ✓ *Treat invasives near the north entrance and in the floodplain.*
- ✓ *Study solutions for Eanes Creek bank erosion.*
- ✓ *Eliminate stormwater flows through the Pistol & Skeet Range.*

Medium

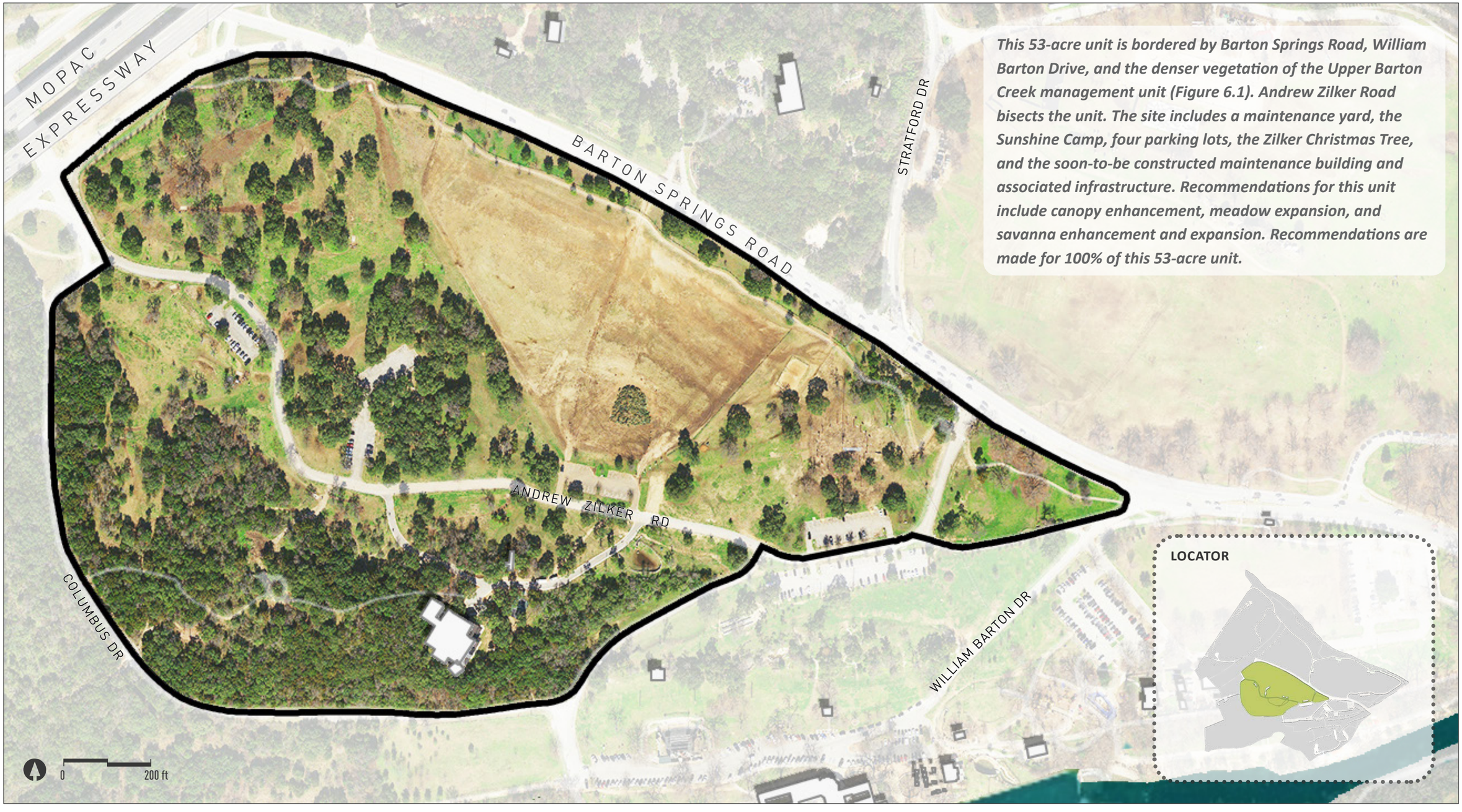
- ✓ *Treat invasives throughout.*
- ✓ *Meadow expansion around the Zilker Clubhouse.*
- ✓ *Rehabilitate at least half of current informal trails.*
- ✓ *Monitor for and address invasive species.*
- ✓ *Seed in woodlands and savannas.*

Low

- ✓ *Implement wayfinding to direct users to formal trails.*



ZILKER SAVANNA & MEADOW MANAGEMENT UNIT



This 53-acre unit is bordered by Barton Springs Road, William Barton Drive, and the denser vegetation of the Upper Barton Creek management unit (Figure 6.1). Andrew Zilker Road bisects the unit. The site includes a maintenance yard, the Sunshine Camp, four parking lots, the Zilker Christmas Tree, and the soon-to-be constructed maintenance building and associated infrastructure. Recommendations for this unit include canopy enhancement, meadow expansion, and savanna enhancement and expansion. Recommendations are made for 100% of this 53-acre unit.

ZILKER SAVANNA & MEADOW MANAGEMENT UNIT

ECOLOGY

Canopy density in the Zilker Savanna & Meadow unit ranges from woodland near Columbus Drive to open savanna in the Disc Golf Course and meadow at the Polo Field. There are 8 acres of subsurface critical habitat for the Austin Blind Salamander in this management unit.

The land slopes gently to the northwest where the site meets Mopac and stormwater is piped under the highway eventually flowing into Eanes Creek. Existing green stormwater infrastructure installations along this path include berms and a rain garden.

Major canopy species include live oak, cedar elm, box elder, and juniper. There are also some planted Chinese pistache and Chinaberry. The understory is dense in the southeast of the unit but decreases to the northwest and is almost absent north of Andrew Zilker Road. In the closed savanna and woodland area, understory shrubs include elbow bush, mouse ears, mountain laurel, Texas persimmon, and beebrush.

Invasives in the savanna area include Ligustrum and Nandina. In the meadow, Bermudagrass and King Ranch bluestem are present. The Polo Field is heavily compacted as a result of being used as parking for large events. The Disc Golf Course is highly trampled by users and in general, the entire area shows signs of erosion.

Because the Polo Field is frequently used as a temporary parking lot, the soils have been compacted. Foot traffic through the unit has compacted soils around the Disc Golf Course infrastructure and throughout the fairways, as well as along auxiliary roads to the maintenance yard.

MANAGEMENT RECOMMENDATIONS

This area includes meadow and savanna enhancement and expansion. Management and resource allocation should begin with reducing mowing, adding green stormwater infrastructure, enhancing canopy, enhancing understory, directing the user experience, and adding plant diversity in open areas. Creating greater plant diversity in open areas will require a system of pushing back invasives over time with a process of reduced mowing, soil enhancement, spot treatment, and seeding. Understory enhancement will be reliant on a process of reducing erosion, soil enhancement, physical barriers to trampling and mowing, and seeding. Work should be done to enhance recreation in this unit with a focus on creating a more directed experience in the Disc Golf Course that reduces trampling. While there is a system of swales already in place in this unit, it is in need of more disciplined management.

- *Remove Chinese pistache from the formal landscape.*
- *Treat Ligustrum and Nandina in the savanna and woodlands.*
- *Follow spot treatment method laid out in the Restoring Plant Communities section of the Natural Area Management Guidelines chapter for King Ranch bluestem, Bermudagrass, and Johnsongrass—this should be followed by soil amendment and seeding.*

- *Decompact and prepare soil in the Polo Field, in preparation for meadow planting including aeration, inoculation, and amending.*
- *Address erosion under the savanna canopy, where up to 8 inches of soil have been lost. Fence seeded and planted areas with cable or split-rail fencing to reduce trampling. In areas with no understory vegetation, add up to 3 inches of mulch per year.*
- *Address the drainage at the northwest corner of the unit, adjacent to Mopac, where soil around previous rock berms is eroding.*

- *Plant trees along the edges of parking lots and trails to improve the user experience and reduce localized temperatures (this should be completed after green infrastructure is installed, so newly planted trees can take advantage of additional water availability).*

- *Reduce trampling in the Disc Golf Course—create "roughs" by increasing mowing heights to 6 inches or taller and reducing mowing frequency to 6+ months. The roughs can be developed directly along the launch sites and within 50 ft of the baskets.*

- *Add rain gardens and swales in recommended areas to decrease runoff from roads and parking lots.*

- *Reduce mowing outside designated active recreation and picnic areas to no more than two times a year (an 18-month cycle is ideal) and at a minimum height of 6 inches. Continue mowing within 2 ft of parking lots and curbs, along designated mown trails, or where mowing is needed as a fire break.*
- *Expand meadows into the Polo Field and above Barton Creek Pool and enhance open areas in savannas through seeding with focus on pollinator plants, wildflowers, and native grasses.*
- *Reduce mowing under tree canopy to no more than 50% of the understory area. Seed the remaining 40% of the understory with a hardy, shade-tolerant mix including Virginia wildrye, coralberry, straggler daisy, inland seaoats, Turk's cap, and Virginia frostweed. Add shrubs and small trees to 10% of the understory.*
- *Seed natives after invasives are spot treated.*
- *Work with preserve mangers and Austin Fire Department to evaluate the use of fire to reduce understory and make carbon available for the soil.*

ZILKER SAVANNA & MEADOW MANAGEMENT UNIT

TASK PRIORITIES

High

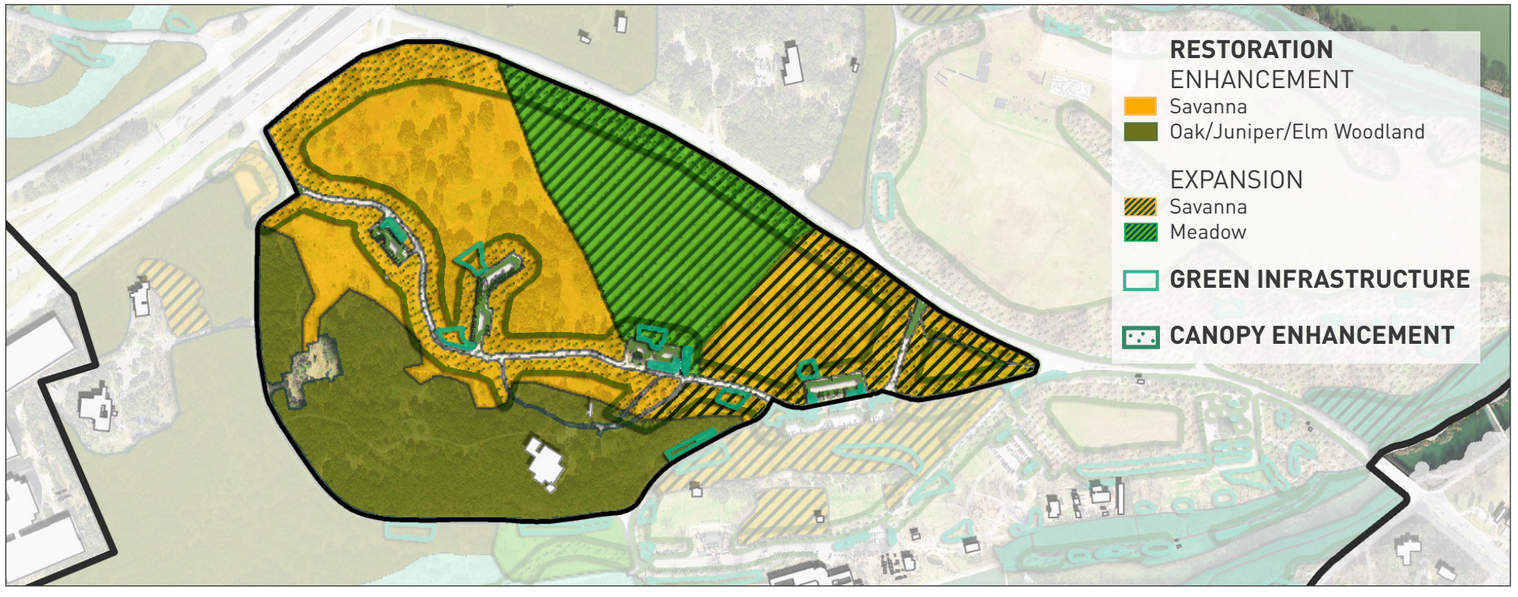
- ✓ *Reduce mowing.*
- ✓ *Install a chain of green stormwater infrastructure.*
- ✓ *Plant trees along trails and enhance understory.*
- ✓ *Enhance herbaceous and understory layer under canopy.*
- ✓ *Use protective barrier around enhanced areas.*

