CITY OF HOUSTON

PARKS & RECREATION DEPARTMENT

NATURAL RESOURCES DIVISION

Water MANAGEMENT PLAN

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND U.S. ENVIRONMENTAL PROTECTION AGENCY

GALVESTON BAY ESTUARY PROGRAM

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HPARD HOUSTON PARKS AND RECREATION DEPARTMENT

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Plan Team

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Consultant Team

- Asakura Robinson

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Introduction

From the Bayous to Galveston Bay, water systems are an integral part of life throughout the greater Houston region. Water in the Houston region can be a vibrant asset that fosters a higher quality of life and deeper connection with natural systems. However, challenges posed by increasingly severe and unpredictable weather events, alongside continual population and industry growth, requires prudent management of water resources region-wide to ensure continued prosperity.

In an effort to align with city, county, and regional efforts to manage water use and quality, the Houston Parks and Recreation Department (HPARD) has developed this Water Management Plan (WMP) to standardize internal water use practices, improve water efficiency, and support HPARD efforts to implement nature-based solutions, such as restoring riparian ecological functions to the Bayous and beyond. By leveraging Houston's robust park systems, HPARD aims to establish and demonstrate best management practices (BMPs) that support regional water initiatives while offering new models of water management to inform related efforts throughout the metroplex.

Project Goals

The following goals and objectives provide an overarching framework to guide the development and implementation of this plan:

Goal 1: Reduce Water Use

In collaboration with Houston Public Works (HPW) and other regional partners, HPARD aims to reduce water use system wide and establish standardized, streamlined procedures for irrigation, maintenance, and water feature management. Through standard operating procedures (SOPs) that improve efficiency, monitoring capacity, and intervention efficacy, HPARD can reduce water use systematically while ensuring the same level of amenity provision and environmental restoration activities. The following objectives provide a more in-depth look at how HPARD can integrate reduced water use throughout park operations:

- Tree Irrigation - Streamline SOPs for tree establishment and long-term maintenance irrigation to maximize water efficiency and reduce water use.
- Non-Tree Irrigation - Conserve water by removing unnecessary irrigation, retrofitting existing sites with new technology, developing more robust standard procedures for leak detection and response, and establish consistent restrictions on irrigation where not necessary for vegetation upkeep.
- Drought - Reduce water use during periods of drought through consistent adherence to drought watering protocols, maintaining robust leak detection and response practices, and reducing or fully restricting water use and park maintenance practices that impede water efficiency.
- Water Features - Reduce the quantity of water used by water fountains, splashpads, and pools through more efficient features, water-conscious design, consistent maintenance, and seasonal use restrictions.
- Water Meters - Improve water meter use to develop a more accurate understanding of park water use and leverage monthly water meter reports to identify and prioritize parks in need of intervention due to disproportionate water use levels.

- Horticulture - Leverage vegetation as a tool for conserving water through the use of more drought tolerant native plant selections and more tailored plantings designed to flourish with minimal watering and upkeep.

- Buildings - Maximize water efficiency across HPARD facilities through higher performance fixtures, systems, and building design methods.

- Esplanades - Establish and enforce water efficiency standards for esplanade irrigation and promote the use of new irrigation technologies that enhance water efficiency and support weather-conscious watering.

Goal 2: Improve Water Quality

Water systems in Houston face a range of challenges to improving and maintaining a high degree of water quality throughout the region, including contamination from construction, pesticide and herbicide use, and mismanaged waste. With this plan, HPARD seeks to identify potential contaminants occurring within parks and establish a series of BMPs for minimizing internal use of potential pollutants while implementing strategies for mitigating external contaminants through green infrastructure and other nature-based solutions. The following objectives illustrate how HPARD can integrate improved water quality through reduced contamination potential throughout HPARD's operations:

- Pesticides and Herbicides - Reduce contamination potential from pesticide and herbicide use by prioritizing non-chemical alternatives, employing more rigorous selection criteria, and restricting use around sensitive environmental areas or where not necessary for maintaining quality features.

- Fertilizers - Decrease contamination potential from fertilizers by reducing or restricting use, prioritizing non-chemical alternatives, and providing more comprehensive guidance on selection and application criteria.

- Nature-Based Solutions (NBS) – Prioritize NBS interventions to filter pollutants, reduce erosion, and mitigate flooding to reduce contamination and take advantage of co-benefits.

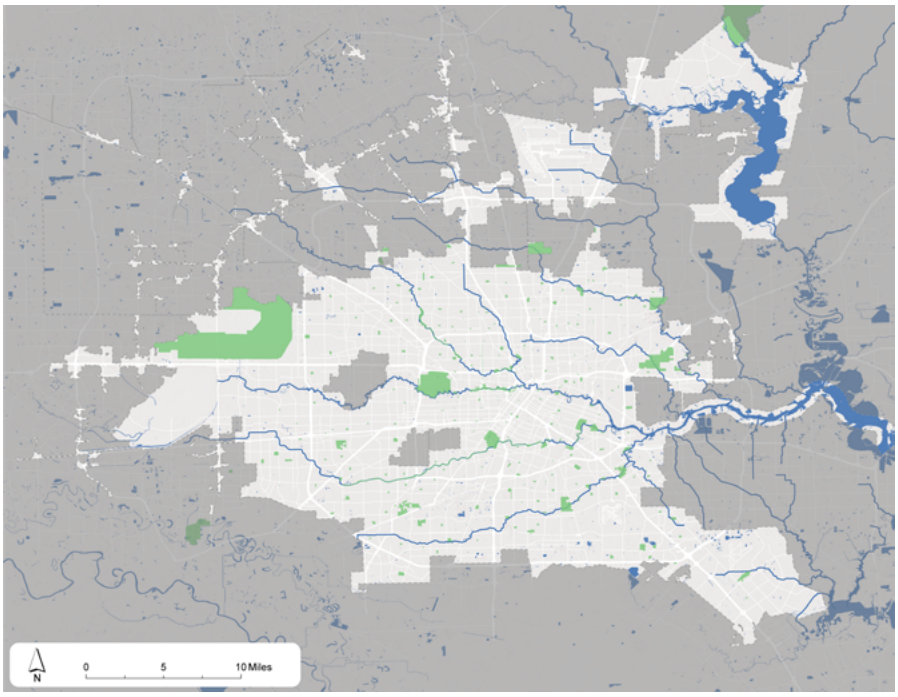


Figure 1: Map highlighting boundaries of the City of Houston and the City's parkland (green).

Understand

Houston's On-going Water Planning Efforts

Throughout the greater Houston area water management is an integral component of resilience and sustainability in the face of increasing uncertainties around water. To maximize the efficacy and impact of HPARD's water management efforts, it is vital to align and further support on-going water planning efforts throughout the region. By taking a holistic approach to water planning, this plan aims to foster greater alignment and collaboration between HPARD, State and Federal agencies, key City departments like Houston Public Works, and other public organizations serving the greater Houston area.

State Planning Alignment

Two key planning documents at the state level provide high-level priorities and guidance for HPARD's water management efforts: the 2022 **State Water Plan** and the 2023 **Texas Coastal Resiliency Master Plan**.

State Water Plan
Developed by the Texas Water Development Board (TWDB), the **2022 State Water Plan** offers a state-wide assessment of water supplies and constraints in consideration of continual population growth and industry expansion throughout the state. The plan calls attention to the disparity between population growth and existing water supply, highlighting the need for greater water conservation efforts statewide to ensure there is adequate water resources to support both current and future populations. Serving the largest urban population in the state, HPARD can support conservation efforts state-wide by stewarding water conservation, reducing usage, and prioritizing best practices for water quality.

Texas Coastal Resiliency Master Plan
The Texas General Land Office's (GLO) 2023 **Texas Coastal Resiliency Master Plan** is a key state-level planning document with implications for HPARD's resiliency and water management efforts. With significant influence on coastal watersheds, Houston is the primary development driver along the Gulf and is a critical partner in the GLO's resiliency building efforts. HPARD's Riparian Restoration Initiative is a key component of resiliency-building in the City and mitigating development impacts on regional waterways. The Initiative was listed as a Tier 1 Priority Project in the plan for its alignment with several key actions, including "Managing Coastal Habitats" and "Managing Watersheds." Continual implementation of HPARD's Riparian Restoration Initiative is vital to support regional resilience and water management.

City and Regional Planning Alignment

This plan is also informed by and aligns with a number of local planning efforts. The plans summarized below are intended to highlight opportunities to foster greater collaboration and coordination on shared priorities.

Houston Public Works (HPW)

One Water Houston

From stormwater and wastewater to potable water, the planning wing of Houston Water is currently developing a One Water approach to integrate the management of resources and enhance the city's water, wastewater, and stormwater utilities. One of the goals of the plan is to promote sustainable water use. HPARD can collaborate with HPW in this effort to identify opportunities to improve reporting of water use data to set targets for reducing water use.

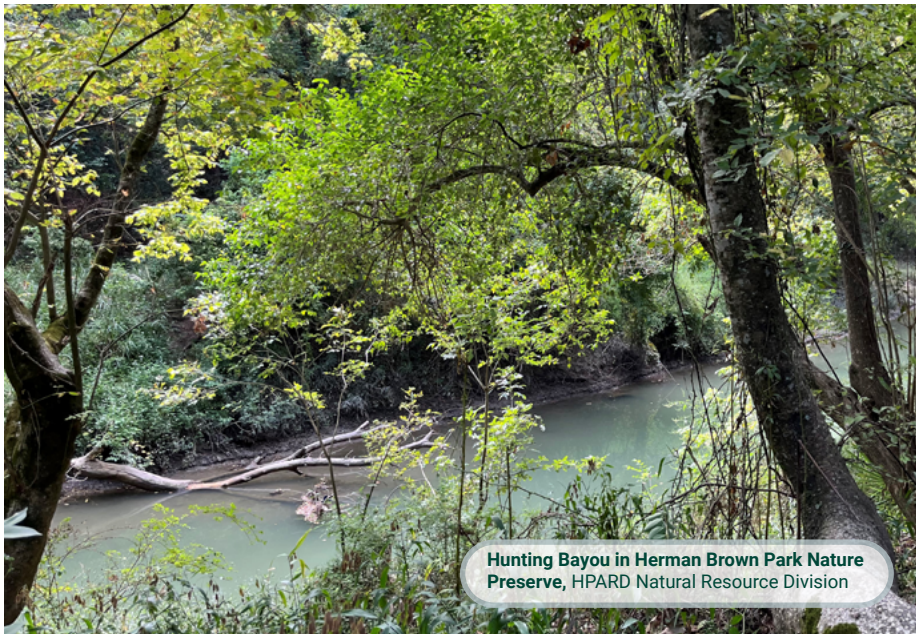
Public Works Water Conservation Plan

With 7,000 miles of water lines, 92 groundwater pumping stations, and 142 wells, the 2019 Water Conservation Plan set forth by HPW aims to deliver water to the region in an efficient and quality-driven manner. The plan is set to be updated next year, as the state requires an update every five years. HPARD's water management goals will be aligned with the updated plan.

