

**Dr. Ned and Fay Dudley Clear Creek Nature Center
Management Plan
League City, Texas**

April 2016



<u>Table of Contents</u>	<u>Pages</u>
A. Executive Summary	3
Abstract	3
Acknowledgements	3
B. Introduction	5
Project Background	5
Property Description	6
Habitat Descriptions	8
Coastal Riparian Forest	12
Coastal Prairie	14
Estuarine Mixed Wetlands	17
Estuarine Wetlands	17
Unclassified Habitat	19
Recreation and Visitor Amenities	20
Birding and Nature Viewing	20
Fishing	21
Archeology	21
Purpose and Objective of the Management Plan	22
C. Natural Resource Management Plan	24
Introduction	24
Coastal Flatwoods Management	24
Invasive Species	25
Forest Restoration	26
Coastal Prairie Management	27
Prairie Restoration	27
Monarch Butterfly Waystations	28
Specific Considerations for Herbicide Management	29
Estuarine Wetland Management	30
Eastern Embayment Management	30
Aquatic Invasive Species Control	31
Shoreline Protection and Management of Clear Creek	32
Western Embayment Management	33

D. Public Access Plan	34
Introduction	34
Short Term Public Access Management	34
Trail and Boardwalk Maintenance and Improvements	36
Bird Blind Maintenance	37
Addition of Bird Viewing Platform	38
Long Term Public Access Management and Maintenance	39
Manage Public Access and Signage	39
Addition of Non-Motorized Boating Access Launch Site	40
E. Public Education Plan	42
Educational Programming Highlighting Environmental Features	42
Continue Cooperative Efforts with Community Groups	43
Implement WaterSmart Best Management Practices	44
Ethnobotany	44
Signage	45
Community Engagement	46
F. Exhibits	47
Nature Center Aerial Photo - 2012	47
Nature Center Historical Photo - 1943	48
Nature Center Historical Photo - 1988	49
G. Resources	50
Other References	50
Native Trees and Shrubs	50

A. Executive Summary

Abstract

This document provides general guidance to the City of League City (“COLC”) staff, assigned contractors, and volunteers for the management and maintenance of the Dr. Ned and Fay Dudney Clear Creek Nature Center (“Nature Center”). This 148-acre tract of land along the south shoreline of Clear Creek is situated in Northeast League City in Galveston County, adjacent to Clear Lake. The property was acquired for preservation and protection of valuable coastal riparian wetland habitats in the Clear Creek watershed which include: coastal flatwoods, coastal prairie, scrub/shrub wetlands, and freshwater and estuarine wetland habitats along Clear Creek and Robinson Bayou. Guidance is outlined in this plan to direct future management of natural resources, develop low impact nature based recreational and educational opportunities for the public, and provide maintenance of the Nature Center’s infrastructure.

Acknowledgements

The City of League City would like to thank all of those individuals and organizations who participated in the Management Plan process for the Nature Center. Their involvement helped create this Dr. Ned and Fay Dudney Clear Creek Nature Center Management Plan. Advisory Group members (with their affiliations at the time of participation) include:

League City Mayor and City Council

League City Parks Board

Judy Anderson, Galveston Bay Chapter Texas Master Naturalist and TERN Volunteer

Heather Biggs, Coastal Ecologist, Texas Parks and Wildlife Department

Rusty Bolen, Park Operations Superintendent, City of League City

Jan Culbertson, Coastal Ecologist, Texas Parks and Wildlife Department

Jeff Dalla Rosa, Ecological Programs Manager, Center Point Energy

Anna Deichmann, Land Stewardship Coordinator, Galveston Bay Foundation

Vaness Hamilton, City of League City Parks Board Member and Galveston Bay Chapter Texas Master Naturalist

Mark Kramer, Stewardship Director, Armand Bayou Nature Center

Vic Madamba, Galveston Bay Chapter Texas Master Naturalist and Local Monarch Expert

Julie Massey, County Extension Agent - Coastal & Marine Resources, Texas AgriLife Extension Service

Mike Mize, Board Member, Clear Creek Environmental Foundation

John Orsag, Parks Coordinator, City of League City

Matt Singer, Land Stewardship Manager, Galveston Bay Foundation

Bob Stokes, President, Galveston Bay Foundation

Chien Wei, Director of Parks & Cultural Services, City of League City

Woody Woodrow, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service



B. Introduction

The Management Plan for the Dr. Ned and Fay Dudney Clear Creek Nature Center (“Nature Center”) was prepared by the City of League City Parks Department in collaboration with an advisory group comprised of federal and state government natural resource experts, local conservation groups, various recreation groups, and interested private citizens. This management plan will complete one of the objectives of the original Grant Agreement between the City of League City and the Texas Parks and Wildlife Department (TPWD). The 148-acre Nature Center was created as the result of a land acquisition in 2005 with the goal of protecting in perpetuity a diversity of habitats including riparian coastal flatwoods and estuarine wetland habitats adjacent to Clear Creek. Funding for the project was provided through grants from U. S. Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department’s Regional Grant Program. Additional funding was provided by the City of League City, Galveston County, and the Galveston Bay Estuary Program. Great appreciation is due to all of these agencies for their role in making this land acquisition and the resulting Nature Center possible.