Medium

- ✓ *Expand meadows and enhance open areas of savannas, including soil prep, spot treatment of invasives, and seeding.*

Low

- ✓ *Evaluate feasibility of fire as a management tool.*



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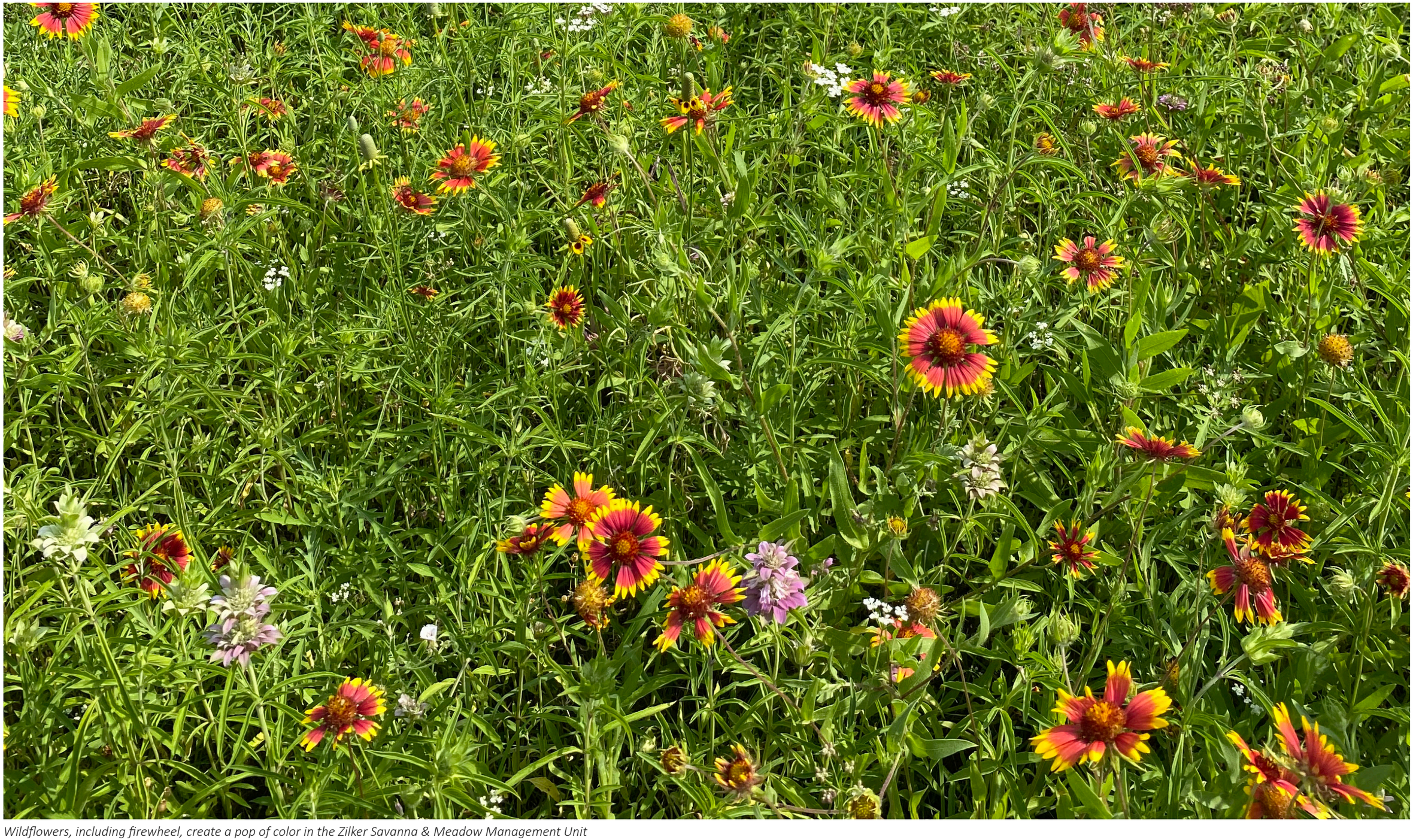
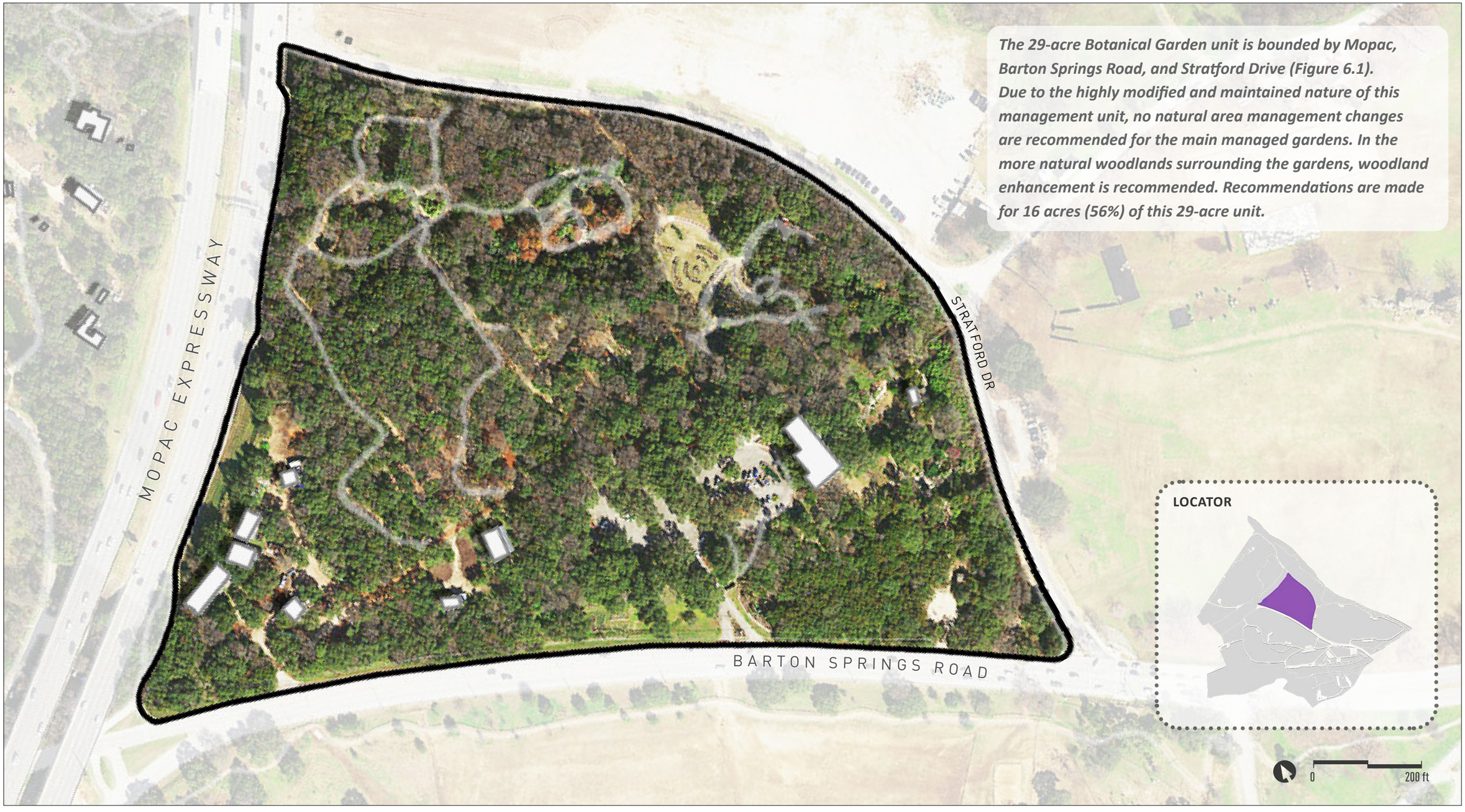


Wildflowers, including firewheel, create a pop of color in the Zilker Savanna & Meadow Management Unit

2021

BOTANICAL GARDENS MANAGEMENT UNIT



The 29-acre Botanical Garden unit is bounded by Mopac, Barton Springs Road, and Stratford Drive (Figure 6.1). Due to the highly modified and maintained nature of this management unit, no natural area management changes are recommended for the main managed gardens. In the more natural woodlands surrounding the gardens, woodland enhancement is recommended. Recommendations are made for 16 acres (56%) of this 29-acre unit.

BOTANICAL GARDENS MANAGEMENT UNIT

ECOLOGY

The natural areas of the Botanical Garden unit consist of Oak/Juniper/Elm Woodlands that surround the formal gardens. There are 22 heritage live oaks that have been identified in this unit, along with 12 protected live oaks and 7 protected Ashe junipers. The area is not impacted by outside stormwater. Also, due to this unit having less intense use than other parts of the park, there are fewer erosion issues. Problematic invasive species in this unit include Ligustrum, Nandina, catclaw vine, and bamboo.

MANAGEMENT RECOMMENDATIONS

Woodland enhancement is recommended for the natural areas, with a focus on invasive removal and seeding herbaceous species.