Resilience and Sustainability Office

Resilient Houston

One of the key planning efforts for addressing flood resiliency is the Resilient Houston plan. The plan provides a framework for entities across the region to develop efforts to combat natural disasters that range from hurricanes to droughts. The water management practices in the plan making room for water and improving its quality through efforts like riparian restoration, tree canopy expansion, and invasive species removal. Many of HPARD's ongoing programs are aligned with the practices that are outlined in Resilient Houston.



Hunting Bayou in Herman Brown Park Nature Preserve, HPARD Natural Resource Division

Climate Action Plan

Pairing with Resilient Houston, the Climate Action Plan presents methods to reduce the impact of extreme weather events. The Climate Action Plan outlines energy transition practices for increasing carbon storage, which includes how HPARD can increase nature-based solutions efforts like increasing the tree canopy, restoring riparian zones, and dedicating more land to parks.

Living With Water

The Living With Water plan focuses on the Resilient Houston strategy for reducing risk and increasing resiliency across multiple scales. The plan highlights different neighborhoods of Houston and their potential challenges and solutions for flood mitigation and how to use bayous and waterways as community assets. These solutions include expanding parks and restoring habitats along the bayou that are addressed by HPARD's ongoing programs.

Other Local Efforts

Harris County Flood Resiliency Plan

One of the most significant areas of focus for water management in the Houston region is flood resiliency. Harris County Flood Control District is currently developing a County-wide Flood Resiliency Plan. HPARD's Water Management goal to improve water quality through riparian restoration and green infrastructure will provide benefits that extend beyond park boundaries to support community-based resiliency efforts.

Galveston Bay Plan

The Galveston Bay Plan is a Comprehensive Conservation and Management Plan that serves as the guiding document for the Galveston Bay Estuary Program (GBEP). Plan components include various topics relating to the Galveston Bay watershed including water quality, natural resources, research, and public participation and education. With Houston's position in the lower section of the Galveston Bay watershed, the water quality in local bayous has a large impact on the Bay's sensitive estuarine ecosystem. The GBEP has funded multiple habitat restoration and green infrastructure projects undertaken by HPARD, as well as the creation of this Water Management Plan.

Ongoing HPARD Programs

Within the Natural Resources Division, there are a number of programs that are actively supporting and contributing to Houston's water planning efforts. These programs are focused around flood resiliency, water quality, and ecological restoration.

Nature Preserve Ordinance
The recently approved ordinance protects over 7,400 acres of natural habitat across 26 parks in the Houston area. The protection of these habitats includes restoration and preservation practices that will be developed by HPARD's Natural Resources Division.

Riparian Restoration Initiative
HPARD has initiated an effort to restore and revitalize riparian zones along bayous and streams that traverse the city. The initiative calls for removing invasive species and installing a diverse range of native plants across 70 different parks. These efforts are aimed to increase flood resiliency and improve water quality, which are outlined in state and local level plans like the Texas Coastal Resiliency Master Plan and the Resilient Houston plan.

Prairie Restoration Initiative
The Prairie Restoration Initiative attempts to restore and protect the former prairie habitat that used to be a dominant feature of the Houston area. HPARD leads this effort with its largest habitat restoration project at Sylvan Rodriguez Park, where 72 acres of prairie land have been restored. The plants used in HPARD's prairie restoration projects are propagated by Natural Resource Division staff and volunteers at the City's greenhouse.

Tree Canopy Expansion
The city aims to plant 4.6 million new trees by 2030. Increasing the region's tree canopy would not only improve air quality and mitigate urban heat, but also act as a filter during flood events. Throughout the city's park systems, HPARD has planted and maintained a diverse array of native trees. Using native trees, particularly along riparian zones, are key to increase flood resiliency and improve water conservation.

Invasive Species Removal
This is largely relevant to the riparian restoration initiative and prairie restorations, which specifically involves removing invasives. Also supported by nature preserve ordinance, which promotes removal of invasives and establishment of native species within nature preserves.

Clinton Park Prairie Planting (2022), HPARD Natural Resource Division

External Coordination

In addition to municipal partners, external organizations including conservancies play a role in water management of public greenspace. These organizations provide additional leadership and capacity for research, collaboration, stewardship, piloting effective practices and procedures at site-specific areas, like Memorial Park, Buffalo Bayou Park, Hermann Park, and the Houston Arboretum and Nature Center.

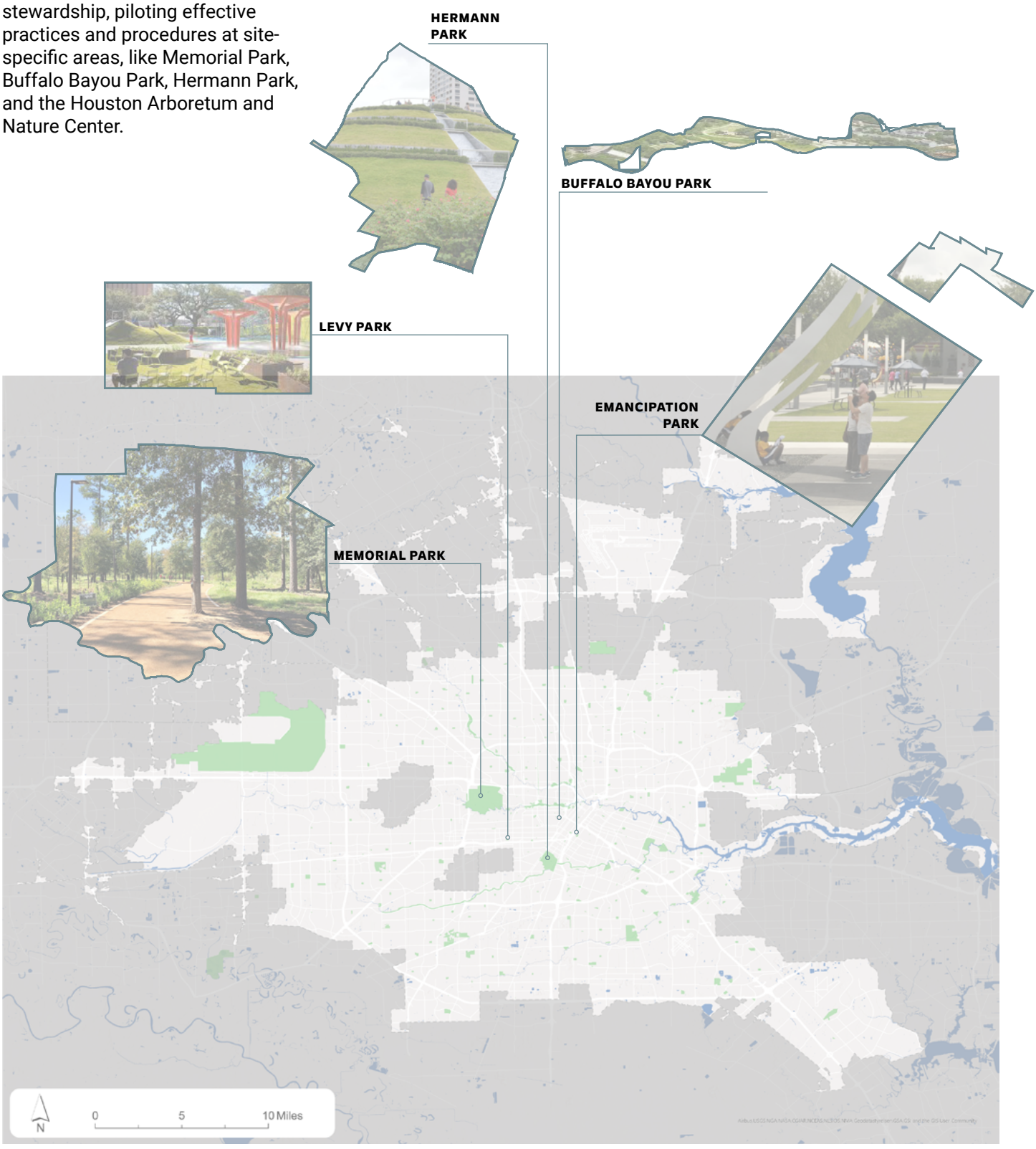


Figure 2: Map highlighting City of Houston Parks with external partners.

Townwood Bioswale

Water Use Baseline

This section aims to develop a baseline for HPARD's water use and assesses data between 2019 and 2023 to understand how much water HPARD uses, what trends exist in the water data, and how trends play out across different types of amenities and park contexts. The goal of the baseline is to identify patterns to calibrate expectations of water use throughout the year, such as identifying seasonal patterns that remain consistent across different park scales. This allows for targeted interventions where water use deviates from the norm, such as a park with unseasonably high winter water use that may be misaligned with actual water needs. Looking at the trends also helps to highlight seasonal periods where water use can be reduced or adjusted to develop new norms for maintenance that better reflect realistic expectations for maintenance while helping to conserve water and reduce wasteful practices.

Understanding HPARD Water Use Inventory

The data used to develop HPARD's water use inventory was provided by Houston Public Works, and is primarily derived from water meter data collected and managed by Houston Public Works staff. The dataset includes water use from 2019 - 2023. See Appendix for a detailed presentation of HPARD water use broken down by individual parks and recreational amenities.

Types of Water Uses

The dataset used in this report provided water use data for parks, pools, splashpads, fountains, golf courses, esplanades, and community centers.

Classifications of Water Uses

For parks, additional classifications were employed to draw out deeper, more accurate understandings of how the scale of these different park types influenced water use levels.

Dataset Caveats

Due to the nature of the data, a few things must be kept in mind when interpreting the data analysis that follows:

- The available data was collected from 2,053 water meters and included 195 parks in addition to a range of other water use types (see Figure 3). As the data set did not cover all parks and recreation amenities in the HPARD system, total water use figures are intended to give an idea of the raw water quantities used by the selected parks and are not to be interpreted as comprehensive totals.
- Water usage analysis used averages to account for gaps in monthly data.
- The data analysis for this report could not account for all discrepancies or errors resulting from malfunctioning water meters or inaccurate read.
- For larger parks, such as Hermann or Memorial Park, there may be quantities of water use that are not captured in the data set due to limitations in verifying that all water meters at a given park are accounted for in the dataset.
- Where possible, data from park amenities such as pools or fountains were kept separate from park data to avoid double counting and most accurately represent different water use types.

WATER USE INVENTORY

Data Source:

Houston Public Works Department

Time Range:

2019 - 2023

Types of Water Use:

- Parks (195)
- Pools (35)
- Splashpads (21)
- Fountains (18)
- Golf Courses (6)
- Esplanades (43)
- Community Centers (52)

Park Classifications:

- Pocket (<1 acre)
- Neighborhood (1-15 acres)
- Community (16-150 acres)
- Regional (>150 acres)

Figure 2: The above figure provides an overview of the water use data inventory used for the data analysis in this report.

Overall Monthly Water Use

Median monthly water consumption figures were used to illustrate trends in overall water use across the available date range (2019 - 2023). By looking at overall water consumption for each use type, a preliminary understanding can be formed about how consumption changes across time and how those patterns vary depending on the use type.