During the Nature Center’s land acquisition process, a similarly structured stakeholder group provided direction for initial development of public access infrastructure and habitat restoration efforts, as well as strategies and concepts for long term management and maintenance of the property. Their initial guidance formed the basis for this current management plan. The plan’s goals for management of the diversity of habitat types and maintenance of the Nature Center property is to be implemented through the City of League City’s Park Operations Department in cooperation with local natural resource experts and experienced volunteers. The mission of the City of League City’s Park Operations Department is to utilize all available resources to provide clean, safe and attractive parks and facilities for the community to enjoy.

Project Background

At the time the Dr. Ned and Fay Dudney Clear Creek Nature Center property was acquired, the City of League City, Texas Parks and Wildlife, the Galveston Bay Estuary Program, and various agencies, citizens groups, and private individuals identified several sites along the Clear Creek shoreline and pursued funding to purchase these lands for conservation. The main objectives of this effort were to protect the existing shoreline habitat, and install trails and canoe launches for public access to the waterway for low-impact recreation and educational

opportunities. The regional strategy was to create a protected corridor along Clear Creek to preserve wildlife habitat, protect water quality from further degradation, facilitate environmentally sound economic development through eco-tourism, and maintain a high quality of life in the region.

A continuation of this regional strategy was pursued by the cities of Nassau Bay and League City. The promotion and conservation of natural resources through land acquisition and environmentally sensitive planning and development is also included in League City's Parks & Open Space Master Plan. In pursuit of this objective, Myrtle Park, just west of Interstate 45, is 51 acres of riparian forest and palustrine wetlands acquired shortly after the Nature Center property. Nassau Bay acquired and opened the Peninsula Park, a nature preserve with a linear trail, lying immediately across the waterway from the Nature Center. These projects are designed to build momentum for conservation efforts in the Clear Creek watershed and provide a model for similar endeavors in other watersheds of the Galveston Bay complex.

The League City Parks & Open Space Master Plan identifies Clear Creek as League City's greatest natural resource asset. This plan further spotlights the Nature Center specifically as part of a series of pedestrian linkages across the city connecting planned and existing parks, schools, and natural areas. This Master Plan recognizes the need for a greenway along the Clear Creek corridor, the need to preserve natural areas including wetlands for wildlife habitat and floodwater retention, and recommends the creation of linear parks through the corridor to provide pedestrian linkages. This plan also includes development of a Paddling Trail along Clear Creek with a proposed boat launch site within the Nature Center.

The League City Nature Center Management Plan will provide League City Park Managers and their partners with specific goals, objectives, and tasks such that the habitats in the park can be managed in a sustainable way with minimal impact to the City and maximum benefit to its citizens. This Management Plan will also provide low impact recreational related opportunities that would enhance visitor experience and preserve the cultural and natural resource values associated with the site's purpose.

Property Description

The Dr. Ned and Fay Dudney Clear Creek Nature Center is a valuable coastal riparian habitat along the south shoreline of Clear Creek which form ecologically diverse and productive natural communities. The Nature Center displays a canopy

of riparian forest, remnants of coastal prairie, and the unique hydrology and geology of the Clear Creek floodplain. The presence of riparian forest, coastal prairie, and both freshwater and estuarine wetland habitats attracts a diverse array of wildlife species to the Nature Center. These distinct but complimentary habitats create an ideal opportunity to showcase the ecological diversity of the region at a single iconic destination.

The 148-acre Nature Center is divided into two large tracts by FM 270 (also known as Egret Bay Boulevard), and a smaller parcel adjacent to Robinson Bayou, accessible from Davis Road (see Figure 1 below). Galveston County owns just over 20 acres of right-of-way through the property and maintains a public boat ramp, established by the Texas Parks and Wildlife Department, on the south side of the FM 270 Bridge. Thus the Nature Center provides a valuable greenway along the Clear Creek corridor linking the city with planned and existing parks, and fulfills the need to preserve natural areas including wetlands for fish and wildlife habitat and floodwater retention.