- *Treat Ligustrum, Nandina, catclaw vine, and bamboo in the woodlands.*

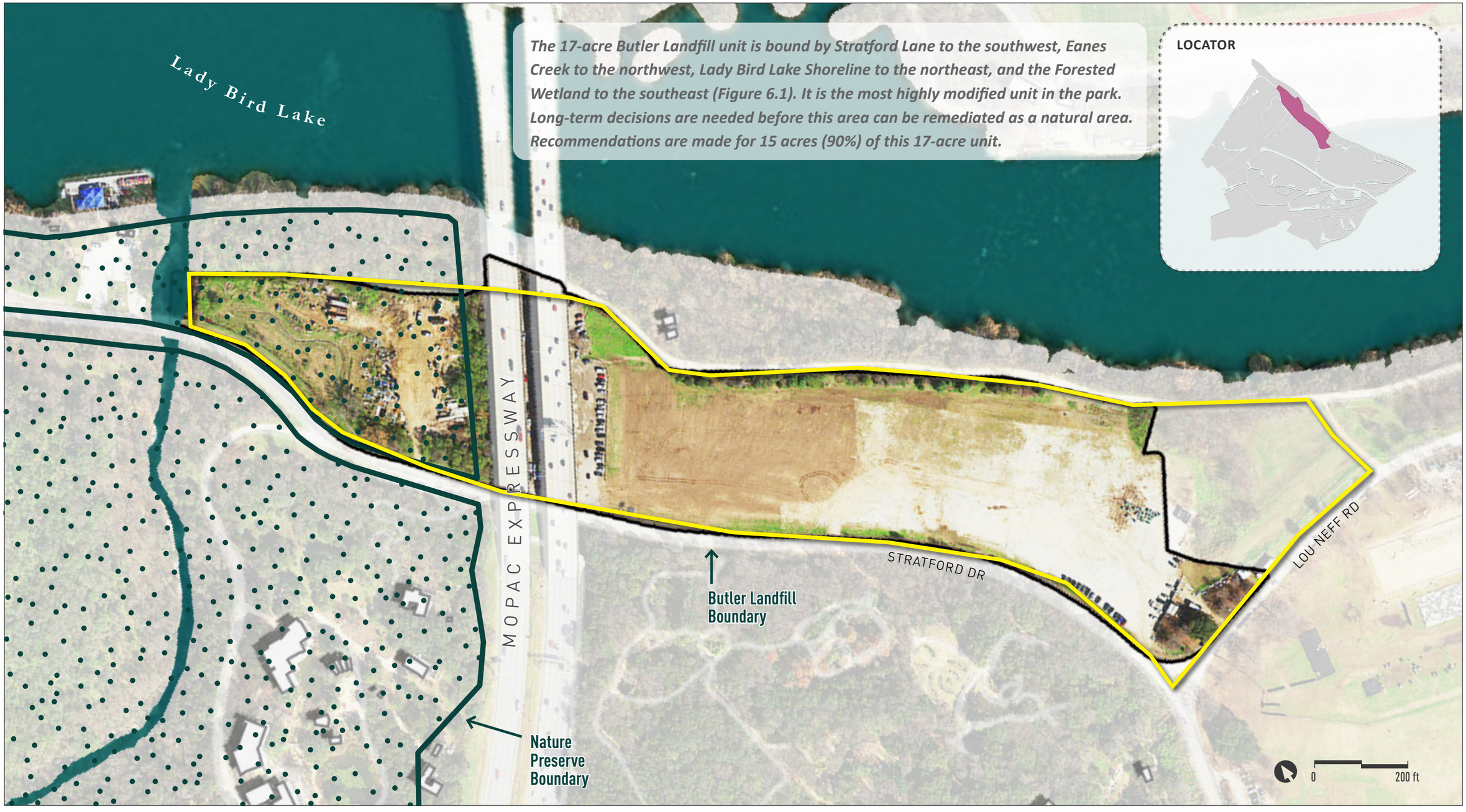
- *Seed woodlands to increase the the herbaceous layer.*

TASK PRIORITIES

High

- ✓ *Treat invasive species in woodlands.*

BUTLER LANDFILL MANAGEMENT UNIT



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BUTLER LANDFILL MANAGEMENT UNIT

ECOLOGY

The capped Butler Landfill currently serves as overflow parking. As mentioned in the Historic and Cultural Use chapter, approximately 100,000 cubic yards of waste lie under an earthen cap that was deposited as part of a landfill operated by the city from 1948 to 1967. There is no canopy cover over most of the Butler Landfill due to constraints on woody vegetation, although the berms on the lake-facing side of the eastern end are an example of how the area can be planted in its current condition without impacting the land fill cap.

In its current condition, the area is substantially compacted and not appropriate for planting. Sheet erosion is washing into both the Forested Wetland and Lady Bird Lake Shoreline. The flows result in gullies as they flow down the steep slopes of the Lady Bird Lake Shoreline. Invasive species are found at its edges and include Johnsongrass, King Ranch bluestem, and Bermudagrass.

MANAGEMENT RECOMMENDATIONS

The management fate of the Butler Landfill is unclear and was a large part of the Zilker Park Working Group's (ZPWG) discussion and motivation for a master planning process at the park. The ZPWG elected to allow existing rock to remain on the Butler Landfill until the end of the master plan process as a temporary solution for parking and staging. They also elected to eliminate the Bone Yard as soon as possible. Beyond that, an alternative recommendation was added to the ZPWG. This recommendation came from the Barton Hills Neighborhood Association, Zilker Neighborhood Association, Save Our Springs Alliance, City Council District 7, and City Council District 5. These groups collectively recommend that the mayor and city council adopt a maximum 4-year timeline for the master plan process to deliver a plan that restores the landfill area to permanent open green space.

The highest and best use for this area from an ecological perspective—considering its adjacency to the Lake and location within Zilker Park—is to extract the waste material or add additional soil to the top of the cap and restore the area to a woodland and/or savanna. This scenario results in the greatest increase to the ecological health of the park and enhancement of the user experience. The area is one of the last opportunities the city has to create lakeshore parkland that can alleviate pressure on other park amenities and create a robust passive recreation experience to interact with nature. The result could be up to 17 acres of robust plant and wildlife habitat with an integrated user experience. This use takes advantage of topographic changes, as a result of either extracting the landfill debris or increasing soil volume on top of it. While this is the best ecological use for the space, the importance of parking for the Zilker Botanical Garden, Austin Nature & Science Center, Butler Trail, and event facilitation is recognized. Therefore, this recommendation should be taken into consideration when attempting to find a compromise between ecological function and pragmatic use of the park space.

If the area retains all or part of its current function, stormwater flows, lack of shade, and dust need to be addressed. Green stormwater infrastructure should be installed to capture stormwater runoff from Mopac and Stratford Drive, as well as anywhere permanent and/or temporary parking is occurring to increase infiltration, filter out pollutants, and reduce downslope erosion. This can be done in conjunction with a berm and swale system similar to what is found on the northern boundary of the unit today and what has been done at other former landfills such as the one at Mabel Davis District Park. The additional soil creates enough soil volume above the landfill cap to allow for healthy vegetative growth.

- *Preferred Ecological Scenario 1: Extract landfill debris, ensure safe soil conditions, amend soil to prepare for restoration.*
- *Preferred Ecological Scenario 2: Import sufficient soil volume on top of the landfill cap that can support healthy native plant communities.*
- *Alternative Scenario: Use berm and swale system along with green stormwater infrastructure to create soil areas appropriate for planting.*

- *All scenarios: Enhance canopy throughout the site to create shade, increase user comfort, reduce localized temperatures, and reduce particulate matter in air.*

- *All scenarios: Build rain gardens that capture stormwater from Stratford, Mopac, and any remaining parking.*

- *Preferred Ecological Scenarios 1&2: Direct the user experience to allow for ecological recovery of the site.*

- *All scenarios: Treat invasive as they arise in new plantings.*

- *Preferred Ecological Scenarios 1&2: Create up to 17 acres of restored native vegetation and wildlife habitat.*
- *Alternative Scenario: N/A*

BUTLER LANDFILL MANAGEMENT UNIT

TASK PRIORITIES

High

- ✓ *Complete Zilker visioning process to determine best use of the unit.*

GREAT LAWN MANAGEMENT UNIT

The 50-acre Great Lawn unit is bounded by Barton Springs Road, Stratford Drive, and Lou Neff Road (Figure 6.1). It is one of the highest-use units in the park and serves as a music venue during Austin City Limits, Blues on the Green, as well as a daily recreational area for sports and off-leash dog play. The primary recommendation for this unit is canopy enhancement. Recommendations are made for 19 acres (38%) of this 50-acre unit.

GREAT LAWN MANAGEMENT UNIT

ECOLOGY

The Great Lawn unit does not include any natural areas, and the only canopy lies along the roads that bound the park and atop Rock Island, with a few additional trees scattered across the lawn. There are three acres of subsurface critical habitat for the Austin Blind Salamander in this management unit.

This unit is dominated by invasive grasses. The most common invasives in the area are Bermudagrass, Johnsongrass, King Ranch Bluestem, Chinaberry, and Ligustrum.

MANAGEMENT RECOMMENDATIONS

The primary recommendation for this unit is green stormwater infrastructure along the periphery, canopy enhancement, and the establishment of understory vegetation beneath the canopy.

- *Build rain gardens that capture stormwater from Lou Neff road and parking areas.*

- *Add mulch to understory of trees where they are not being planted.*

- *Seed herbaceous groundcover species under 40% of the existing canopy and plant understory trees and shrubs under 10% of the existing canopy.*

- *Treat Ligustrum and Chinaberry.*

- *Use knee-high cable fencing, split rail fencing, and/or hardscape to protect 40% of the understory.*

- *Plant trees along the edges of the Great Lawn and on Rock Island in the center of the field to create shade and reduce temperature. This should be done in conjunction with green stormwater infrastructure installation.*

GREAT LAWN MANAGEMENT UNIT

TASK PRIORITIES

High

- ✓ *Build rain gardens.*
- ✓ *Plant trees along Great Lawn edges and on Rock Island.*
- ✓ *Add fencing around 40% of canopy.*