WATER USE INVENTORY

Time Range:
2019-2023

Types of Water Use:
Parks (195)
Pools (35)
Splashpads (21)
Fountains (18)
Golf Courses (6)
Esplanades (43)
Community Centers (52)

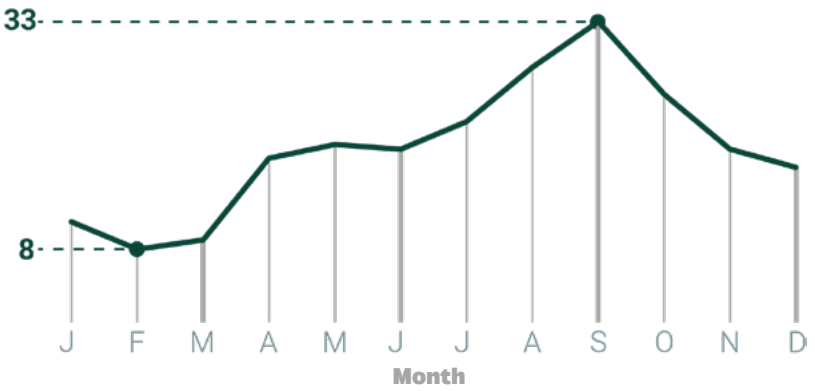
Note: All units are in 1,000's of gallons, where 1 = 1,000 gallons of water used.

Type of Water Use: Parks

# of Water Meters: 195

Park water use is lowest in winter, with February marking the lowest point. Use begins to steadily increase in Spring, leveling off from May through June until use begins to spike again as summer rolls on. Water use increases consistently until reaching its peak in September, then falls off at a similar rate throughout the fall until it reaches the low winter use period. Overall there are fairly clear, steady patterns in spring and winter, with summer and fall being the periods of greatest variation.

Median Monthly Park Water Use

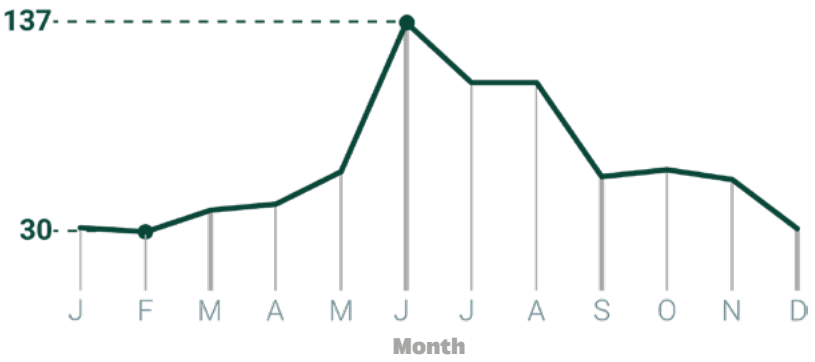


Type of Water Use: Pools

# of Water Meters: 35

Pools also see their lowest water use in the winter months, with the least use in the month of February. Use remains fairly low throughout the spring before rapidly increasing in May and hitting the highest point in June. Use levels dip slightly in July, but remain high through August. A second dip in September sees water use begin to reach its seasonal low, with fall use only showing slightly higher use than winter.

Median Monthly Pool Water Use

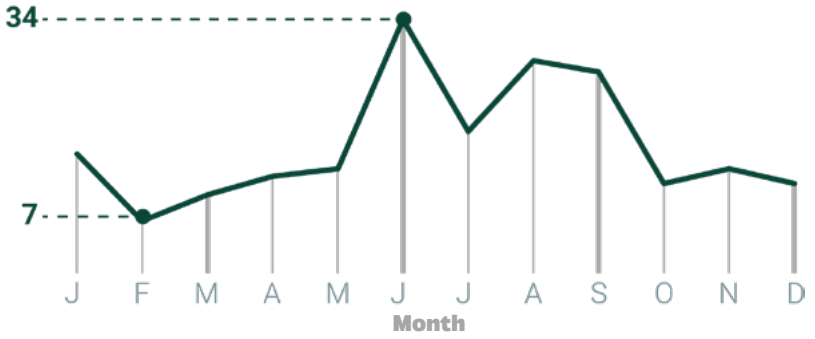


Type of Water Use: Community Centers

# of Water Meters: 52

Community centers use less water in winter and fall than in spring and summer. Water use peaks in June and July, then dips in August and September before falling again in October. Perhaps this pattern suggests a correlation between water use and school year timing.

Median Monthly Community Center Water Use



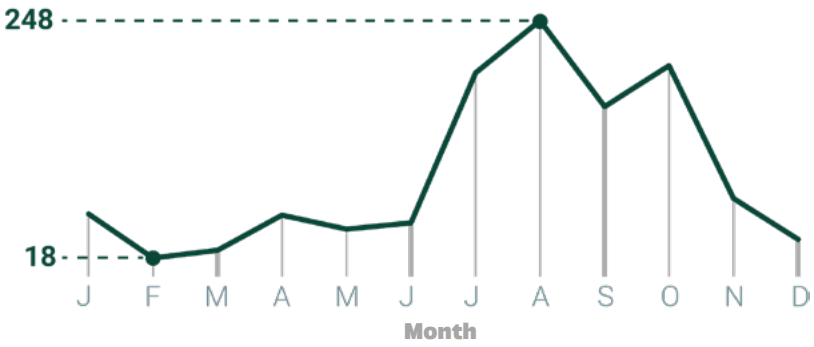
Note: All units are in 1,000's of gallons, where 1 = 1,000 gallons of water used.

Type of Water Use: Splash Pads

# of Water Meters: 21

Splash pad water use is 10x higher in summer than winter. Water use is low in winter and spring, high in summer with a peak in August, and gradually declines again in fall.

Median Monthly Splash Pad Water Use

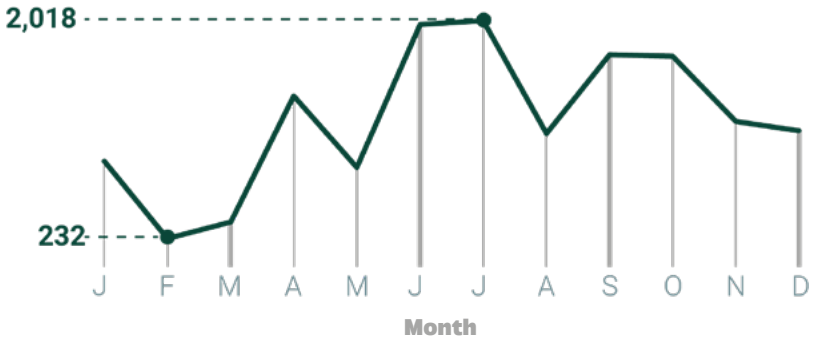


Type of Water Use: Golf Courses

# of Water Meters: 6

Golf course water use is highest in the summer months of June and July, and lowest in the winter months of January and February.

Median Monthly Golf Course Water Use

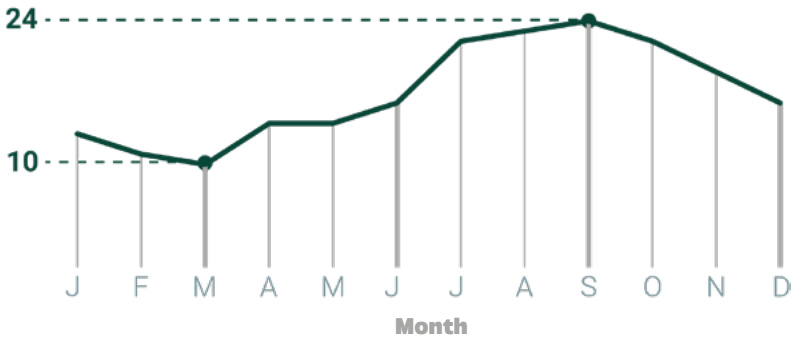


Type of Water Use: Esplanades

# of Water Meters: 43

Esplanade water use has a low of 10,000 gallons of water in March and a high of 24,000 gallons in September. Water use is lowest in winter, peaks in September, and is generally high in summer and fall.

Median Monthly Esplanade Water Use

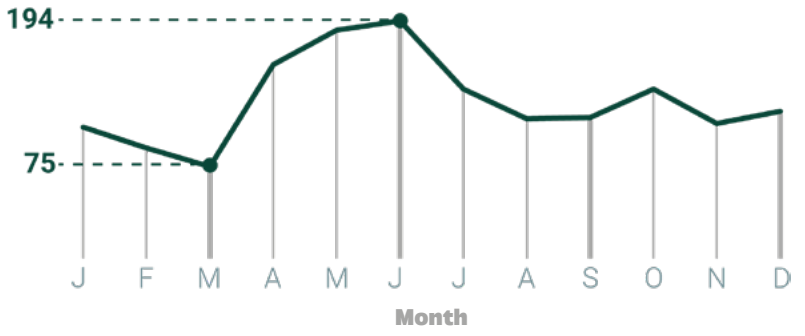


Type of Water Use: Water Fountains

# of Water Meters: 18

Water fountain use is highest in spring and lowest in winter. Use increases throughout spring to peak in June, then decreases steadily throughout summer, with a brief peak in October.

Median Monthly Water Fountain Water Use



Comparing Overall Monthly Water Use

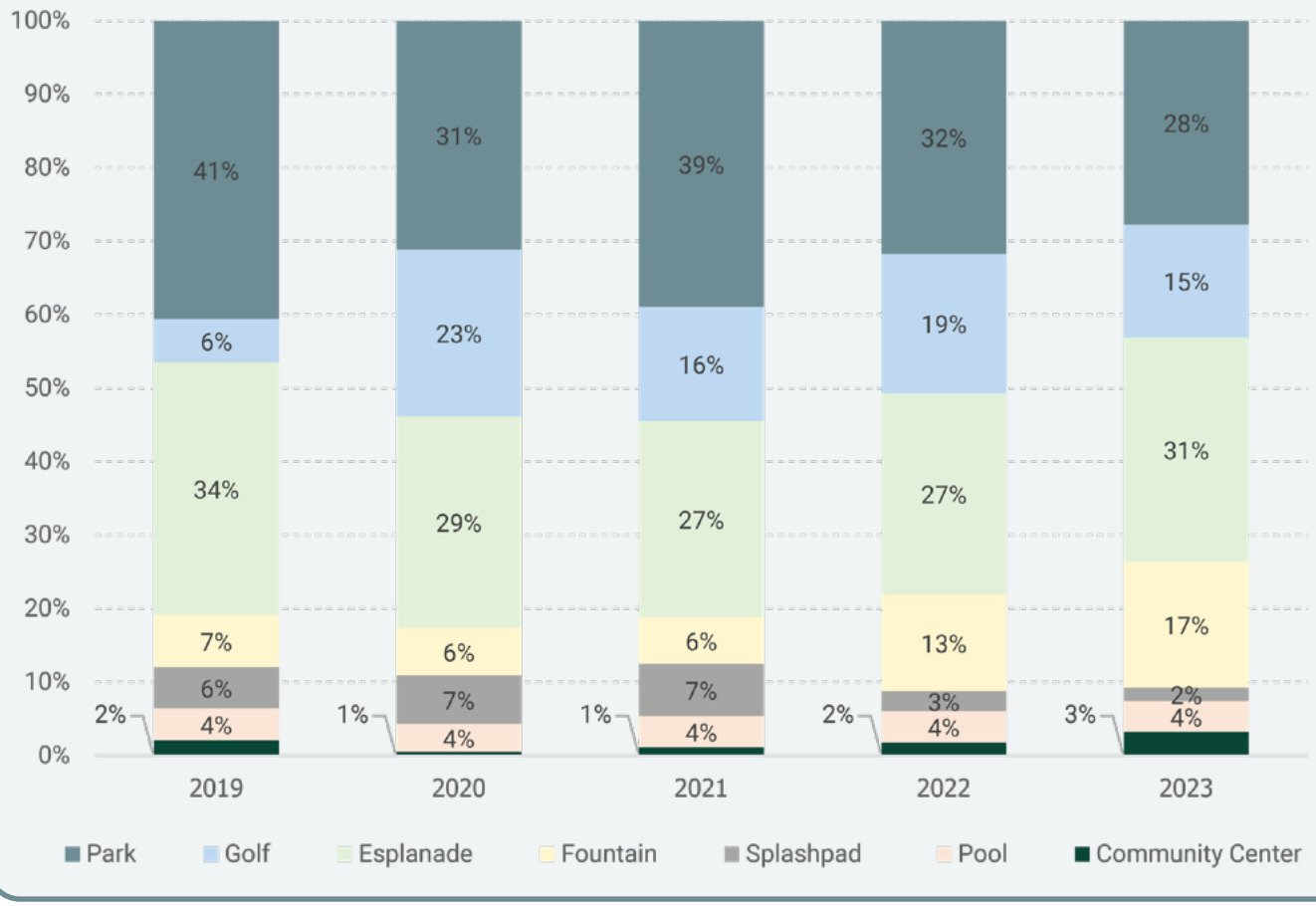
To develop an understanding of how these different types of water uses relate or compare to each other, it's helpful to consider how they stack up together in a given year and how the proportion of water used by each type may vary across the five years of data used in this study. While each use may not directly influence the others, its insightful to identify patterns of change and explore what some implications may be for better water management.