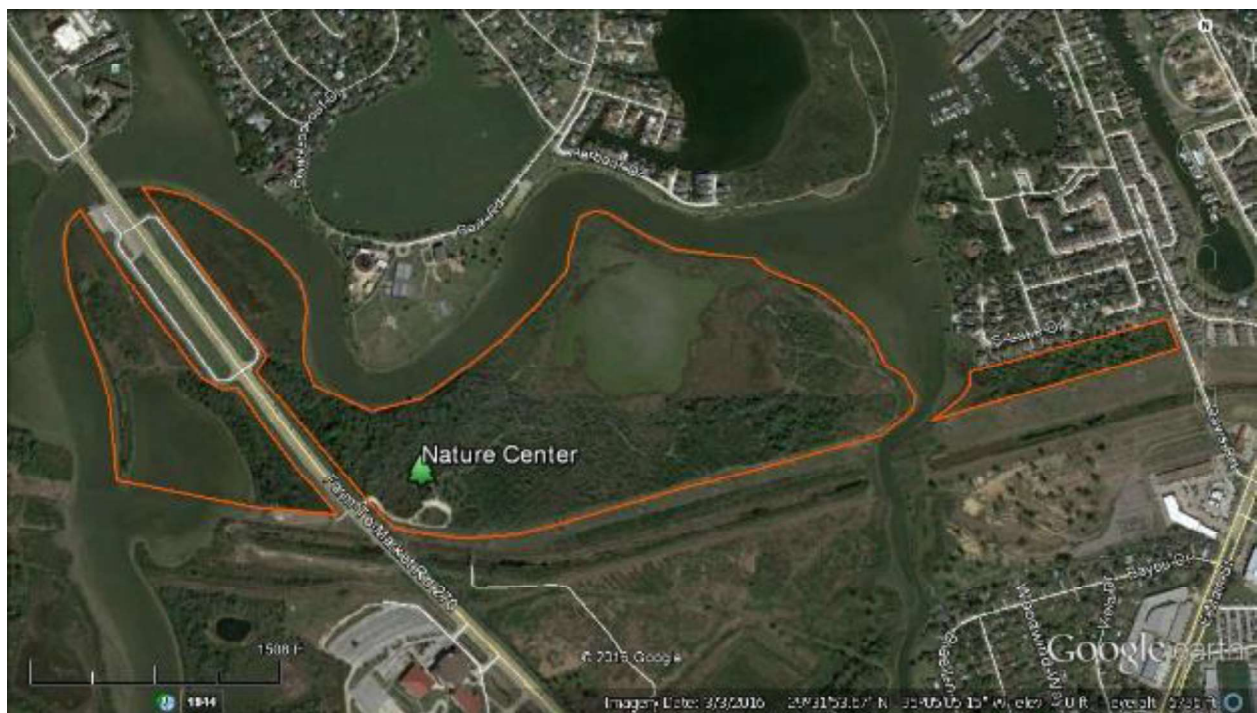


Figure 1. The Nature Center is located on the south shoreline of Clear Creek and divided into two large tracts by FM 270 (also known as Egret Bay Boulevard). A smaller tract of land is also located adjacent to Robinson Bayou and accessible from Davis Road.

Habitat Descriptions

Clear Creek is one of six major watersheds in the Galveston Bay estuarine complex. Aerial imagery of the Nature Center property in 1943 shows coastal riparian forest, coastal prairie, and estuarine wetlands along Clear Creek (see Figure 2 below).



Figure 2. The Nature Center property in a 1943 aerial imagery shows many characteristic habitats of the Clear Creek watershed including: coastal riparian flatwoods (dark green), coastal prairie (yellow) and estuarine wetlands (light green).

Characteristic habitats of the Clear Creek watershed found within the Nature Center according to the National Coastal Wetland Conservation Grant Program Application (C-21-L) included: 36 acres of coastal riparian forests, 44 acres of coastal prairie, 38 acres of scrub shrub habitat, 31.6 acres of estuarine wetland habitats, and 19 acres unclassified habitat (see Figure 3 on the next page). Specific features within the estuarine wetlands included a 20.1-acre shallow subtidal embayment on the east side of the property, and an 11.5-acre deep water embayment on the west side of FM 270. Several freshwater wetland features were also found within the coastal riparian forest and coastal prairie habitats on the property (see Figure 4 on page 10).