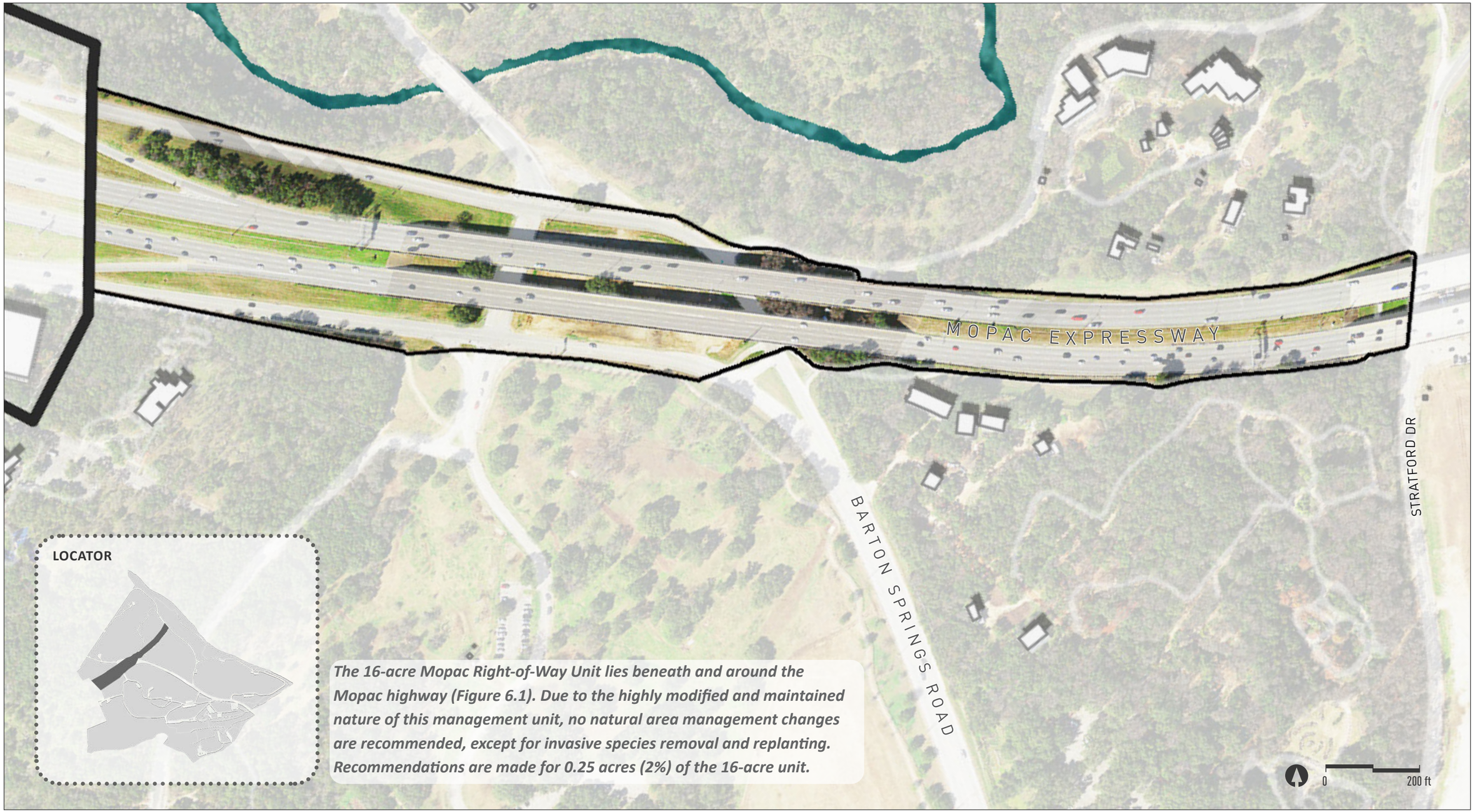
Medium

- ✓ *Seed and plant fenced understory.*

Low

- ✓ *Treat invasives.*

MOPAC RIGHT-OF-WAY MANAGEMENT UNIT



The 16-acre Mopac Right-of-Way Unit lies beneath and around the Mopac highway (Figure 6.1). Due to the highly modified and maintained nature of this management unit, no natural area management changes are recommended, except for invasive species removal and replanting. Recommendations are made for 0.25 acres (2%) of the 16-acre unit.

MOPAC RIGHT-OF-WAY MANAGEMENT UNIT

ECOLOGY

The area is highly disturbed and impacted substantially by the highway. It includes the greatest diversity of invasives in the study area including: Arundo, Asian jasmine, Bermudagrass, catclaw vine, chaste tree, Chinaberry, Chinese lacebark elm, Chinese parasol tree, Chinese tallow, hedge parsley, Japanese honeysuckle, Johnsongrass, King Ranch bluestem, Ligustrum, Nandina, photinia, sweet autumn clematis, trailing lantana, and tree of heaven.

NOTE: A complete survey for erosion and invasive issues was not conducted in the MoPac Right-of-Way. Further survey should be conducted in order to identify locations for management recommendations.

MANAGEMENT RECOMMENDATIONS

To manage this area, the City of Austin Parks and Recreation Department and/or Barton Springs Conservancy will need to work with the Central Texas Regional Mobility Authority. The area can be managed as a meadow, where feasible, to increase aesthetics, create pollinator habitat, and decrease invasive species. As with meadow expansion and enhancement recommendations, mowing should be reduced, the area should be seeded, and where there is a desire for greater natives, monocultures of invasive grasses should be spot treated.

- *Where feasible, install raingardens to capture stormwater.*

- *Evaluate the need for soil aeration, inoculation, and amendments before seeding.*

- *Seed entire area with a focus on pollinator plants and native grasses.*
- *Seed areas treated for invasives with high seeding rates.*

- *Spot treat invasive grasses.*
- *Treat woody invasives.*

- *Where feasible, plant native woody species.*

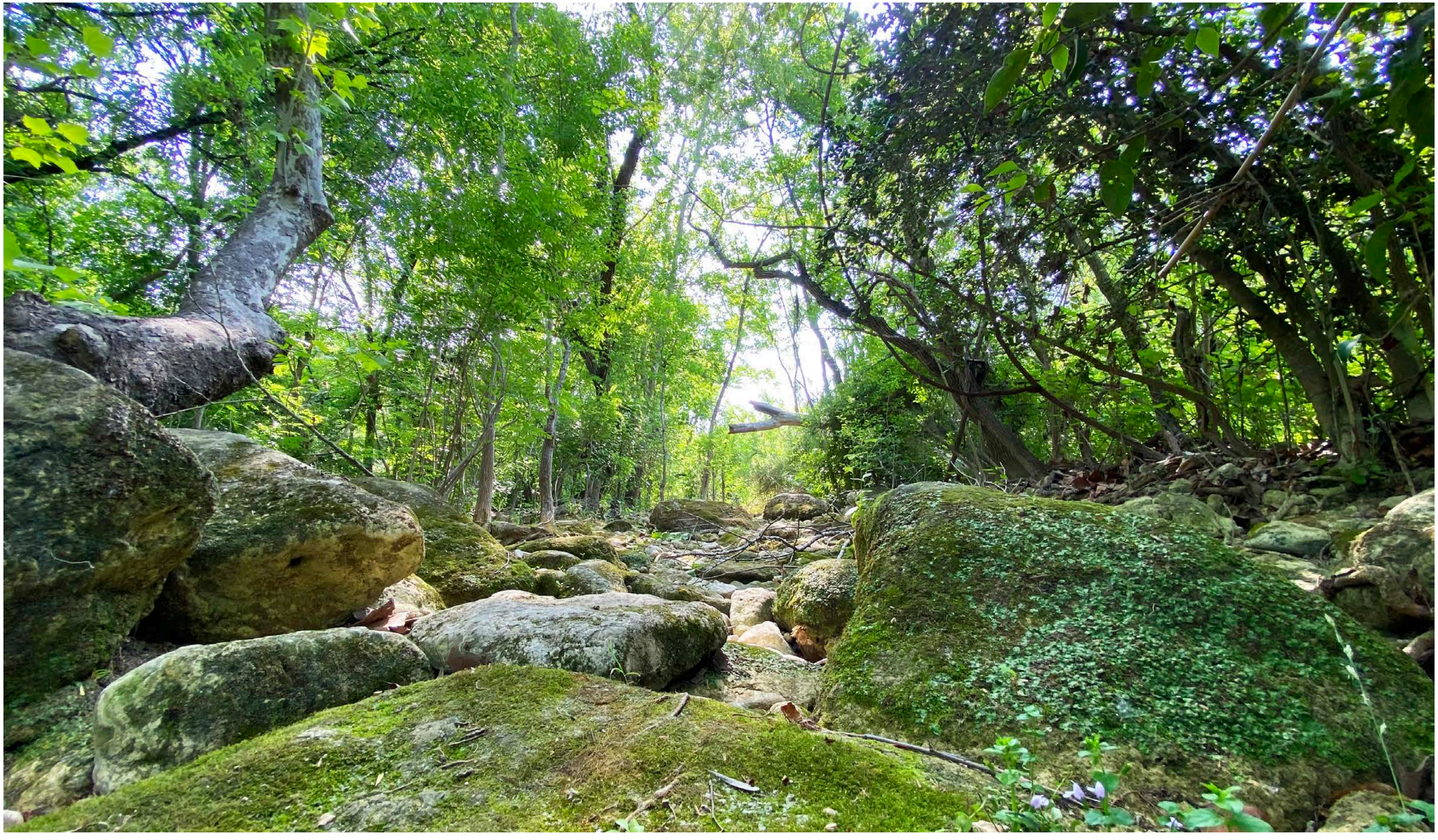
TASK PRIORITIES

Medium

- ✓ *Seed native species to increase diversity.*
- ✓ *Add green stormwater infrastructure where feasible.*

Low

- ✓ *Treat invasives.*



PART 7
TOWARD IMPLEMENTATION

Active management of Zilker Park's natural areas will be necessary to sustain the benefits that users receive from the park. This chapter focuses on the practical elements needed to complete tasks, including professional and volunteer services, scheduling and coordination, documentation and monitoring, and metrics to evaluate success.

PROFESSIONAL SERVICES AND VOLUNTEER SERVICES

Implementing the management recommendations in this document will require trained oversight in all cases. The work can be done by a team of professionals or professionals can work in coordination with volunteers. The two approaches will differ in overall cost, professional accountability, length of time before completion, and the quality of some tasks. Professional services are regularly used in Austin for land management and restoration, including projects at Lady Bird Lake, Pease Park, Waller Creek, and the University of Texas at Austin Dell Medical School.

Previous partnerships between the City of Austin and Texas Conservation Corps' (TxCC) provides a great example of how this work can be delegated and shared with private and non-profit partners. TxCC and similar organizations have the ability to implement a wide variety of management activities including invasive plant removal, trail building, soil remediation, planting, and seeding. They can also work with professionals on other tasks including installing and repairing culverts, some components of tree care, constructing swales and rain gardens, decompacting soils, removing concrete, and installing gabions. In addition, appropriate private and non-profit organizations can support Barton Springs Conservancy with volunteer days by training and overseeing volunteers.

With limited funds and the ongoing need for land management, many parks and preserves have turned to volunteers. For instance, on the east side of the study area south of Barton Creek, the Friends of South Zilker Park adopted a quarter mile long stretch of the creek alongside Azie Morton Road and the abandoned channel draining into the south side of Barton Springs Pool through Keep Austin Beautiful's Adopt-a-Creek program. Over the course of a year, more than 50 volunteers removed 150 invasive plants, established native seedlings, and removed 200 pounds of litter.[130]

Using volunteers has lower costs, generates public interest, and fosters community buy-in, but sometimes lacks accountability and can take longer. Volunteers also cannot take on all tasks done by professionals. The tasks laid out in this report can be accomplished by professional and volunteers working together to create a more robust, ecologically healthy landscape at Zilker Park.

Several organizations already offer programming that would be beneficial for volunteers in Zilker Park, including:

- Invasive plant identification and treatment training with the Invaders of Texas Program at the Lady Bird Johnson Wildflower Center, http://www.texasinvasives.org/invaders/
- Capital Area Master Naturalist training, http://camn.org/
- Native Plant Society in Central Texas for educational programming and native plant material sources, http://npsot.org/wp/austin/
- Travis Audubon for bird identification and habitat restoration, http://travisaudubon.org/

These organizations offer opportunities for volunteers to gain knowledge that will be helpful in accomplishing many of the ongoing tasks called for in this document, though the work itself should be coordinated and overseen by Barton Springs Conservancy and the City of Austin.

NON-PROFIT AND COMMUNITY PARTNERSHIPS

A number of projects have already been completed in Zilker Park through the Community Activated Park Projects (CAPP) program. This program was initiated in 2018 to streamline, approve, and track community-led improvement projects. Since its inception the program has been used 17 times in Zilker Park (Table 7.1). In 2019, Barton Springs Conservancy submitted a CAPP to restore and establish plant life in Barton Springs Pool. Much of the work suggested in this report will require approval from the Parks and Recreation Department that will likely be acquired through the CAPP process.