WATER USE INVENTORY

Time Range:
2019-2023

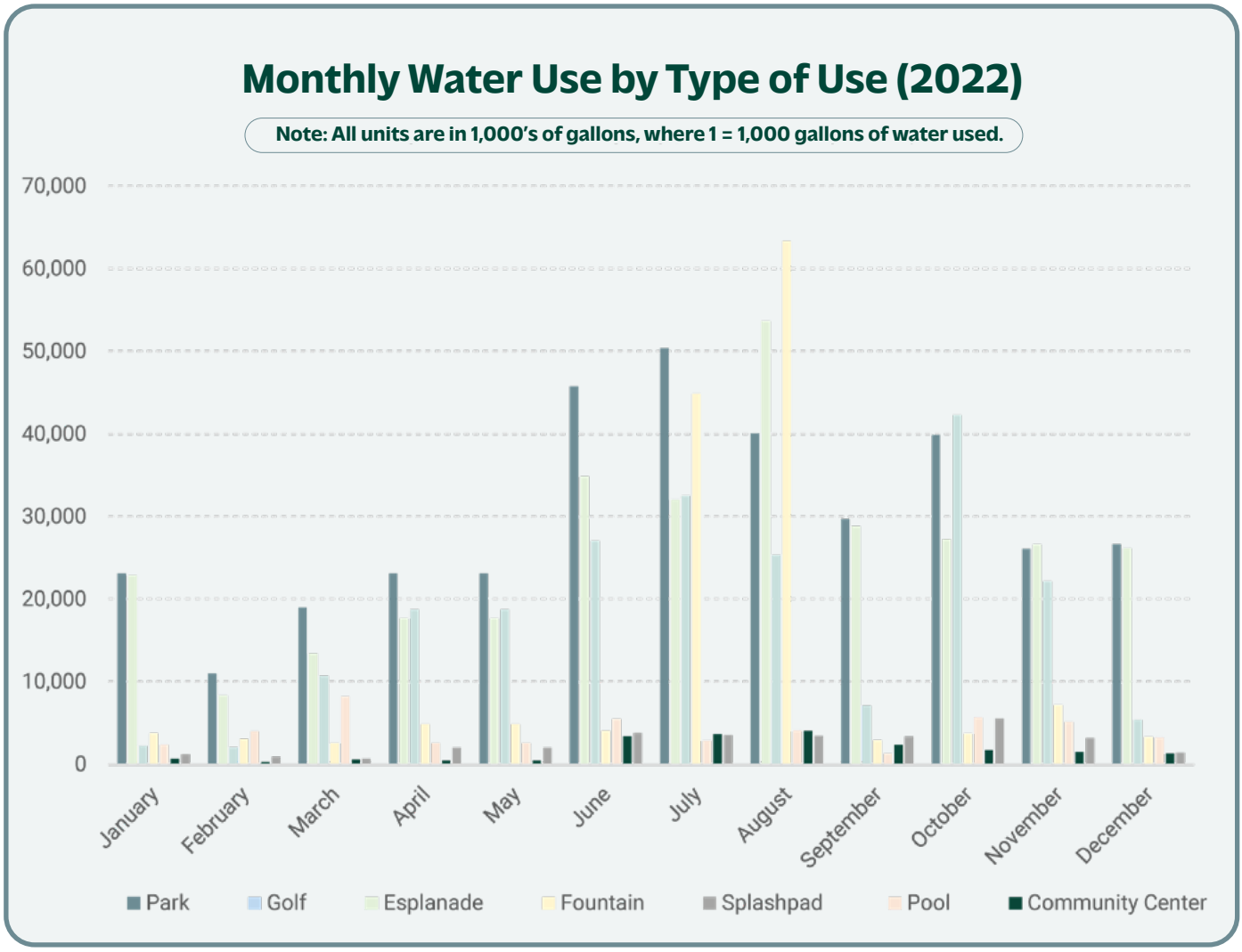
Types of Water Use:
Parks (195)
Pools (35)
Splashpads (21)
Fountains (18)
Golf Courses (6)
Esplanades (43)
Community Centers (52)

Annual Water Use by Use Type (2019-2023)



Comparing the Annual Share of Water Use by Use Type

There are several interesting patterns of change that become evident when all water use types are considered as part of an annual whole. Parks are generally the highest water user, but the pattern is not consistent, with 2019 and 2021 seeing shares of roughly 10% greater than other years. In 2023 park use was actually a lower share than esplanades, which is the second highest type of water use across the board. Fountain water use remained fairly stable in relation to other uses from 2019 to 2021, but begins to use a dramatically higher share, doubling from 2021 to 2022 and increasing again in 2023. Community centers, while the lowest share of use overall, remains consistent from 2020 and 2021 before doubling in 2022 and increasing by the same percentage in 2023. Splashpads also show a pattern of consistent use levels followed by a substantial change, maintaining steady use levels from 2021 - 22 before dropping by more than half in 2022 and continuing to drop off in 2023. Golf has a consistent pattern of alternating between increasing and decreasing its share from year to year, but notably has the most dramatic change from 2019 to 2020, where it increases more than threefold in just one year.



Comparing Monthly Water Use by Use Type

To compare water use between use types in a single year, the most recent complete year of water use data (2022) was used to make a comparison in context of what usage looks like on a monthly basis. From this perspective there are several interesting variations from trends identified in the median water use and annual water use analyses. Late fall (November), winter, and spring water use continues to consistently show the lowest levels of water use across the board, with February being the overall lowest water use month, while summer use being the highest and peaking between July and August. Parks and esplanades are generally the highest users in this time, and together are only passed by fountains in July through August and golf in October. Golf is noteworthy in that it passes esplanades on several months, and shows similar water use levels to both parks and esplanades for roughly half of the year. These higher use levels are important to recognize for both fountains and golf as there are only 18 and 8 of these features respectively, in comparison to 195 parks and 403 esplanades, meaning that a very small number of fountains and golf courses use similar or greater quantities of water than hundreds of parks and esplanades. Community centers, pools, and splashpads remain the lowest water users by far overall, rarely approaching even half the water use of higher use types for the exception of pools in March.

Water Use by Park Classification

The wide variety of park types and sizes creates challenges to interpreting what the expected water use for a given park type may be. To get a better understanding of how park water use varies across different park scales, park data was further divided by park classifications to illustrate what median water use looks like for each type of park and how water use varies across time throughout the year.

WATER USE INVENTORY

Time Range:
2019-2023

Park Classifications:
Pocket (<1 acre)
Neighborhood (1-15 acres)
Community (15-150 acres)
Community (150+ acres)

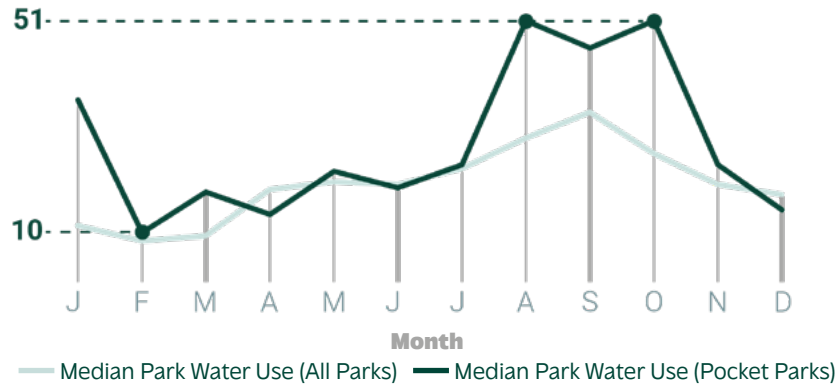
Note: All units are in 1,000's of gallons, where 1 = 1,000 gallons of water used.

Type of Park: Pocket Parks

# of Parks: 19

Despite their small size, the 19 pocket parks in this dataset use more water than neighborhood parks, and are on a similar use level to community parks. Whereas overall parks have a median high of 33,000 gallons in September, pocket parks have a median high of 51,000 gallons in August and October. Water use drops in winter and spring, but spikes in January.

Median Monthly Water Use - Pocket Parks

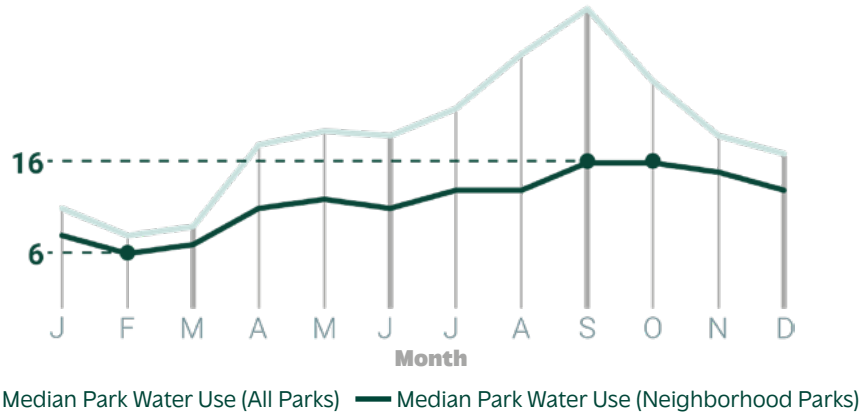


Type of Park: Neighborhood Parks

# of Parks: 125

Neighborhood parks represent the largest dataset with 125 parks. These parks use less water than the average median park use. Neighborhood park water use is lowest in February and highest in September-October. Use declines gradually through winter, with a dip in December-January. Use remains below overall park use throughout the year.