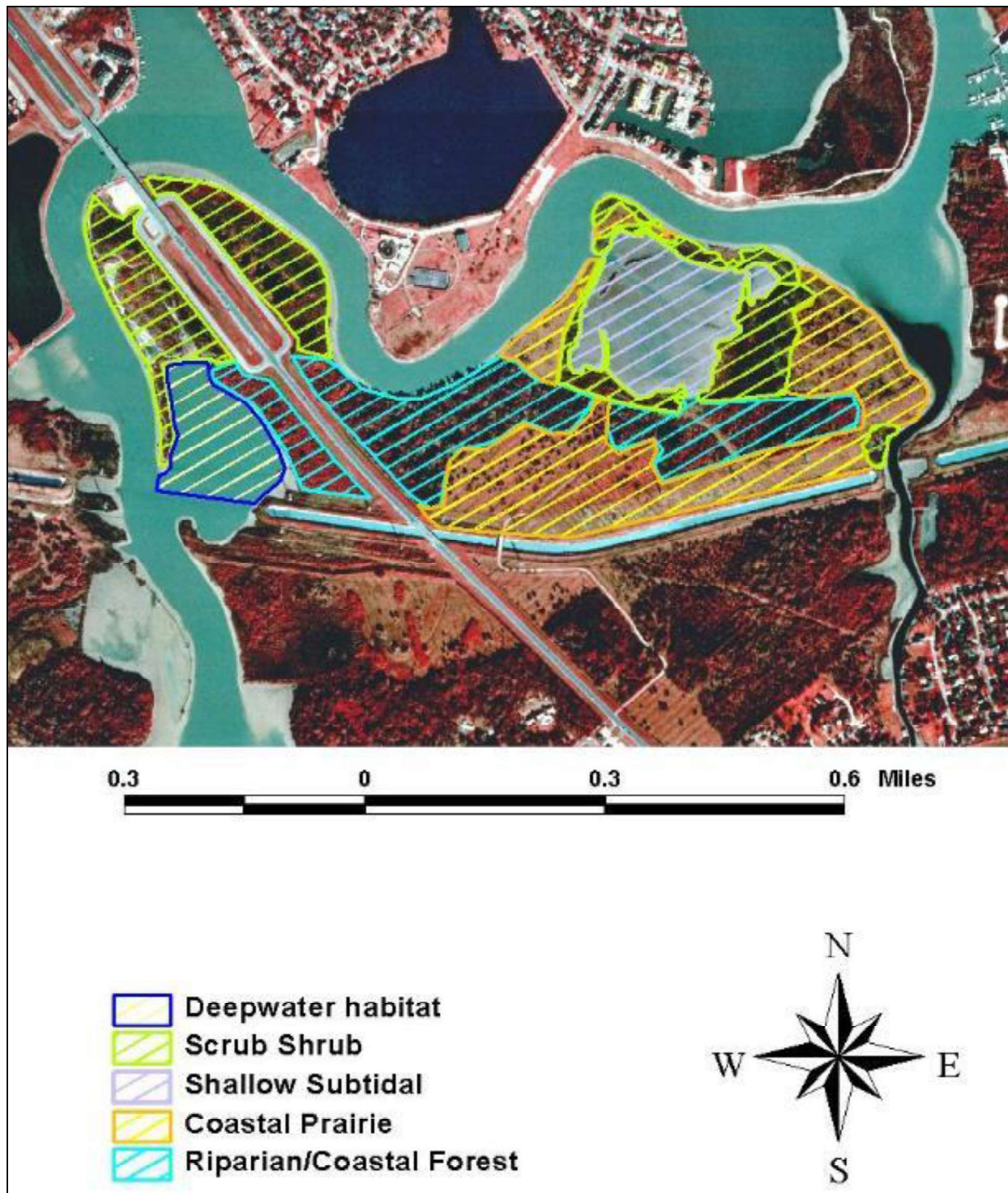


Figure 3. The Nature Center property initially contained many characteristic habitats of the Clear Creek watershed including: coastal riparian forests, scrub/shrub, coastal prairie, and estuarine wetlands comprised of shallow subtidal and deep water habitats (1995 NAIP aerial imagery). Map provided by National Coastal Wetland Conservation Grant Program application (C-21-L).