This type of community-led work on public lands is a huge asset for Zilker Park. These community partners enhance public open spaces using their own time and resources, while allowing for a level of open space development and maintenance that is not feasible when relying on Parks and Recreation Department resources alone.

Partner Organizations & Neighborhood Groups

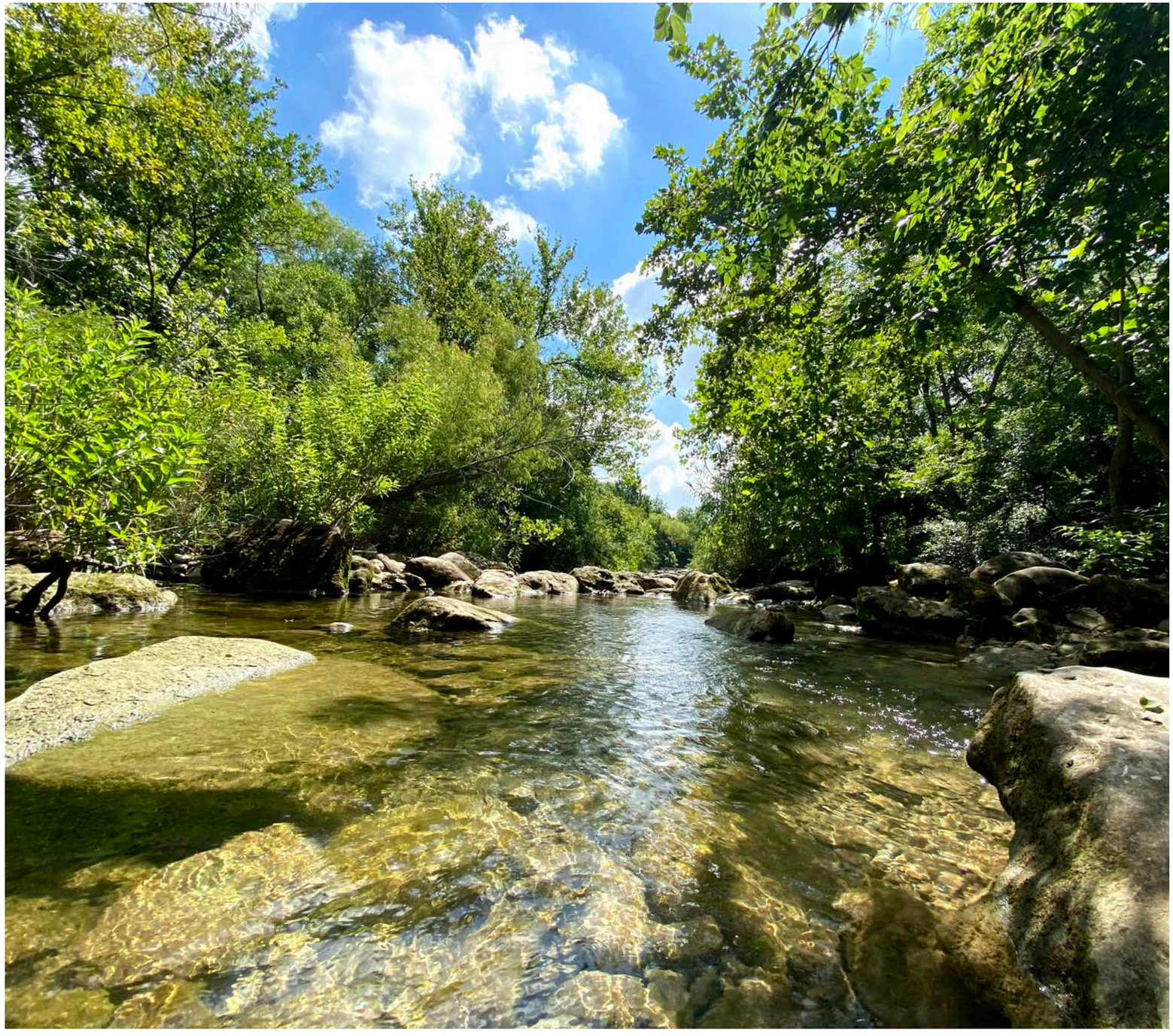
Year	Partner Organization or Neighborhood Group Name	Facility	Recent Activities
2019	Austin Nature & Science Center	Austin Nature & Science Center	The installation of shading structures over the Dino Pit at the Austin Nature & Science Center.
2019	Austin Nature & Science Center	Austin Nature & Science Center	Construct a tree-house pavilion as well as an amphitheater area for meetings, instructions, and teaching.
2018	Austin Ridge Riders	Barton Creek Greenbelt	Maintain the existing trails.
2018	Austin Parks Foundation	Barton Creek Greenbelt	Continuation of ongoing maintenance work on the Barton Creek Greenbelt.
2018	BHNA Greenbelt Guardians	Barton Creek Greenbelt/Violet Crown Trail	Trail surface and erosion repair work, removal of invasive species, tree plantings, installation of trail edge safety rails and water-crossing bridges, as needed.
2019	Hill Country Conservancy	Barton Creek Greenbelt/Violet Crown Trail (proposed) Trailhead	Construction of a new trailhead per design approved by PARD Director in 2017.
2018	Friends of Barton Springs Pool	Barton Springs Pool	Tree planting
2019	Friends of Barton Springs Pool	Barton Springs Pool	Tree planting
2018	Girl Scouts of Central Texas	Girl Scouts Hut (Zilker Cabin)	Roof replacement
2018	Girl Scouts of Central Texas	Girl Scouts Hut (Zilker Cabin)	Bamboo removal
2018	Parents of Children with Disabilities	Zilker	Add more accessible sensory play opportunities.
2019	Zilker Theatre Productions	Zilker Hillside Theater	Enclose east wing of the theater.
2018	Zilker Theatre Productions	Zilker Hillside Theater	Maintenance and Repairs at the theater as funds and resources are available.
2019	Zilker Theatre Productions	Zilker Hillside Theater	Build the interior of the enclosed east wing.
2019	Barton Springs Conservancy	Zilker Metropolitan Park	Restore and establish plant life in Barton Springs Pool.
2018	Capital Area Master Naturalists	Zilker Nature Preserve	Removal of outdated and damaged signage, and the installation of fourteen new signs.
2019	Austin Parks Foundation	Zilker Playscape	Maintenance work on the Zilker Playground.

Table 7.1. *Partner Organizations and Neighborhood Groups*

SCHEDULE AND COORDINATION

Restoration and land management are not discrete events, but ongoing processes. A four-year land management schedule can be seen in Figure 7.1. It is organized by Zilker Park's 10 management units, as well as areas generalized by vegetation type that exist in multiple management units. It is a flexible schedule that can be altered based on shifting priorities, management successes, degradation concerns, and available funding. The schedule serves as a baseline of important tasks that should be considered for completion in the coming years. In 2025, it is recommended that the entire document be revised to look forward an additional four years.

To ensure all efforts are being coordinated between the many City departments and other non-profit partner organizations working in the study area, Barton Springs Conservancy (or another appropriate coordinating entity representing the non-profit partner organizations) should hold quarterly work plan meetings with key personnel from PARD, COA Urban Forestry Department, and WPD. In these meetings, work plans associated with the tasks in these guidelines, new priorities, and documented efforts described below can be discussed. Through this coordination, complementary actions and resource allocations can be aligned for more efficient and successful implementation. Before work begins in an area, these guidelines and/or equivalent plans should be reviewed by Barton Springs Conservancy, the City, TxCC, and any other parties involved in the work. It is also critical that plans be in place for follow-up treatments, restorations, and resource allocations before work is started in an area. This allows for scheduling coordination between entities and ensures treatments work effectively.



	YEAR 1: 2021 *Ensure ecological health and priorities in this document are integrated into the Zilker Vision Plan process*	YEAR 2: 2022 *Coordinate actions with a completed and approved Zilker Vision Plan*	YEAR 3: 2023 *Begin to implement ecological components of the Zilker Vision Plan.*	YEAR 4: 2024 *Continue to implement ecological components of the Zilker Vision Plan.*
ALL AREAS		1. Yearly monitoring and planning. 2. Decommission 25% of informal trails not called out for formalization.	1. Yearly monitoring and planning. 2. Invasive management throughout park. 3. Plant and seed in select areas. 4. Install green stormwater infrastructure in additional areas called out in the Zilker Vision Plan.	1. Yearly monitoring and planning. 2. Prepare to update plan in 2025. 3. Decommission 25% of informal trails not called out for formalization. 4. Invasive management throughout park. 5. Plant and seed in select areas.
UPPER BARTON CREEK	1. Increase canopy along Violet Crown Trail, thin small diameter trees, and amend soil in area transitioning to Riparian Woodland. 2. Treat woodland invasives.	1. Create formal trails to creek, retire unneeded informal trails. 2. Seed select areas to enhance groundcover diversity.		
LOWER BARTON CREEK		1. Create site plan that addresses formal trails, water access, invasive removal, soil removal, along with a robust planting plan. 2. Plant mottes in woodland expansion areas.	1. Construct planned improvements that result in ecological restoration and an enhanced user experience. 2. Stabilize Hike-and-Bike Trail and reduce gully erosion.	1. Ongoing management.
NATURAL PRESERVE	1. Treat woodland invasives. 2. Use GSI to eliminate stormwater flows through Pistol and Skeet Range. 3. Study solutions for Eanes Creek bank erosion.	1. Seed select areas to enhance groundcover diversity.		
LADY BIRD SHORELINE	1. Treat woodland invasives.	1. Repair gully erosion and add physical barrier between formal and natural areas. 2. Plant and Seed select areas to enhance groundcover diversity where feasible.	1. Stabilize Hike-and-Bike Trail and reduce gully erosion.	Create two water access points along the lake.
ZILKER SAVANNA & MEADOW	1. Seed 40% of understory in groundcover and install knee high fencing or equivalent barrier to trampling.	1. Install green stormwater infrastructure and enhanced canopy. 2. Spot treat invasive throughout open Savanna and Meadow areas.	1. Seed select areas to enhance groundcover diversity.	1. Spot treat invasive throughout open Savanna and Meadow areas. 2. Seed pollinator plants and native grasses on all areas spot treated.
BOTANICAL GARDEN	1. Treat woodland invasives.	1. Plant and Seed select areas to enhance groundcover diversity where feasible.	1. Treat woodland invasives.	
BUTLER LANDFILL	Study mitigation scenarios: 1. Excavating waste and ecological restoration, 2. Adding additional soil to allow for park development and ecological restoration throughout the site—likely a component of the vision plan; 3. improved parking with berms, 4. leave as is.		1. Begin to implement results of Zilker Park Vision Plan process.	
BARTON SPRINGS POOL & ASSOCIATED MAINTAINED AREAS	1. In non formal areas reduce frequency and increase height of mowing.	1. Install green stormwater infrastructure and enhanced canopy.	1. Install rain gardens in pool area and rainwater catchment facilities on buildings. Seed 40% of understory in groundcover and install knee-high fencing or equivalent barrier to trampling.	
GREAT LAWN		1. Install green stormwater infrastructure and enhance canopy.	1. Seed and plant 20% of understory in groundcover and install knee high fencing or equivalent barrier to trampling.	1. Seed and plant 20% of understory in groundcover and install knee high fencing or equivalent barrier to trampling.
MOPAC RIGHT-OF-WAY			1. Work with Central Texas Regional Mobility Authority to incorporate ecological management framework into right of way management.	