Median Monthly Water Use - Neighborhood Parks

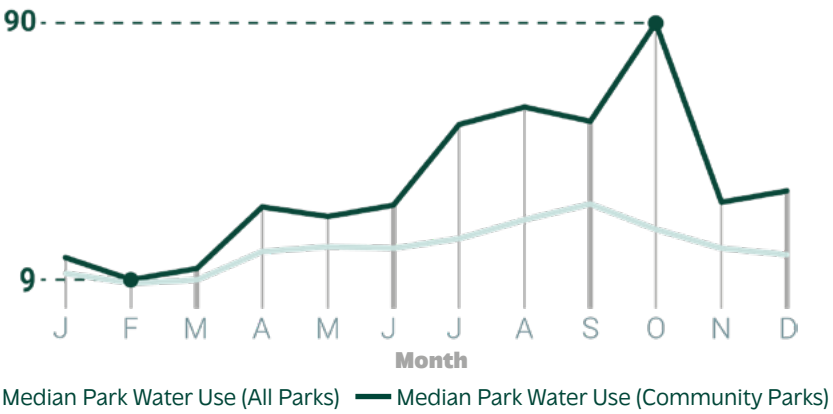


Type of Park: Community Parks

# of Parks: 35

With 33 parks in the dataset ranging between 15-150 acres, Community Parks are larger and contain more amenities than Pocket Parks and Neighborhood Parks. Monthly water usage is typically higher than that of the median park with a peak usage in October of 90,000 gallons. Trends across the 35 community parks indicate that water use is lowest in winter, highest in summer, and consistent in spring and fall.

Median Monthly Water Use - Community Parks



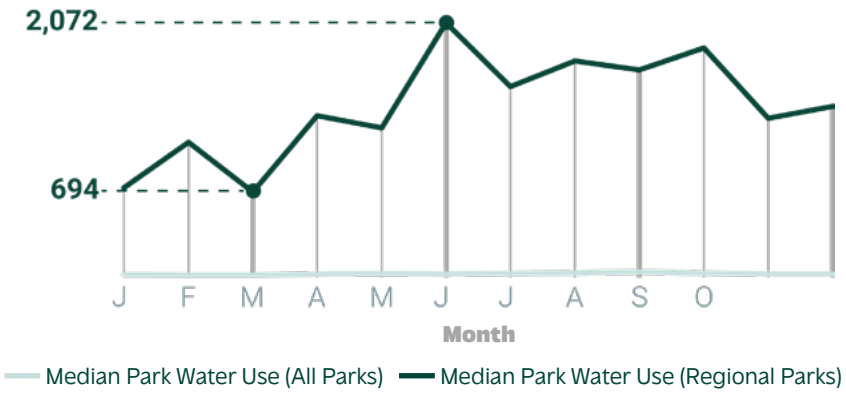
Note: All units are in 1,000's of gallons, where 1 = 1,000 gallons of water used.

Type of Park: Regional Parks

# of Parks: 8

Water usage at regional parks is much higher than other park classifications with a peak use of 2,072,000 gallons in June. Regional park water use varies by season, with the lowest use in winter and the highest use in June. Use levels off in summer and fall, and then decreases in winter.

Median Monthly Water Use - Regional Parks



Highest Annual Use Parks by Category (2022)

Pocket Parks	Water Use (in 1,000 gallons)	
	Annual	Per Acre
Bethel Church Park	6,535	13,904
Live Oak	236	68
Adams Park	91	9,100
Dumble Park	91	393
Milton	64	68

Neighborhood Parks	Water Use (in 1,000 gallons)	
	Annual	Per Acre
Bell Park	23,403	20,350
Levy Park	13,990	2,498
Lansdale Park	10,557	1,257
Charlton Park	6,347	730
Busby Park	5,528	948

Community Parks	Water Use (in 1,000 gallons)	
	Annual	Per Acre
Stuebner-Airline Park	13,296	969
Montie Beach Park	11,762	512
Blueridge Park	8,439	374
Hackberry Park	6,058	292
Gragg Park Complex	5,034	105

Regional Parks	Water Use (in 1,000 gallons)	
	Annual	Per Acre
Hermann Brown Park	49,539	56
Memorial Park	39,264	26
Buffalo Bayou System	28,348	181
Hermann Park	21,699	49
Cullen Park	9,184	2

Figure 3: The above figure shows the top 5 water users in 2022 for each park classification by total water use. The charts also include the amount of water used per acre for the same parks, allowing for a deeper level of comparison between high-use parks.

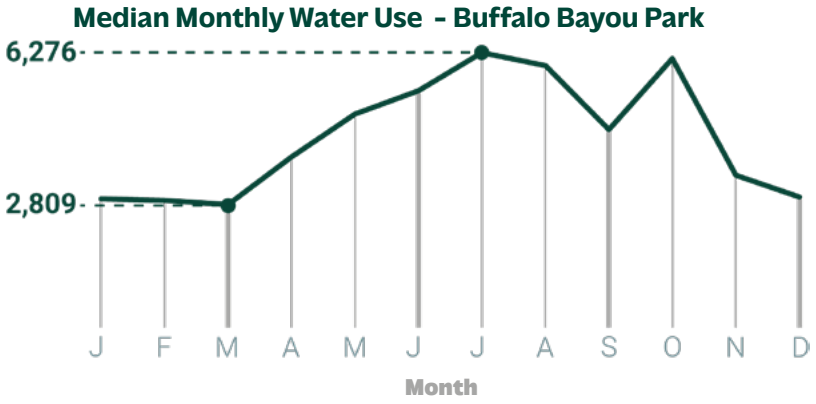
Water Use by Partner Parks (2022)

Parks overseen by partner organizations offer a unique opportunity to take a closer look at individual park water use. Water use data from 2022 was used to offer a clear, up-to-date picture of what water use patterns look like across the year. This offers valuable insight into recent water use trends at some of the largest park systems in the Houston area and provides context for future collaborative discussions between HPARD and partner organizations.

Note: All units are in 1,000's of gallons, where 1 = 1,000 gallons of water used.

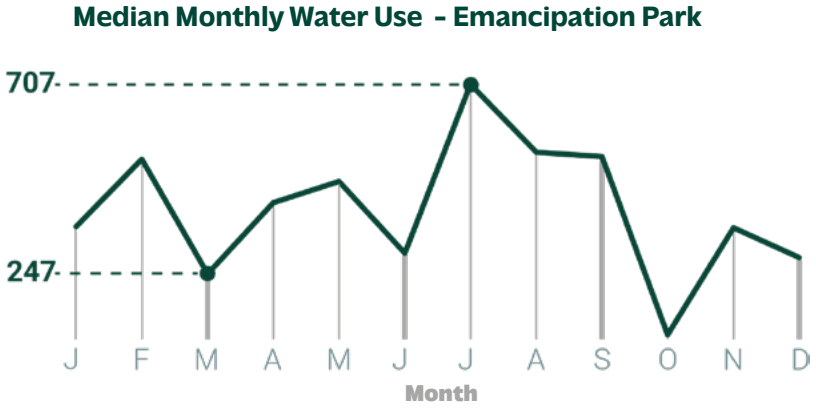
Buffalo Bayou Park System

Encompassing a wide range of parks and recreational amenities, the Buffalo Bayou system displays familiar patterns of water use, with winter seeing the lowest use overall and March being the lowest use month. Water use then steadily increases month-to-month at nearly the same rate until use hits its highest level in June, where use steadily decreases through the fall. The exception is October, which sees a noticeable peak to nearly July levels before continuing to dive into the winter lows.



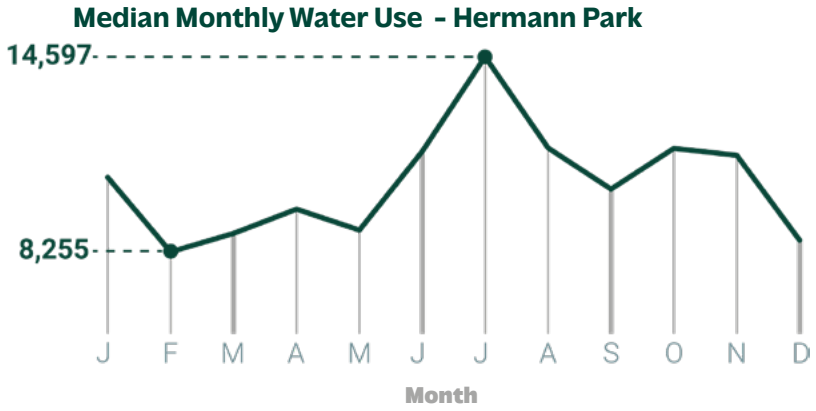
Emancipation Park

Emancipation Park has a more irregular water use pattern than other parks, with even erratic use levels that peak and dip throughout the year. The most consistent low use levels are generally in the Spring, marked at the beginning by the lowest use in March following a February peak. The highest use is in July, which drops somewhat but continues to be high until September, when use begins to drop off. Note the dramatic drop in October is due to there being no data for that month.



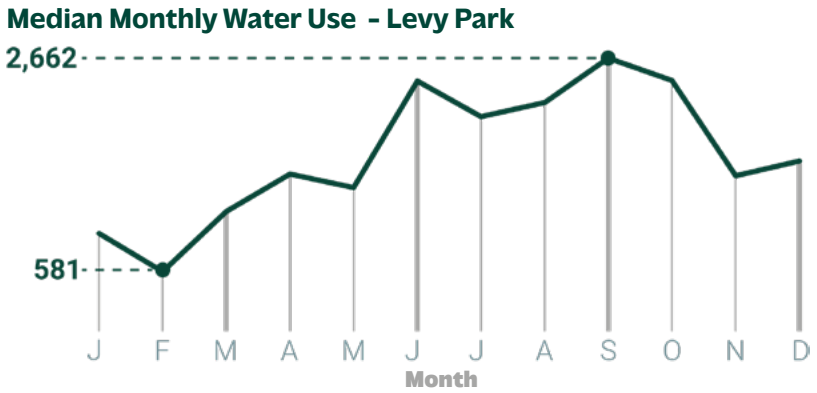
Hermann Park

Hermann Park sees its lowest water use in February, though March through May see consistently similar lows. In July use begins to increase significantly, quickly hitting the annual peak in July before decreasing at nearly the same rate until September, where the fall season sees consistently moderate use in comparison. Use then continues to fall into the winter, with a noticeable jump in January before returning to winter and spring lows.



Levy Park

Levy Park sees a February low as with many other types of water use, but this dip is short lived as use increases throughout the spring and hits its first peak in June. Use then dips slightly through the summer before hitting the highest use level in September. Another drop off then occurs in the fall, with a slight jump in December before resuming a steady decrease to the February low.



Memorial Park

Memorial Park sees dramatically lower use in January and February, with both seeing nearly identical low use but February coming in as the lowest. A steady, fairly rapid increase then begins in March and continues through the spring until beginning to dip in June, a period during which use increases by nearly 20 times the February low. Use then decreases steadily throughout summer, hitting a significant low in September before rapidly increasing to the highest use level in October, where 24 times the water use of February was observed. This high is short lived, however, as use then begins to decline as quickly as it rose through the fall to arrive at the winter lows.