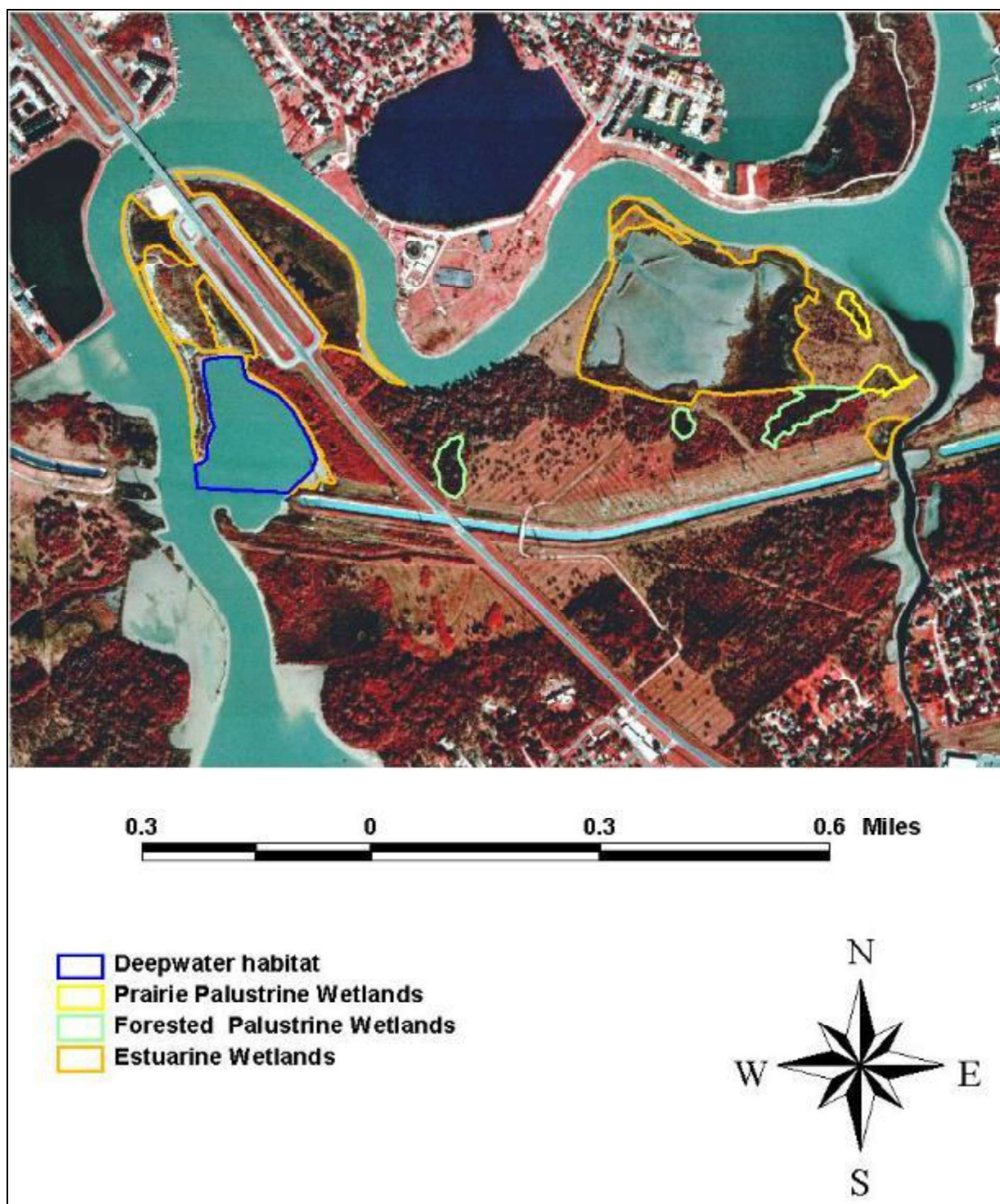


Figure 4. The Nature Center property initially contained specific freshwater wetland features associated with coastal riparian forests and coastal prairie habitats (1995 NAIP aerial imagery). Estuarine wetlands were also comprised of shallow subtidal and deep water habitats. Map provided by National Coastal Wetland Conservation Grant Program application (C-21-L).

Many of the characteristic habitats found within the Nature Center have changed since the land acquisition and development of visitor amenities was completed. In April 2016, biologists from U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department assessed the habitats present in the Nature Center. Based on their assessment, the Nature Center currently supports approximately 51 acres of coastal riparian forest, 24 acres of remnant coastal prairie, 21 acres of estuarine mixed wetlands (sub-tidal fringe, and higher elevation wetland and upland plant species), and 52.7 acres of estuarine wetlands (subtidal fringe wetlands and shallow subtidal water in eastern embayment) and deep open water (western embayment) (see Figure 5 below).



Figure 5. The Nature Center property currently contains coastal riparian forests, coastal prairie, estuarine wetlands, and estuarine mixed wetland habitats (2012 NAIP aerial imagery). Map provided by Texas Parks and Wildlife Department.

Changes from the National Coastal Wetland Conservation Grant proposal are attributed to increases in estuarine wetland habitat from plantings by the Clear Creek Environmental Foundation, protection and recovery of the western tract after

the property was acquired, and natural vegetation succession associated with specific areas of the Nature Center. Vegetation succession has occurred in locations where native species have colonized and converted habitat. Most typical is the colonization of Cedar Elm, *Ulmus crassifolia*, in certain areas. In areas where invasive species have colonized and converted habitat, the biologist agreed that these areas should be managed to their original habitat type, e.g. coastal prairie invaded by Chinese Tallow (*Triadica sebifera*). Descriptions of each habitat type are included in this management plan.

Coastal Riparian Forest

Coastal riparian forest found within the Nature Center is described as coastal flatwoods habitat comprised primarily of Willow Oak (*Quercus phellos*), Water Oak (*Quercus nigra*), and Cedar Elm (*Ulmus crassifolia*) (see Figure 6 on the next page). This forest type is becoming increasingly rare due to development in the Clear Creek watershed. Specific freshwater wetland features (approximately 4.9 acres) are associated with this type of coastal riparian forest (see Figure 7 on page 14). Coastal flatwoods habitat is important to Neotropical migrant birds, resident species including Barred Owl and Red Shouldered Hawk, as well as overwintering birds. These forests also provide breeding habitat for amphibians and reptiles as well as habitat for small mammals. These forests have recently been invaded by non-native trees and shrubs such as Trifoliate Orange (*Poncirus trifoliata*), Chinese Privet (*Ligustrum sp.*), Yaupon (*Ilex vomitoria*), and Chinese Tallow (*Triadica sebifera*). Herbivory by deer, squirrels, and rabbits may also be inhibiting recruitment of native tree and understory seedlings.



Figure 6. Coastal riparian forest within the Nature Center is described as coastal flatwoods habitat (2012 NAIP aerial imagery). Map provided by Texas Parks and Wildlife Department.