Figure 7.1. *Four Year Work Schedule*

2021

DOCUMENTING, MONITORING, & CITIZEN SCIENCE

It is critical that all land management efforts are documented to gauge success, facilitate an adaptive management approach, and track change. This is best achieved when data is recorded as it is performed or shortly after. Ongoing documentation can facilitate coordination by ensuring all entities working in the area are aware of what has been done, what was effective, what remains to be done, and how best to allocate resources.

Monitoring of the study area is recommended through geographic, photographic, and narrative descriptions that include annual photo points, early detection monitoring, land management documentation and evaluation, and biodiversity observations. Records from this monitoring should be standardized and readily available. Over time these collective documents can drive future management practices and educate professionals and volunteers working in the study area.

To ensure fidelity of monitoring information, documentation should take place at the time of monitoring. Example monitoring documents are located in Appendix 2. It is recommended, however, that all monitoring documentation be done through smartphone or tablet devices using a field data application such as Fulcrum. Advantages of using such a program include immediate incorporation of the information into a database, reduced data errors, location tracking, association of photos and voice recordings with specific locations, and customizable datasheets that can meet the needs of Barton Springs Conservancy and the City of Austin.

PHOTO POINTS

Photo points are a relatively quick and easy way to perform qualitative monitoring. Thirty-nine photo points were established within the study area as seen in Figure 7.2. The photographs and descriptions are included in Appendix 3. GPS points were taken at each location so that they can easily be found and the photos can be replicated. Taking photos once a year at each of these points and comparing the photos over time will provide a sense of how areas are changing and guide future management decisions.

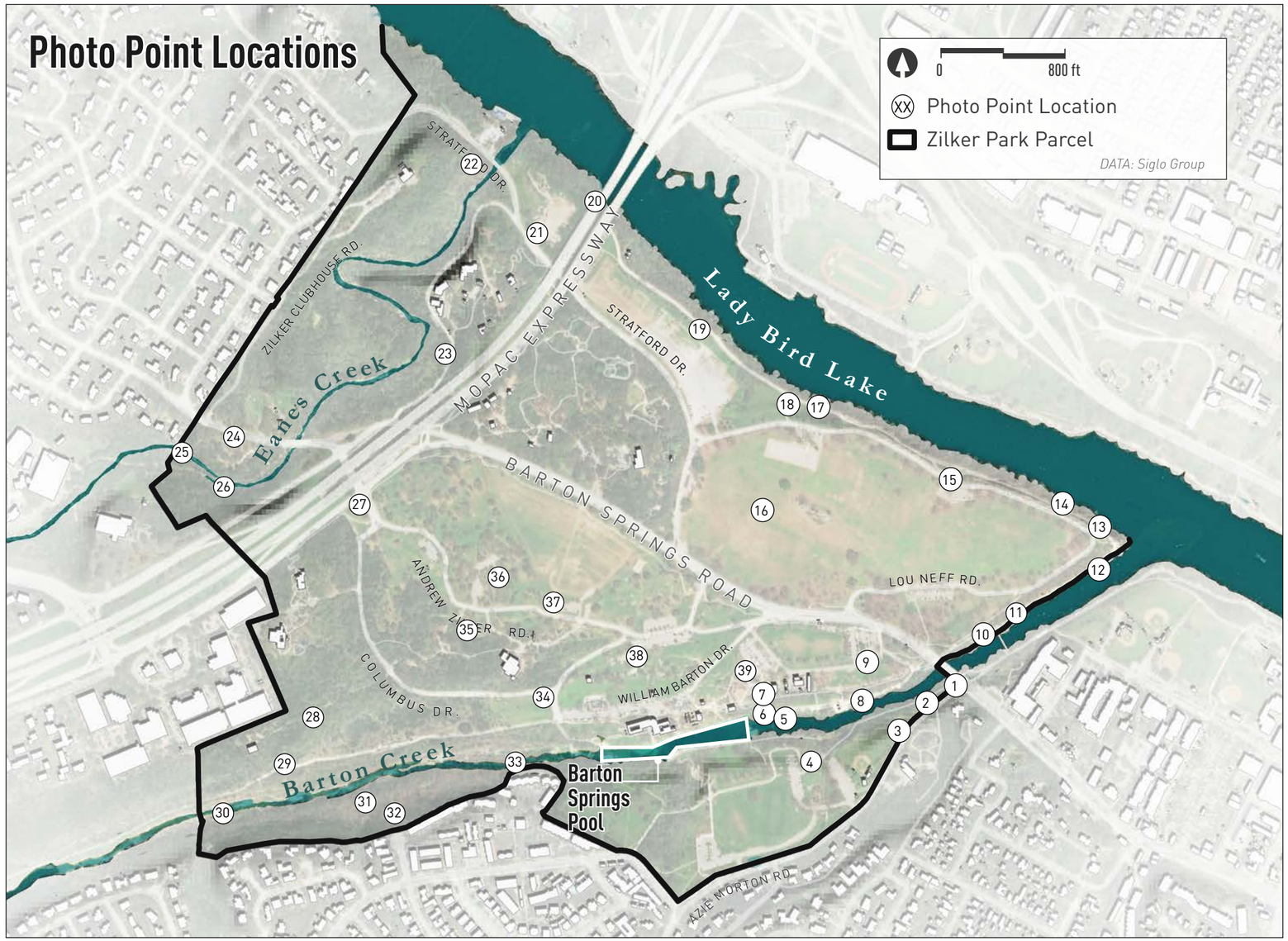


Figure 7.2. *Photo Point Locations*

EARLY DETECTION MONITORING

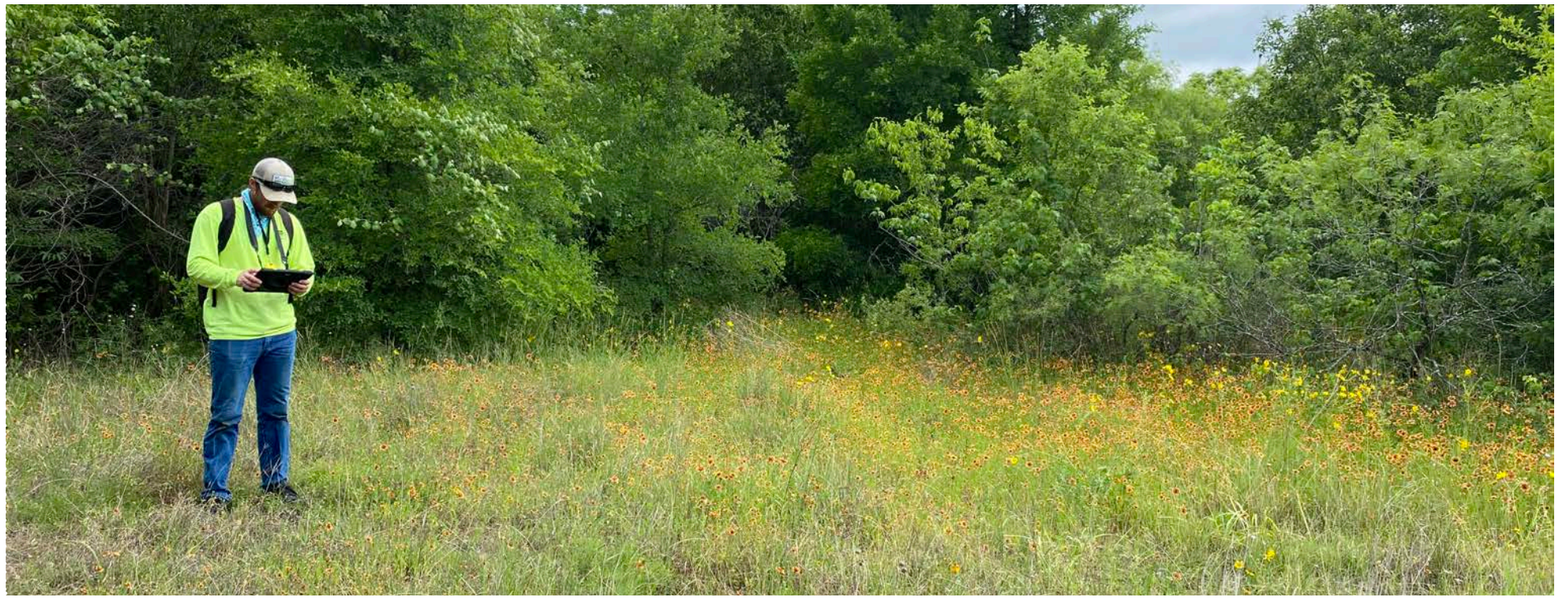
Early detection monitoring is not designed to assess the effectiveness of management actions but rather to detect new threats at an early stage so that they can be addressed quickly. This is considered a best management practice and is called for in both the City's Urban Forest Plan and Invasive Species Management Plan. It is not tied to a specific photo point or vegetation plot, but requires a staff member, professional, or trained volunteer to periodically walk the entire study area and observe new invasive threats, expanding invasive plant issues, areas being overused and denuded, new informal trails, and 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 requires 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 the natural areas of Zilker Park and can accurately determine if change is occurring; and
- Willing to walk the grounds a minimum of twice per year, looking for new threats.

It is recommended that field data be recorded electronically with the following variables: date, recorder, type of threat (species name, new invasive species, expanding invasive species, new or expanding erosion, new or expanding trampling, new or expanding informal trail, new or expanding stormwater flow), location (including latitude and longitude, along with general identifiers), size of issue (for invasive species should include patch size, percent cover, and if appropriate number of plants), and a narrative description of the problem and potential cause. If electronic recording is not feasible, a potential early detection monitoring form template can be found in Appendix 2. This document can also be used as a reference for recommended fields if using an electronic data recording app.

LAND MANAGEMENT TASK MONITORING

The City of Austin, Barton Springs Conservancy, Austin Parks Foundation, and numerous other organizations have been actively managing and improving the natural areas around Zilker Park through plantings, soil amendments, trash clean up, and invasive species control. However, piecing together a narrative of their efforts currently relies heavily on the institutional memory of key individuals. To facilitate an ongoing record, it is recommended that electronic records be kept of all management activities that include the following variables: date, recorder, general activity, area treated, location of area, size of area, how it was treated, and resources used (including labor), along with photo documentation. A simple, standard stewardship action form can be found in Appendix 2. Once management has taken place in an area, the area should be placed on a list of areas to photograph annually along with the existing photo points.



TRACKING BIODIVERSITY

Citizen science is a vital way to track biodiversity information, with numerous individuals in the Austin area actively recording biodiversity data through eBird, iNaturalist, Odonates of Texas, Fishes of Texas, and other online services. Individuals input data, which goes through a validation process that allows final users to understand the quality of the data.

To continue to track biodiversity data within Zilker Park, a "project" titled "Zilker Natural Areas" has been created on the iNaturalist website. New and existing observations will automatically be added to the project for long-term biodiversity tracking. There are also existing eBird hot spots within Zilker Park and along the Ladybird Lake shoreline that park visitors and staff can contribute to.