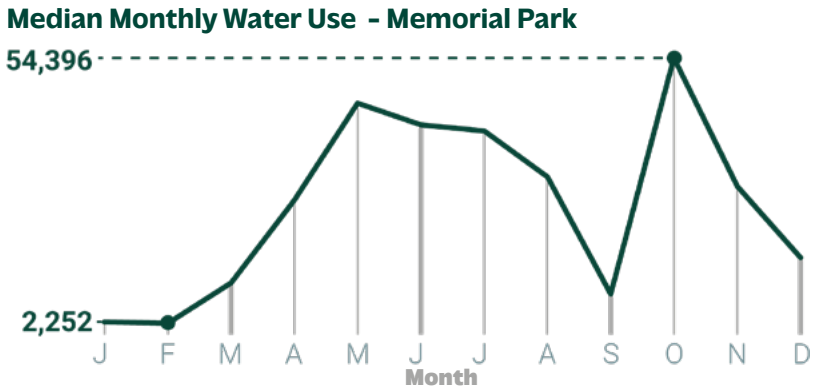


Figure 5: Brock Park Nature Preserve

Water Solutions

Best Management Practices

The core goals of this plan are to reduce water use through water conservation and efficiency measures alongside improved water quality from HPARD activities through prioritizing non-chemical solutions, using more intentional methods for applying herbicides, pesticides, and fertilizers, and prioritizing nature-based solutions. Together these goals build off past and current efforts by the Natural Resource Division alongside other HPARD divisions to improve the performance of HPARD's water systems and resources while maintaining a consistently high level of service and amenity provision throughout the year.

Goal 1: Reduce Water Use

Reduce overall water use through water conservation measures that:

- **streamline tree and non-tree irrigation practices,**
- **standardize watering practices in drought conditions,**
- **improve efficiency of water features and HPARD buildings,**
- **set new standards for esplanade irrigation,**
- **enhance water metering and monitoring, and**
- **leverage vegetation strategies**

Tree Irrigation

OBJECTIVE:

Streamline standard operating procedures for tree establishment and long-term maintenance irrigation to maximize water efficiency and reduce overall water use.

1. Establishment

Establish and enforce consistent standards for tree irrigation for both establishment periods and for long-term maintenance needs.

Water 1-1.5 gallons per caliper inch:	First 1 to 2 weeks	3 weeks to 3 months	3+ months
	Daily	Every 2-3 days	Weekly until established

Water Conservation SOPs:

- **New and established trees are watered at a rate of 1 to 1.5 gallons of water per caliper inch of tree.**
- **Standardize and restrict irrigation for new tree plantings to a 2 year establishment period.**
- **Discontinue any scheduled irrigation and/or manual watering following the 2-year establishment period.**
- **Beyond the 2-year period, supplemental watering, on an as-needed basis, should be performed during periods of low rainfall or drought conditions.**
  - **Baseline supplemental watering for established trees is 1 to 1.5 gallons of water per diameter inch on a weekly basis.**

2. Standard Water Schedule

Ensure consistent water-efficient irrigation practices through enforcement of a standard watering schedule for established trees over 2 years old.

Initial Planting	November - February	March - April	May-October
Slow soak root zone once a week for 4 weeks.	Slow soak root zone once every 3 weeks.	Slow soak root zone once every 2 weeks.	Slow soak root zone once a week.

Water Conservation SOPs:

- **Standard schedule for watering throughout the calendar year is outlined above.**
- **Irrigation will be run once per month for 5 minutes for systems that are not regularly operated to make sure that the lines are functioning properly.**

Non-Tree Irrigation

OBJECTIVE:

Conserve water by removing unnecessary irrigation, retrofitting existing sites with new technology, developing more robust standard procedures for leak detection and response, and establishing consistent restrictions on irrigation where not necessary for vegetation upkeep.

1. Retrofits

Pursue a retrofit strategy that aims to remove or reduce unnecessary irrigation while incorporating new technology and hardware that will improve water efficiency.

Water Conservation SOPs:

- Prioritize adding all new sites that have electricity to WeatherTrak.
- Identify all existing irrigation installed for trees and/or native vegetation features that have already been established and create plan for removal.

2. Leak Detection

Develop a standard procedure for detecting and responding to leaks that accounts for both technology-supported systems and manual on-site detection.

Water Conservation SOPs:

- Establish standard general processes for leak detection for both WeatherTrak and non-WeatherTrak supported irrigation systems.
- Sites with WeatherTrak will send an alert when higher than normal usage has occurred, at which point a crew will visit the site to troubleshoot the system.
- Sites without WeatherTrak are tested periodically, and park superintendents monitor and report problems within their parks.

3. Restrictions

Restrict non-tree irrigation on all HPARD vegetation features other than specified exceptions to reduce water use across the HPARD system.

Water Conservation SOPs:

- Non-establishment irrigation is broadly restricted across HPARD parks & facilities with the following exceptions:
  - Annual/ornamental flower beds
  - Permitted sports fields,
  - And a small number of turf grass areas. Turf grass areas include specific park sites that have heavy foot traffic use (Hermann Park, City Hall, Sam Houston Park).

4. System Guidelines

Embed reduced water use patterns and an emphasis on water efficiency into irrigation system design and operations.

Water Conservation SOPs:

- For turf irrigation, ensure sprinklers are spaced appropriately for head-to-head coverage to minimize overlap.
- Restrict watering using irrigation systems to between the hours of 11pm and 6am.
- Irrigation systems are turned off between Nov. 1 and Feb 28, except for seasonal color and rye grass.

Drought

OBJECTIVE:

Reduce water use during periods of drought through consistent adherence to drought watering protocols, maintaining robust leak detection and response practices, and reducing or fully restricting water use and park maintenance practices that impede water efficiency.

1. Drought Watering Stages

Establish consistent, practical drought protocols for reduced or restricted water use in accordance with HPARD's drought watering stages and Public Works' Drought Contingency Plan.

Water Conservation SOPs:

- Ensure water use during drought conditions is in accordance with the following drought stage guidelines:

Drought Stage 1:	Drought Stage 2:	Drought Stage 3:	Drought Stage 4:
• Check for and repair all leaks. • Change irrigation schedules to comply with Houston Public Works Drought Contingency Plan. • Reduce mowing frequency not to exceed a 21-day cycle.	• Achieve a 10% reduction in overall water use. • Change irrigation schedules to comply with Houston Public Works Drought Contingency Plan. • Stop regular mowing throughout parks and esplanades.	• Achieve a 20% reduction in overall water use. • Wildfire mitigation activities: ◦ Shaded fuel breaks. ◦ Wildfire pamphlets. ◦ Ban on campfires. ◦ Wildfire signs about prevention in natural areas.	• Achieve a 35% reduction in overall water use.

2. Tree Support

Increase watering as needed on trees planted within the previous six year period to prevent tree loss and support establishment through drought period.

Schlumberger Office
Asakura Robinson

Splash Pad
HPARD Natural Resource Division

Water Features

OBJECTIVE:

Reduce the quantity of water used by water fountains, splashpads, and pools through more efficient features, water-conscious design, consistent maintenance, and seasonal use restrictions.

1. Design

Incorporate water efficiency into the design of future water features and ensure current features are effectively fitted with water efficient equipment.

Water Conservation SOPs:

- All new fountain installation will be required to include water efficient features.
- All new fountains will have reduced water surface area to minimize evaporation.
- All new splashpads must be designed to ensure splashing does not extend past play area to minimize water loss, runoff, and contamination potential for adjacent vegetation.
- Ensure all pool renovations include installation of recirculation equipment.
- Ensure overflow drains are properly channeled to flow into the recirculation system to avoid water loss and ensure safe operations.

2. Restrictions

Limit the operational period of water features based on seasonal patterns of lower use to reduce overall annual water use.

Water Conservation SOPs:

- Limit splashpad operations to a seasonal period extending from March 15 through November 30.

3. Monitoring & Maintenance

Employ consistent monitoring & maintenance practices to ensure water features operate efficiently and are in optimal condition consistently.

Water Conservation SOPs:

- Ensure drains are functioning appropriately and no standing water is collecting anywhere in the splashpad.
- Perform regular cleanings and maintenance checks on every splash pad at a minimum of once per month to detect leaks or other malfunctions.
- Schedule routine off-season pool maintenance during winter months for leak checks and water loss testing.

Water Meters

OBJECTIVE:

Improve water meter use to develop more accurate understandings of park water use and leverage monthly water meter reports to identify and prioritize parks in need of intervention due to disproportionate water use levels.

1. Water Meters

Incorporate water efficiency into the design of future water features and ensure current features are effectively fitted with water efficient equipment.

Water Conservation SOPs:

- **Future features that utilize more than 20% of a total parks water use will have a separate meter.**
- **Current features with more that 20% water use will be moved to their own water meter if feasible.**

2. Water Use Monitoring

Review water meter reports on a monthly basis to track and evaluate water use across HPARD's system to identify parks with disproportionate water use patterns.

Water Conservation SOPs:

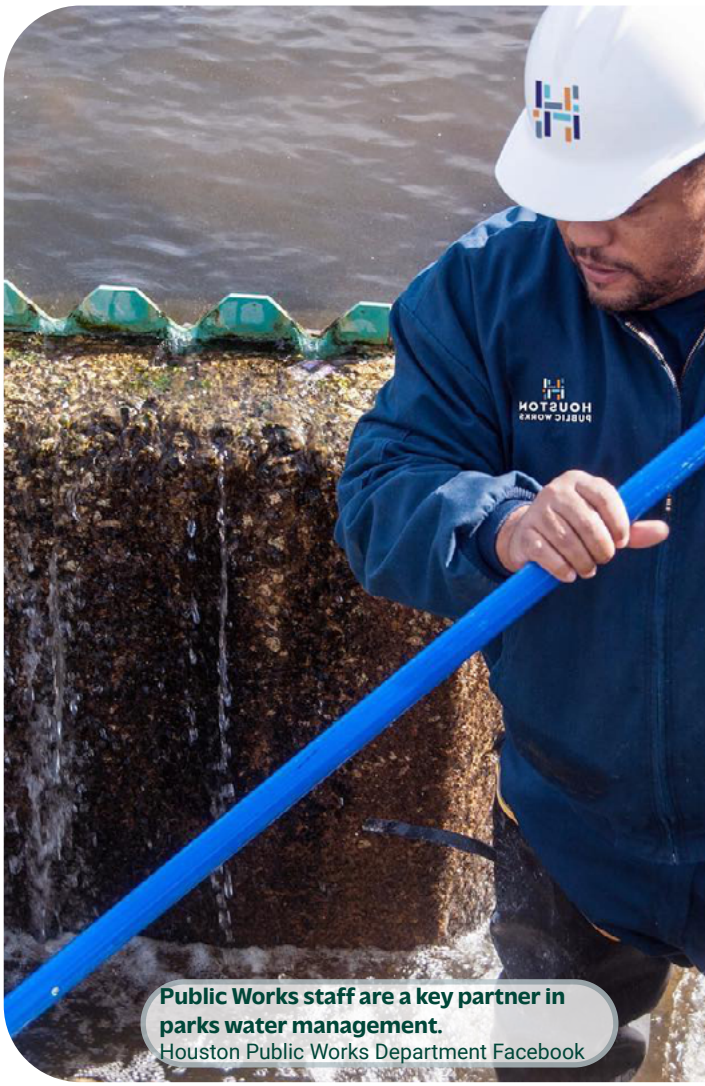
- **Leverage NRD capacity to monitoring monthly water meter reports from Houston Public works on a monthly basis.**

3. Interventions

Develop HPARD internal processes for addressing water use issues identified through water meter reporting.