Figure 7. Specific freshwater wetland features are associated with coastal riparian forests (2012 NAIP aerial imagery). Map provided by Texas Parks and Wildlife Department.

Coastal Prairie

When the Nature Center property was first acquired only remnants of the original coastal prairie habitat were located along the southern boundary of the park (see Figure 8 on the next page). Specific freshwater wetland features (approximately 2.5 acres) are also associated with these coastal prairie habitats (see Figure 9 on page 16). Previous cattle grazing practices prevented trees and shrubs from encroaching on these grasslands. Once the cattle were removed, the remaining coastal prairie habitat was invaded by Chinese Tallow (*Triadica sebifera*), Trifoliate Orange (*Poncirus trifoliata*), Chinese Privet (*Ligustrum sp.*), Yaupon (*Ilex vomitoria*), and Alabama Supplejack (*Berchemia scandens*). Coastal prairie habitat is important to a wide variety of animals and plants including grassland birds, plant pollinators and butterflies. Mechanical removal of trees, routine mowing, and introduction of native grass species by transplanting or seeding would be required to restore this area to a more natural prairie-type grassland.

Routine and specific management actions would also be required to maintain this restored coastal prairie habitat in the Clear Creek watershed.

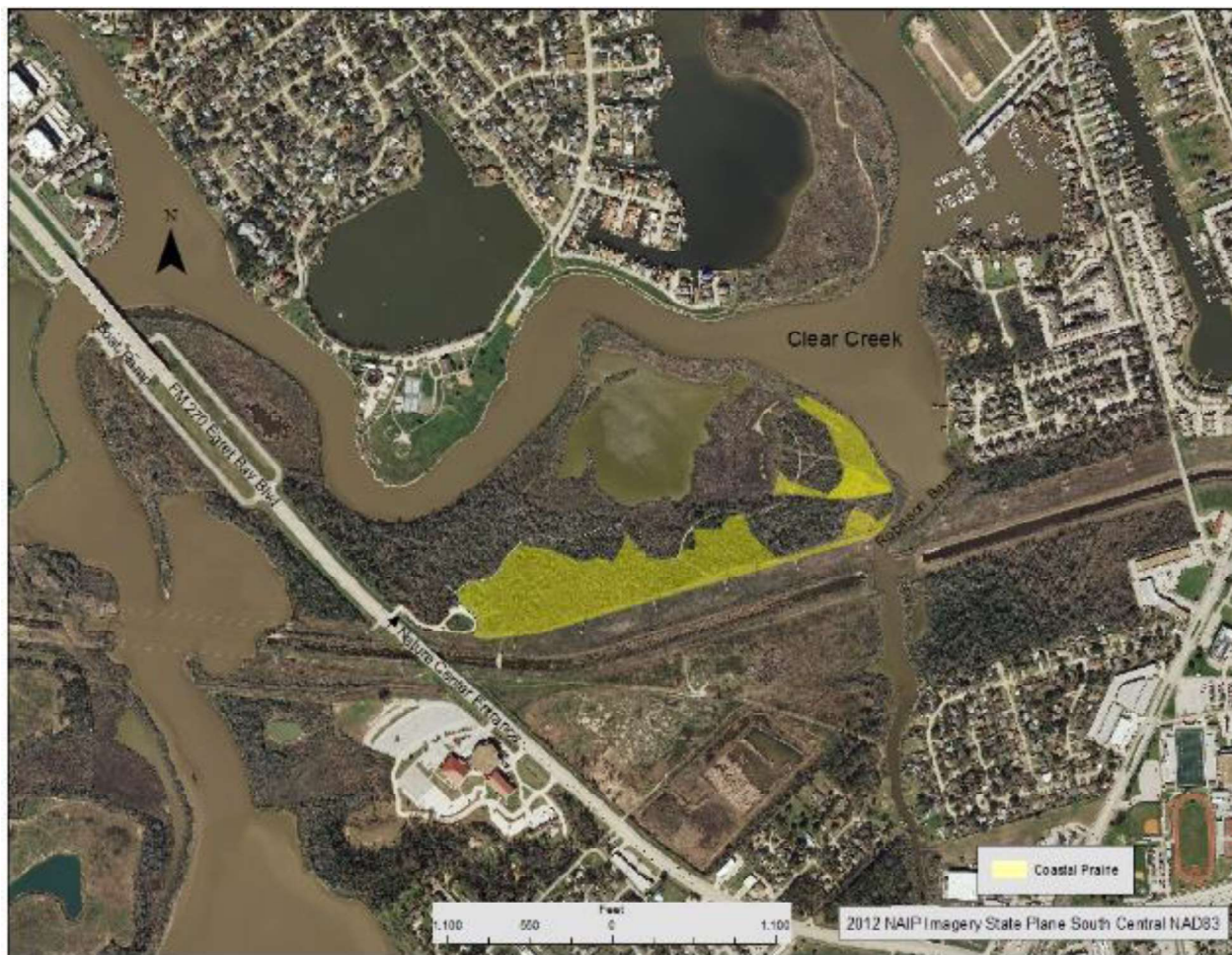
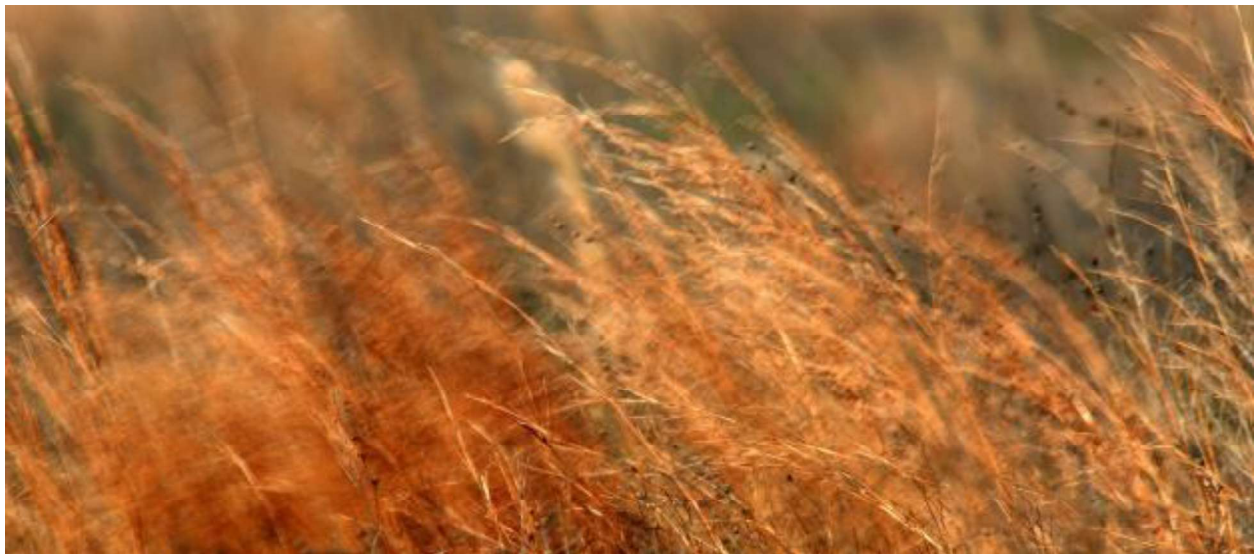