Travis Audubon is engaging its volunteers to serve as monthly spotters to encourage recording observations and to promote interest and participation by the general public. Wildlife observations can, if desired, also be linked on the City of Austin Zilker Park landing page from iNaturalist and eBird.

METRICS

The process of restoration and long-term care of Zilker Park's natural areas will have successes and failures in the coming years, with an overall trend toward enhancing these natural areas. By following the recommendations presented in this document and employing an adaptive management approach, Barton Springs Conservancy and the City of Austin will see measurable changes. To evaluate these changes, we recommend the metrics below as measures of success (Figure 7.3). For our purposes, a metric can be measured easily and indicates progress is being made toward the goals stated on pages 6 & 85.

These metrics suggest a path toward success and provide a quick articulation of some of the overall reasons for the land management practices laid out in these guidelines. They also provide a motivation for people to become more familiar with and committed to the study area. 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. The objectives catalyze involvement and resource allocation while allowing for measurable, tangible outcomes.

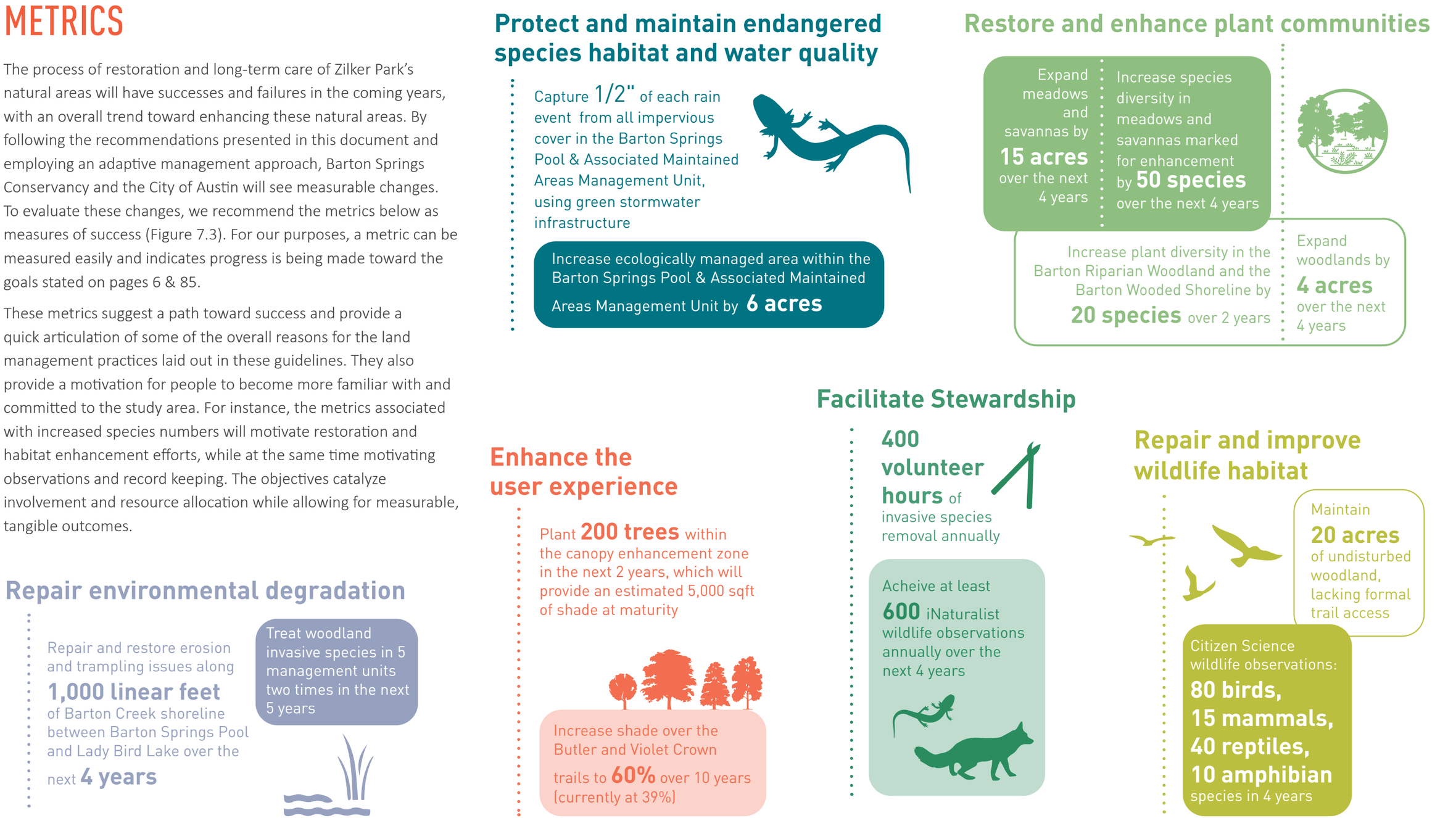


Figure 7.3. *Restoration and Maintenance Metrics*

PART 8
CONCLUSION

The urban forest and natural areas of Zilker Park are an irreplaceable part of Austin. They form an ecological and cultural nexus unmatched in the City and rarely matched in other places. Over 3 million people visit the site each year. People flock to Zilker Park for swimming, relaxation in nature, beautiful views, and great recreation. It is among the largest open spaces within the City. Via Barton Creek and Lady Bird Lake, it is connected both up and downstream to a larger complex of open space that includes the Barton Creek Greenbelt, the Ann and Roy Butler Hike-and-Bike Trail, and Auditorium Shores, which work together to provide ecosystem services and a natural refuge for Austinites and wildlife alike.

Beyond aesthetics and play, the site gives back to the community by cleaning the air, reducing urban temperatures, providing shade, cleaning water, building soil, reducing erosion, and providing habitat for over 600 species of plants and animals. To maintain the current level of service and to move toward the site's full potential, Barton Springs Conservancy, the City, and their partners can strategically

allocate resources per the recommendations in this report to enhance the ecological function and improve the user experience of Zilker Park.

The Barton Springs Conservancy commissioned this report to proactively look at opportunities and challenges within Zilker Park's 351 acres of natural area and urban forest and support the integration of ecological health and management into the Zilker Park Vision Plan process beginning in early 2021. The park is clearly loved and numerous improvements have been made to the site in the last four decades. To maintain and improve it over time, however, additional management and investment are critically needed. To this end, management recommendations are made in this report based on the ecology of the site, restoration potential, and sustainable land management practices. A variety of management recommendations are made—to be carried out over the next four years—as shown in the management schedule. The first tasks address degradation found throughout the site, including addressing water issues via green infrastructure, erosion & soil health, user impacts, and invasive species. As these issues are addressed, restoration of the woodlands, savanna, meadow, and aquatic plant communities should be implemented to better meet the aesthetic and ecological potential of the site including:

161 acres of woodland enhancement
21 acres of woodland expansion
20 acres of savanna enhancement
17 acres of savanna expansion
5 acres of meadow enhancement
11 acres of meadow expansion
25 recommended aquatic plant species to increase diversity of the park's waters

The implementation of the recommendations here will result in restored plant communities and wildlife habitat, improved ecological function, increased resiliency, and an enhanced user experience. In addition, the implementation will facilitate greater stewardship and involvement in the natural areas. Success of the project will rely on the use of the best management practices laid out in this report, regular maintenance and follow-up treatments, and ongoing monitoring as well as an adaptive management approach that recognizes land management and restoration as a dynamic process. Success will be measured via objectives that aim to increase overall canopy, trail shade, and number of trees planted, while reducing invasive plant populations and mitigating erosion issues.

The path forward for this vital part of the Central Texas cultural and natural environment is at a pivotal point. Through strategic allocation of resources as outlined in these guidelines, including defined management tasks, ongoing best management practices, and monitoring, the site's health and value can be maintained and substantially improved. The end result is a heightened user experience and enhanced ecological function that fosters enjoyment, excitement, interest, and participation for current and future generations.

Key findings of this report include:

- The site has over 130 historic features.
- The site has 383 existing plant species and 262 wildlife species.
- The Ann and Roy Butler Hike-and-Bike Trail is the most popular area of the park for pedestrian and bicycle use.
- The natural areas along Barton Creek downstream of Barton Springs is the area in most critical need of restoration and protective management.
- The endangered Barton Springs Salamander is most abundant in Eliza and Barton Springs.
- Zilker Park's natural areas provide opportunities for visitors to enjoy nature including the Zilker Nature Preserve, the Lady Bird Lake Shoreline, and Barton Creek upstream from Barton Springs Pool.
- The implementation of the recommendations here will result in substantial improvements in the ecological health of the park.
- There are three areas—the Butler Landfill, the Pistol and Skeet Range, and the Bone Yard—that contain hazardous materials and are in need of remediation in order to adapt these spaces for ecological restoration and/or recreation.
- The recommended investments are small in comparison to the overall value of the park and can result in a substantial rate of return

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Appendix 2:

Monitoring Documents

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 type)

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

Notes:

Stewardship Activity Log

Date: _____ Recorded by: _____

General Activity: _____

Example include: tree planting, invasive plant inventory or removal, seed sowing, trail maintenance, soil enhancement, monitoring of past activites, 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:

Example 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)

Appendix 3:

Land Management Photo Points

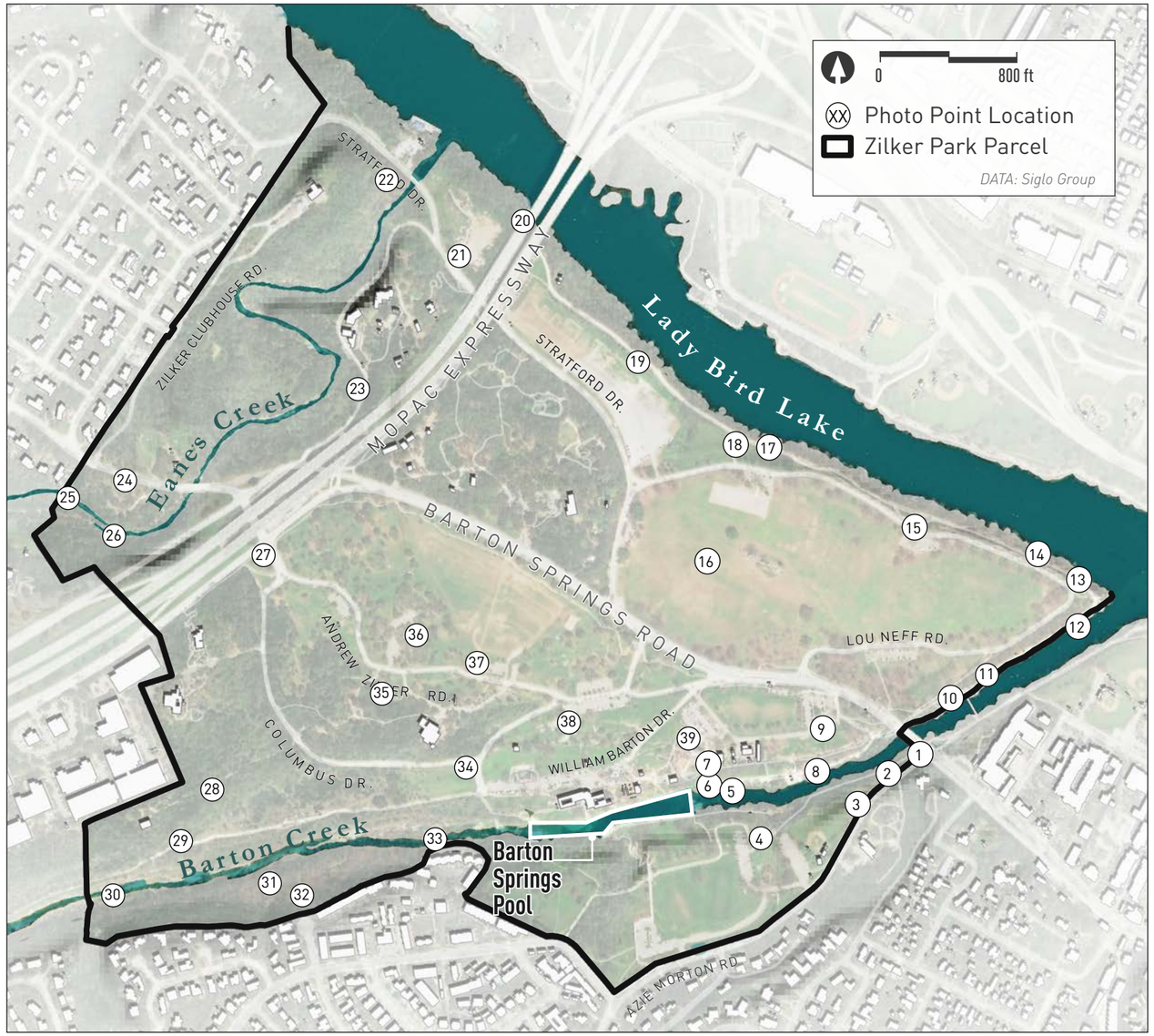
Photo Points: Long-term Monitoring Locations