Water Conservation SOPs:

- **Analyze high water using sites using water meter reports to determine and address the source of over-use.**



Public Works staff are a key partner in parks water management.
Houston Public Works Department Facebook

Native Plants at City Hall Annex
HPARD Natural Resource Division

Horticulture

OBJECTIVE:

Leverage vegetation as a tool for conserving water through the use of more drought tolerant native plant selections and more tailored plantings designed to flourish with minimal watering and upkeep.

Vegetation Strategies

Employ vegetation strategies that help reduce water use and improve water efficiency through site appropriate plant selections, native perennials, and drought-hardy plant species.

Water Conservation SOPs:

- **Use a "right plant, right place" approach to vegetation selection, ensuring varieties are well matched to soil, light/shade, and watering conditions of the planting site.**
- **Incorporate more perennials into annual plant beds to reduce the watering needs associated with change out.**
- **Incorporate more drought-hearty plant species wherever possible to minimize water needs.**

Emancipation Park Recreation Center
Emancipation Park Conservancy

Buildings

OBJECTIVE:

Maximize water efficiency across HPARD facilities through higher performance fixtures, systems, and building design methods that enhance building water performance.

Building Performance

Utilize more efficient water-related technology through new design and retrofits alongside higher overall building performance standards for new construction.

Water Conservation SOPs:

- **All new buildings and upgrades on buildings will be fitted with water efficient fixtures.**
- **All new city buildings over 10,000 square feet must be silver-level LEED certified (required by the Green Building Resolution).**

Esplanades

OBJECTIVE:

Establish and enforce water efficiency standards for esplanade irrigation and promote the use of new irrigation technologies that enhance water efficiency and support weather-conscious watering.

1. Watering Standards

Establish more rigorous standards for esplanade watering in accordance with the HPARD watering standards for tree establishment and long-term maintenance.

Water Conservation SOPs:

- **Require esplanade adopters to follow the same standards for trees as utilized by HPARD and detailed in the Park Tree Watering section above.**
- **Limit tree establishment watering to the two-year watering standard employed by HPARD with options to water as needed in drought conditions.**
- **Monitor esplanade water usage through monthly reports to identify over-use or potential irrigation malfunctions.**
- **Include HPARD water use standards for tree establishment and long-term maintenance in esplanade adoption agreements.**

2. Irrigation Standards

Strengthen irrigation requirements for esplanade adopters to maximize water efficiency through monitoring and automation technology alongside improved irrigation hardware.

Water Conservation SOPs:

- **Require all esplanade adopters to install rain sensors and controllers on irrigation systems.**
- **Encourage esplanade adopters to purchase Weather Track System for improved irrigation system efficiency.**
- **Require esplanade irrigation systems to include backflow preventers to prevent water contamination.**
- **Require drip irrigation in lieu of pop-up spray heads for all vegetative features excluding trees.**

3. Irrigation Maintenance

Establish standards for long-term irrigation use that minimizes unnecessary water use while allowing flexibility for future maintenance needs.

Water Conservation SOPs:

- **For adopters that want to utilize irrigation in the future, allow for the use of irrigation after the 2-year establishment period once per month for five minutes to prevent the system from breaking.**

Esplanade Tree Planting
HPARD Natural Resource Division

Goal 2: Improve Water Quality

HPARD seeks to identify potential contaminants occurring within parks and establish a series of BMPs for minimizing internal use of potential pollutants while implementing strategies for mitigating external contaminants through green infrastructure and other nature-based solutions. HPARD will work to improve water quality by:

- **reducing contamination potential from pesticide and herbicide use,**
- **reducing contamination from potential fertilizers, and**
- **prioritizing nature-based solutions including green stormwater infrastructure.**

Pesticides & Herbicides

OBJECTIVE:

Reduce contamination potential from pesticide and herbicide use by prioritizing non-chemical alternatives, employing more rigorous selection criteria, and restricting use around sensitive environmental areas or where not necessary for maintaining quality features.

1. Applicator Guidelines

Set more thorough guidelines for applicators to ensure the highest efficacy interventions when chemical use is necessary.

Water Conservation SOPs:

- Each pesticide applicator must complete the HPARD pesticide application training annually and sign an affidavit to work under an employee with a Pesticide Applicator License from the Texas Department of Agriculture (TDA).
- Applicators are required to follow all regulations necessary to comply with the TDA.
- Conservancies may utilize pesticides if they follow TDA requirements and have a licensed applicator applying the chemical or oversee the chemical application through a Direct Supervision Affidavit. A copy of the Applicator License and TDA Pesticide Applicator Record must be submitted to HPARD staff.

2. Selection

Ensure that all chemical interventions are only used when necessary and that strict controls are applied to employ the most context-tailored solution available.

Water Conservation SOPs:

In selecting pesticides or herbicides, applicators must ensure that:

- Chemicals interventions are only used when determined to be necessary after eliminating the possibility of alternative interventions.
- The correct product is used to effectively and efficiently address the target weed or pest, determined by reading the instructions of each option carefully to ensure they are effective for the use case being considered.
- The product is applied following product label, using the minimum effective rate.

3. Use Guidelines

Develop guidelines for pesticide and herbicide use that prioritizes non-chemical interventions and requires more limited, targeted use around habitat or restoration areas.

Water Conservation SOPs:

- **Utilize alternative methods, such as prescribed fire, mowing, and/or weedeating, to control invasive species and avoid chemical use.**
- **Prioritize spot-spraying individual target plants in habitat restoration areas to avoid unwanted disruptions to natural life cycles.**

4. Use Restriction

Define and enforce clear restrictions on pesticide and herbicide use where not necessary or where there is higher risk to contaminating water systems or restoration areas.

Water Conservation SOPs:

- **Restrict or strictly limit pesticide use within a 25-foot buffer of storm drains.**
- **Limit herbicide application along trails to twice per year, by utilizing non-chemical control methods such as hand-pulling or weedeating for additional maintenance as needed.**
- **Strictly prohibit esplanade adopters from utilizing pesticides.**
- **Provide guidance on alternative weed management strategies for esplanade adopters.**

Prescribed Fire
HPARD Natural Resource Division

Fertilizer

OBJECTIVE:

Decrease contamination potential from fertilizers by reducing or restricting use, prioritizing non-chemical alternatives, and providing more comprehensive use guidance on selection and application criteria.

1. Selection

Support more efficient use of fertilizer through prioritizing alternatives and using a needs-based selection criteria that emphasizes targeting specific nutrient needs.

Water Conservation SOPs:

- Ensure fertilizers are only providing the specific nutrients found to be deficient by soil testing.
- Prioritize the use of organic soil improvements and inorganic amendments to improve soil quality and support soil biological cycles rather than use fertilizer.

Native Plant Garden and Cistern, City Greenhouse
HPARD Natural Resource Division

2. Use Restrictions

Establish and enforce restrictions on fertilizer use around water or stormwater features, on native plantings, and during inclement weather that could result in fertilizer runoff.

Water Conservation SOPs:

- Strictly prohibit fertilizer application within 4 days of rainfall events to prevent runoff into nearby waterbodies.
- Fertilizer is not applied on sloped areas.
- Restrict or strictly limit granular fertilizer use within a 5 foot buffer of paved surfaces.
- Restrict or strictly limit granular fertilizer use within a 25 foot buffer of storm drains.
- Establish 50-foot fertilizer-free buffer zones along edges of water bodies, using hand-applied chemicals when necessary that are specified for water-proximate use based on composition and minimal impact.
- Avoid use of fertilizers on native plantings. Texas natives often developed to thrive in nutrient-deficient conditions, making fertilizers unnecessary and potentially detrimental to plant health.

3. Use Guidelines

Develop standards for fertilizer use that minimizes quantities applied and provides guidance on appropriate application methods and timing.

Water Conservation SOPs:

- When using granular fertilizer, ensure at least ¼" of irrigation is received after fertilizer application to distribute granules and minimize potential future runoff.
- Unless widespread application is necessary, consider using lower fertilizer quantities with more frequent applications when fertilizing to establish new vegetation to avoid runoff contamination.

Water Features

OBJECTIVE:

Prioritize nature-based solutions (NBS) to reduce contamination and take advantage of co-benefits.

Reduce Flow and Filter Water

Install and maintain NBS through GSI measures that 1) reduce flow of stormwater over impermeable surfaces to mitigate flooding impacts and reduce the conveyance of pollutants in waterways and groundwater, and 2) filter pollutants conveyed by stormwater into waterways and groundwater.

Rain gardens

- Integrate rain gardens into new and existing park landscapes.
- Integrate native/naturalized plantings best practices into rain garden planting plans.
- Develop educational materials and signage to support environmental initiatives.
- Reach out to local organizations to sponsor the development and maintenance of rain gardens, including faith organizations and churches, school groups, and neighborhood groups.

Green roofs

- Look for opportunities to incorporate green roof design into new structures on HPARD-owned or operated sites.
- Assess the feasibility of retrofitting existing structures to incorporate green roofs.

Permeable pavers

- Look for opportunities to replace concrete footpaths and impermeable parking lots (dirt or concrete/ asphalt) with permeable pavers.

Rainwater harvesting (RWH) systems

- Install RWH systems in areas with persistent drainage issues to prevent runoff.
- Develop maintenance protocols for periodic removal of debris from RWH systems.
- Re-use collected water for on-site irrigation, to meet water needs for sites eligible for the Urban Gardening Program, and provide water source redundancy for fire protection.
- Develop educational materials and signage to support environmental initiatives.

Biofilter strips:

- Install biofilter strips in areas with significant localized flooding to filter out pollutants and more efficiently convey stormwater.

Bioswales and swales

- Prioritize bioswales for park boundaries that are adjacent to major roadways and critical waterways, such as the Bayou parks, to mitigate roadway runoff that would otherwise reach waterways.

Planting Bioswale, Almeda
HPARD Natural Resource Division

Ecosystem Management

OBJECTIVE:

Restore and maintain ecosystems that reduce flooding and remove contaminants from stormwater runoff.

Water Conservation SOPs:

Native Plantings

- Prioritize drought-hardy native varieties (including grasses) wherever possible to minimize water needs, maximize planting resilience, and support localized biodiversity.
- Continue to implement targeted seed collection efforts from plants displaying high-performance qualities to further HPARD's propagation of more resilient native plants.

Riparian habitat restoration

- For critical water features, particularly the bayous, install riparian buffers to maximize both ecological restoration and stormwater runoff mitigation.
- As a general practice, establish a 100-foot buffer of native forest around linear water features for bank stabilization, slowing/filtering of runoff, and ecosystem services.

Land preservation, including wetlands (keep the permeable surfaces)

- Continue to seek additional land to protect under the Nature Preserve Ordinance.