Figure 8. Remnants of former coastal prairie habitat along the southern boundary of Nature Center and adjacent to Robinson Bayou (2012 NAIP aerial imagery). Map provided by Texas Parks and Wildlife Department.



Figure 9. Specific freshwater wetland features are associated with coastal prairie habitats (2012 NAIP aerial imagery). Map provided by Texas Parks and Wildlife Department.



Native Coastal Prairie Habitat was once a part of the landscape at the Nature Center.

Estuarine Mixed Wetlands

Estuarine mixed wetlands habitat is associated with tidal waters and dominated by both subtidal and higher elevation emergent wetland vegetation such as Marshhay Cordgrass (*Spartina patens*), Sea Oxeye Daisy (*Borrchia frutescens*) and Wiregrass (*Spartina spartinae*), and also shrub scrub species such Marsh Elder (*Iva frutescens*), Eastern Baccharis (*Baccharis halimifolia*)(see Figure 10 below). This habitat type typically requires minimal management.



Figure 10. Estuarine mixed wetlands habitat is found on both the west and east sides of FM 270 along the perimeter of Clear Creek, the shallow water and deep water embayments, and is also located in an area adjacent to Robinson Bayou on the east side of the Nature Center (2012 NAIP aerial imagery). Map provided by Texas Parks and Wildlife Department.

Estuarine Wetlands

Estuarine wetland habitats identified in the Nature Center includes the subtidal shallow water habitat and tidal fringe wetlands along the shoreline of the eastern

embayment (see Figure 11 below). These estuarine wetlands support the healthy growth of Smooth Cordgrass (*Spartina alterniflora*), Marshhay Cordgrass (*Spartina patens*), and Saltmarsh Bulrush (*Schoenoplectus robustus*). The eastern embayment also provides habitat for wading birds and many species of juvenile fish and shellfish. This area can be utilized by these species with minimal human disturbance. This area also provides secluded wildlife viewing opportunities for visitors of the Nature Center. Recent loss of the culvert, and a breach in the levee surrounding the eastern embayment, has caused uncontrolled dewatering and loss of fish and wildlife resources to this habitat. Thus short term management goals of this plan will include repairs to the levee and replacement of the culvert to maintain water levels within the eastern embayment. Long term management goals of this plan will require bank stabilization measures, and replanting the outer shorelines of Clear Creek with native wetland plants as essential components for maintaining the estuarine wetlands within the Nature Center.



Figure 11. Estuarine wetland habitats characteristic of the Nature Center includes subtidal shallow water habitats, tidal fringe wetlands, and deep water habitats (2012 NAIP aerial imagery). Map provided by Texas Parks and Wildlife Department.