Photo points are a fairly quick and easy way to perform qualitative monitoring. Thirty-nine points were established within the study area for Zilker Park on October 22nd, 2020, November 9th, 2020, and February 6th - 8th, and February 11th, 2021. 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, in the same direction(s). Comparing the photos over time will provide a sense of how areas are changing and guide future management decisions.

Point	Latitude	Longitude	Collection Date
1	30.2647790	-97.7652630	11/09/2020
2	30.2644580	-97.7657360	11/09/2020
3	30.2639810	-97.7663500	10/22/2020
4	30.2634040	-97.7681010	11/09/2020
5	30.2639430	-97.7688250	11/09/2020
6	30.2643260	-97.7690630	10/22/2020
7	30.2645290	-97.7690950	11/09/2020
8	30.2645500	-97.7668690	11/09/2020
9	30.2650750	-97.7669670	11/09/2020
10	30.2653750	-97.7643980	11/09/2020
11	30.2659790	-97.7639410	11/09/2020
12	30.2668010	-97.7623570	11/09/2020
13	30.2676560	-97.7625560	11/09/2020
14	30.2681690	-97.7638470	11/09/2020
15	30.2684000	-97.7652217	02/11/2021
16	30.2677660	-97.7691150	11/09/2020
17	30.2696443	-97.7679614	11/19/2020
18	30.2697990	-97.7685550	11/09/2020
19	30.2711250	-97.7702880	11/09/2020
20	30.2732754	-97.7723390	11/19/2020

Point	Latitude	Longitude	Collection Date
21	30.2727250	-97.7735000	02/10/2021
22	30.2740347	-97.7748938	02/07/2021
23	30.2706580	-97.7754970	11/09/2020
24	30.2692400	-97.7798190	11/09/2020
25	30.2689960	-97.7807600	11/09/2020
26	30.2684190	-97.7799140	11/09/2020
27	30.2680417	-97.7771387	02/08/2021
28	30.2641830	-97.7784390	02/08/2021
29	30.2635377	-97.7786530	02/08/2021
30	30.2627017	-97.7800283	02/06/2021
31	30.2628533	-97.7771000	02/06/2021
32	30.2625633	-97.7765433	02/06/2021
33	30.2634617	-97.7741617	02/06/2021
34	30.2646170	-97.7734920	10/22/2020
35	30.2658330	-97.7750560	10/22/2020
36	30.2667522	-97.7744188	02/08/2021
37	30.2663292	-97.7733063	02/08/2021
38	30.2653310	-97.7716000	10/22/2020
39	30.2650800	-97.7694932	11/09/2020

Photo Point Locations



Produced by Siglo Group

Photo Points 1&2

PPT.01 Direction: NW

Direction: SE

Direction: S

Direction: SW

Paved trail passing under Barton Springs Road on south side of Barton Creek.

PPT.02 Direction: E

Direction: SE

Direction: W

Direction: NW

Stairs from developed park area down to trail.

Photo Points 3&4

PPT.03 Direction: S Direction: WSW

Mowed lawn near baseball diamond. Opportunity for green infrastructure implementation.

PPT.04 Direction: NNW Direction: N

Standing on upper portion of the Sunken Gardens looking down to Old Mill Spring.

Photo Points 5&6

PPT.05 | Direction: N | Direction: E | Direction: SE | Direction: W

Standing at the spillway for lower Barton Creek on the concrete peninsula.

PPT.06 | Direction: E | Direction: SW

Heavy use and erosion issues at Barkin' Springs on the north side of Barton Creek just down stream from the pool.

Photo Points 7&8

PPT.07 Direction: N Direction: E Direction: S Direction: W

Intersection of the playground, Zilker Zephyr, and the stairs down to Barkin' Springs.

PPT.08 Direction: N Direction: E Direction: S Direction: W

Trail on the north side of Barton Creek near the boat rental.

Photo Points 9&10

PPT.09 Direction: N

Direction: E

Direction: S

Direction: W

Opportunity for green infrastructure in the parking lot.

PPT.10 Direction: NE

Direction: SE

Direction: SW

Direction: NW

There is potential for green infrastructure and woodland expansion in the pecan grove.

Photo Points 11&12




PPT.11 | Direction: N | Direction: NE | Direction: SW | Direction: NW

Hike and Bike Trail on north side of Barton Creek. Degraded riparian woodland above and below trail.




PPT.12 | Direction: NE | Direction: SE | Direction: SW | Direction: NW

Water access near Lou Neff. Major trampling erosion near water.

Photo Points 13&14

PPT.13 Direction: N

Direction: E

Direction: S

Direction: W

Potential opportunity for canopy enhancement on the side of the trail opposite the water where Barton Creek meets

PPT.14 Direction: N

Direction: SE

Direction: S

Direction: W

Erosion issues on the Hike & Bike Trail along Lady Bird Lake.

Photo Points 15&16




PPT.15 Direction: N Direction: E Direction: S Direction: W

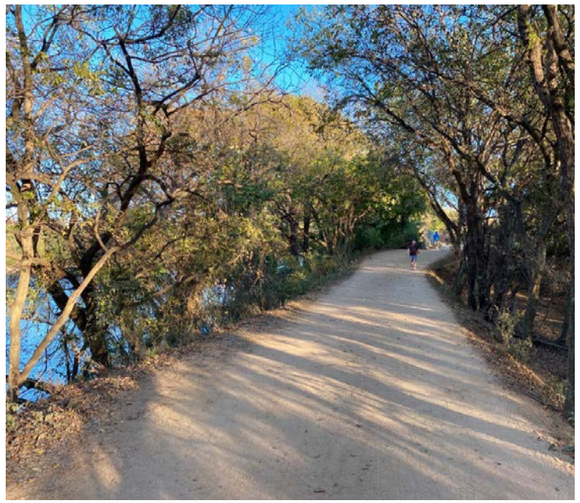
View on the north shore, just off Lou Neff road.




PPT.16 Direction: N Direction: E Direction: S Direction: W

View from the center of the Big Field.

Photo Points 17&18



PPT.17 Direction: N Direction: E Direction: S Direction: W

View from the north shore, across from Austin High.

PPT.18 Direction: NNE Direction: SE Direction: S Direction: W

Small grassy area east of old Butler landfill. Much of area is wet enough to support wetland vegetation.

Photo Points 19&20

PPT.19 Direction: NNE Direction: SE Direction: SW Direction: WNW

Berms and the Hike and Bike Trail on the north side of the old Butler landfill.

PPT.20 Direction: N Direction: E Direction: S Direction: W

At the northern Boundary of the park beneath Mo-Pac.

Photo Points 21&22

PPT.21 | Direction: N | Direction: E | Direction: S | Direction: W

View just off Stratford Dr at the northern section of Zilker Park.

PPT.22 | Direction: NE | Direction: SE | Direction: SW | Direction: NW

On a trail at the northern section of the park, south of the rowing dock.

Photo Points 23&24




PPT.23 | Direction: N | Direction: E | Direction: S | Direction: W

An informal trail along Eanes Creek just west of the road to the Nature and Science Center.




PPT.24 | Direction: N | Direction: E | Direction: S | Direction: W

Parking area and open space on the south side of Rollingwood Drive.

Photo Points 25&26

PPT.25 Direction: SE

Direction: SW

Dry Creek on the western edge of the study area.

PPT.26 Direction: NW

Direction: E

Standing on the low water crossing on Eanes Creek looking upstream and downstream.

Photo Points 27&28

PPT.27 Direction: N Direction: E Direction: S Direction: W

At the intersection where Columbus Dr, Andrew Zilker Rd, and Mo-Pac Service Rd meet.

PPT.28 Direction: N Direction: E Direction: S Direction: W

View from the road to the girl scout cabin.

Photo Points 29&30

PPT.29 Direction: N

Direction: E

Direction: S

Direction: W

View from the Barton Creek Greenbelt trail in the southern section of Zilker Park, north of Barton Creek.

PPT.30 Direction: N

Direction: E

Direction: SE

Direction: SW

View on Barton Creek as it exits Zilker Park.

Photo Points 31&32




PPT.31 Direction: N Direction: E Direction: S Direction: W

Erosion Visible just south of Barton Creek near where it enters Zilker Park.




PPT.32 Direction: N Direction: E Direction: S Direction: W

South of Barton Creek near where Trailside Dr ends at the Zilker Park boundary.

Photo Points 33&34

PPT.33 Direction: N

Direction: E

Direction: SW

Direction: WNW

View on Upper Barton Spring near an apartment complex.

PPT.34 Direction: W

Direction: S

Meadow between Columbus Drive and the Violet Crown Trailhead.

Photo Points 35&36




PPT.35 | Direction: N | Direction: E | Direction: S | Direction: W

Disc Golf course along Andrew Zilker Road.




PPT.36 | Direction: N | Direction: E | Direction: S | Direction: W

Opportunity to increase understory species that are shade tolerant, the need for mulch and reducing human impacts evident through numerous trees showing erosion aroundroots.

Photo Points 37&38

PPT.37 Direction: N

Direction: E

Direction: SW

Direction: WNW

Evident soil compaction near a parking lot just off Andrew Zilker Rd.

PPT.38 Direction: NE

Direction: E

Views of downtown Austin from the historic rock garden.

Photo Points 39

Direction: NE

Direction: SE

Direction: SW

Direction: NW

PPT.39

Large parking area near play area and Barton Springs Pool.