Prairie restoration

- Build upon ongoing coastal prairie restoration – currently totaling over 150 acres of land – by prioritizing prairie restoration in parks that historically contained prairie habitat.
- Provide education to the public about ecosystem establishment, maintenance, and optimal conditions for prairies vs. turf or other traditional city park features

Stuart Park Prairie
HPARD Natural Resource Division

Nature-Based Solutions

Nature-based solutions (NBS) are a critical element of fostering higher water quality and reducing water use throughout the HPARD system and the broader region. By incorporating NBS into Houston parks, HPARD is able to provide education on these practices in public settings, reduce water use by providing alternative green amenities that use less water, and improve water quality by slowing, filtering, and absorbing stormwater runoff. NBS will be a key element for HPARD's objectives to become more water efficient and to support regional water quality improvement efforts while maintaining a high quality sense of natural place.

There are currently three (3) categories of NBS being implemented in the HPARD system. The following is a brief review of what these solutions are and how they contribute to improving water quality and/or reducing water use.

Native Plantings

Native plantings utilize naturalized, non-invasive species which are indigenous to the region, and therefore adapted to the area's unique climatic, environmental, and ecological conditions. When water passes through the vegetation many sediments and pollutants are trapped and filtered out before they reach groundwater or waterways. Native planting areas act as storage for stormwater, preventing a certain amount from flowing across impervious surfaces and entering a waterway. They include trees, flower beds, and pollinator gardens.

Natural Ecosystems

COASTAL PRAIRIE

Coastal prairies are a valuable ecosystem characterized by tall grasses and wildflowers, and serve as habitat for many species of birds, insects, and other pollinators. Due to their deep roots, coastal prairies can absorb enormous amounts of rain and filter pollutants from stormwater runoff. Though formerly ubiquitous across the majority of the greater Houston area, coastal prairie habitat has been declining.

RIPARIAN FORESTED BUFFER

One of the most important NBS to support broader regional goals of improving the health of Houston's water systems, riparian buffers are contiguous stretches of native plantings that run parallel to streams, rivers, and Bayous, providing a buffer between the water and upland areas. These buffers help to slow and filter stormwater runoff as it approaches the water, reducing water quality impacts and creating more stable riparian landscapes. Riparian buffers are historically a natural feature of undisturbed riparian ecosystems, but development patterns throughout the City have rapidly deteriorated their presence, leading to current efforts by HPARD to actively restore and regenerate riparian buffers throughout the parks system that reduce erosion and sediment runoff.

Green Stormwater Infrastructure

Green Stormwater Infrastructure (GSI) stormwater management solutions are grounded in a nature-based approach to reducing flooding and filtering contaminants but incorporate engineered solutions or connect an NBS to traditional gray infrastructure.

BIOSWALES

Bioswales are key GSI feature for stormwater management and may vary in scale, but are generally shallow, recessed channels of native vegetation with gradually sloped sides that can slow, collect, filter, absorb, and convey stormwater runoff. They are highly flexible and able to be designed for a wide variety of scales and contexts ranging from streetscapes to green spaces.

STORMWATER WETLAND BASINS

Stormwater wetland basins are large scale artificial wetlands designed to capture and filter pollutants from stormwater. They differ from natural wetlands in that they are usually aimed specifically at treating pollutants from runoff, but can also provide many similar ecosystem benefits to the natural variety.

PERMEABLE PAVERS

Permeable pavers are alternative materials that can be used in place of traditionally impermeable options to allow for greater permeability of rainwater without sacrificing surface performance. By increasing the permeability of hardscape areas, these pavers can aid in absorbing stormwater runoff, reducing standing water and mitigating flood impacts.

RAINWATER CISTERNS AND RAIN BARRELS

Rainwater cisterns are large-scale containers intended to hold significant quantities of rainwater for future use. They may be either above or below grade, depending on context, and are usually connected to a gutter or conveyance system that collects and deposits rainwater into the cistern. Often they are used in relation to building runoff, though they can also be used to retain surface-level stormwater. They can provide a highly valuable resource for irrigation and other non-potable water needs, reducing the need to use potable water for park purposes. Rain barrels serve a similar function but on a smaller scale.

The following pages include case studies of successful NBS programs and projects.

Case Studies

Native Plantings

Native Planting + City Greenhouse
HPARD Natural Resource Division

Native plants, including trees, grasses, and wildflowers, are crucial for improving water quality. As the water passes through the vegetation, many of the sediments and pollutants are trapped and "filtered" before it reaches the adjacent waterway. HPARD's Natural Resources staff run one of the largest native plant propagation programs in the Houston region. Seeds collected from local remnant prairies are germinated in **HPARD's greenhouse**, potted with a bi-weekly group of Master Naturalist volunteers, and grow until they reach a 1-gallon size. Over 10,000 plants are propagated each year, all of which are used in City parks. Most plants are prairie grasses and wildflowers for use in HPARD prairie restoration projects. Other uses include pollinator gardens and native landscaping projects installed by Friends Groups, community garden programs, and other local organizations.

Riparian Habitat Restoration

Riparian Buffer, Reveille Park
HPARD Natural Resource Division

Habitat restoration projects taking place within city parks improve water quality of the bayous by treating non-point source runoff and mitigate flooding by expanding the capacity of soil to hold water and slowing down the force of the water during storm events. In 2020 HPARD initiated the **Houston Parks Riparian Restoration Initiative** to create forested riparian buffers in all parks adjacent to a bayou or other waterway. This initiative will restore 1,000 acres of riparian habitat throughout 70 parks across the city, with the installation of over 200,000 native trees. So far, riparian forests have been restored in 26 parks with five additional parks scheduled to be added in the next year.

Nature Preserve Ordinance

The Nature Preserve Ordinance, passed by Houston's City Council in November 2022, is the first land protection effort of its kind undertaken in the Houston area. The Ordinance designates 7,423 acres of land within 26 City of Houston Parks for preservation and protection in perpetuity. The purpose of the land preservation is to provide a habitat for native wildlife, ecosystem services, and co-benefits in the form of carbon storage, reduced urban heat island effects, improved air quality, improved water quality and quantity, and educational opportunities for the public. The preserves cannot be developed in any way that would damage the natural ecosystems and scenic value of the land.

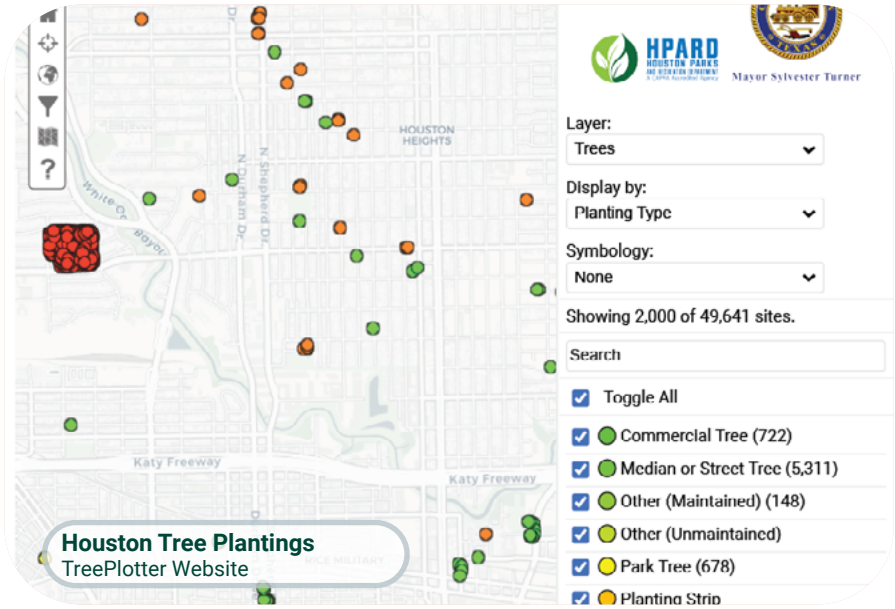
The preserves were selected by the HPARD Natural Resources Division because they contain significant natural resources including threatened ecosystem types, important water resources, and locally rare plant and wildlife populations. These preserves represent some of the last remaining areas of natural habitat within the highly urbanized City of Houston and are critical components of the city's environmental health and biodiversity.

Lake Houston Wilderness Park Nature Preserve
HPARD Natural Resource Division

Urban Tree Canopy: Resilient Houston Tree Planting

Urban tree canopy plays a crucial role in managing stormwater runoff and improving water quality. Urban trees mitigate heat and air pollution, provide habitat for native wildlife, and provide shade for pedestrians and bicyclists.

After decades of tree canopy loss across many of Houston's neighborhoods, in 2020 the City established an ambitious goal to plant 4.6 million new native trees by 2030 (Resilient Houston, Resilience Target 6). So far there have been nearly 1.5 million new native trees planted and the city is on track to reach their goal! The location of new trees is tracked in real-time on the Houston Treeplotter Inventory website.



Houston Tree Plantings
TreePlotter Website

Milby Park planting
HPARD Natural Resource Division

Townwood Park Swale

As part of their efforts to mitigate flooding, improve water quality, reduce air temperature, and provide wildlife habitat, HPARD recently completed the installation of the **Townwood Park Swale**. The Townwood Park swale, adjacent to Sims Bayou, replaced a concrete swale in the southern parking lot with a linear vegetated swale and bioswale to help filter pollutants from runoff within the park and parking lot. The 210 ft. vegetated swale and 26.5 ft. bioswale contain the media, geotextile, stone layers, and underdrain that replaced the existing concrete swale. All of the plants are native to Houston, and most of the plants installed in the swale were grown in the HPARD greenhouse by seed and hand collected from prairies around Houston. This GSI feature meets the Resilient Houston goal of creating 100 GSI features by 2030.

Townwood Bioswale Project
HPARD Natural Resource Division

Partner Shoutout

Stormwater Wetland Basins

Our partners at the **Houston Arboretum** and the **Houston Botanic Garden** have installed innovative stormwater solutions to reduce flooding and purify water while enhancing natural spaces.

Houston Arboretum
Isabelle Asakura

Resources

State Water Planning Efforts

2022 State Water Plan

https://www.twdb.texas.gov/waterplanning/swp/2022/

Texas Coastal Resiliency Master Plan

https://www.glo.texas.gov/coast/coastal-management/coastal-resiliency

City and Regional Planning

Resilience & Sustainability Office

http://greenhoustontx.gov/

Resilient Houston Plan

http://www.greenhoustontx.gov/Resilient-Houston-20200518-double-page.pdf

Climate Action Plan

http://www.greenhoustontx.gov/climateactionplan

Living With Water

https://www.houstontx.gov/mayor/Living-With-Water-Final-Report.pdf

Houston Water Planning

https://www.houstonpublicworks.org/houston-water-planning

Houston One Water Plan

https://onewaterhouston.org/

Houston Public Works Water Conservation Plan

https://www.houstonpublicworks.org/sites/g/files/nwywnm456/files/doc/2019_water_conservation_plan_with_ordinance_in_appendix_01132020.pdf

Galveston Bay Plan

https://gbep.texas.gov/galveston-bay-plan/

Harris County Flood Control District Flood Resilience Plan

https://www.hcfcd.org/Activity/Projects/Countywide-or-Multi-Watershed/Countywide-Capital-Projects/Harris-County-Flood-Resilience-Plan