Another estuarine wetland feature of this habitat is located within an approximately 0.6 acre tidally influenced pond on the east side of FM 270 (see Figure 11 on page 18). This pond has historically supported the growth of submerged aquatic vegetation (Widgeon Grass, *Ruppia martina*). This aquatic vegetation is important to birds for forage, and nursery habitat for fish and invertebrates. This partially secluded tidal wetland pond is connected to Clear Creek during high flow and high tide events, which enhances this area's unique ecological integrity. Currently this type of estuarine wetlands does not require specific management actions.

Another estuarine wetland feature of this habitat is located on the west side of FM 270, and includes a deep water embayment (depths greater than four feet below mean high water - see Figure 11 on page 18). Although the outer shorelines along Clear Creek of this western embayment are protected by tidal fringe wetlands, the inner shorelines are surrounded by higher elevation wetland emergent and scrub shrub vegetation. The western embayment offers a protected shoreline for fishing, and allows paddlers an area to launch or relax out of the main Clear Creek channel. It also provides a potentially secluded wildlife viewing area. Although the interior portion of the western embayment currently requires minimal management, the outer shorelines of Clear Creek may require additional management to stabilize the banks and prevent erosion from boat wakes. The western embayment is also currently being considered for enhanced boating and public access improvements, which may require additional management considerations.

Unclassified Habitat

Approximately 1.4 acres of the property has been developed for trails, paved and gravel roads, parking areas, visitor amenities (composting restrooms), wildlife viewing areas, and picnic areas. These areas will require maintenance and management covered in the recreation section of this plan.



Recreation and Visitor Amenities

Currently there are many low impact recreational opportunities available at the Nature Center. Current improvements and amenities within the carefully planned, low impact park include picnic areas, covered picnic pavilion, nature observation areas, 1.3 miles of birding and multi-purpose observation trails, bird viewing areas, composting restroom, parking area, informational kiosks, geocache locations, and a pet station. Visitors gain access to the Nature Center through the main gate on Egret Bay Blvd., which is open at 7 am and closes at 7 pm daily throughout the year. The access road leads to a parking lot and the trailhead. The trails and amenities are on the eastern portion of the Nature Center. On Egret Bay Blvd., a frontage road loops under the bridge giving access to a public boat ramp. Access to the western portion of the Nature Center is limited by bollards to discourage unauthorized use of all-terrain vehicles or other off road vehicles. Informal foot paths provide access to the western embayment.



Birding and Nature Viewing

The Galveston Bay estuarine complex lies along the Central Flyway and is one of the most important wintering grounds for migratory birds. The variety of habitats found within the Nature Center support a diversity of local and migratory bird species. Colonial water birds, Neotropical migratory birds, and waterfowl use the area to nest and feed. The park is a member of the Great Texas Coastal Birding Trail, a successful program sponsored by the Texas Parks and Wildlife Department

and Texas Department of Transportation. The Great Texas Coastal Birding Trail assists birders in finding prime sites to experience the rich and diverse Texas coastal avian resources.



Fishing

The wetlands and open water habitat of Clear Creek serve as nursery and feeding areas for commercially and recreationally important estuarine species such as Gulf Menhaden, Spotted Sea Trout, Red Drum, Brown and White Shrimp, and Blue Crab. Important forage species such as Minnows, Mullet and Bay Anchovies utilize these shallow embayments and intertidal wetland areas. The Nature Center provides access to multiple fishing opportunities either from the shoreline of Clear Creek or by self-propelled paddle boats such as kayaks or canoes. Currently recreational fishing is permitted along the banks of Clear Creek within the Nature Center. However, in order to insure other recreational interests for birding and wildlife viewing is available to visitors, there may need to be an established protected area for fish and wildlife to be observed without disturbance. This may require prohibiting recreational fishing within the eastern embayment wetlands.

Archeology

The diverse ecology of the Nature Center supported the early human inhabitants as evidenced from a shell midden site within the park. Archeological excavations unearthed artifacts from the Native Americans who foraged on the local abundant

fish, wildlife, and plants of the area. This area has been documented in the Nature Center and will require management to protect its significance within the park.

Purpose and Objective of the Management Plan

The Nature Center was acquired through a partnership between the City of League City, Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, and other partners in 2005 (See Figure 12 below). Under conditions established through agreements between partners, this park is to be held and managed in perpetuity by the City of League City. This management plan provides clear objectives that the City and its partners can use to maintain and improve the Nature Center.

Following the initial phase of development of the Nature Center, several trails and visitor amenities (trash containers and restrooms) are maintained on an on-going basis. Clean-up efforts to clear debris from natural areas and trails after major flood events/storms (such as Hurricane Ike) have been completed as needed by the City Parks Department. Although maintenance to date has been done on an “as needed basis”, this management plan will provide guidelines for the long term protection and management of the Nature Center by the City of League City and its volunteer partners with assistance from local resource agencies.

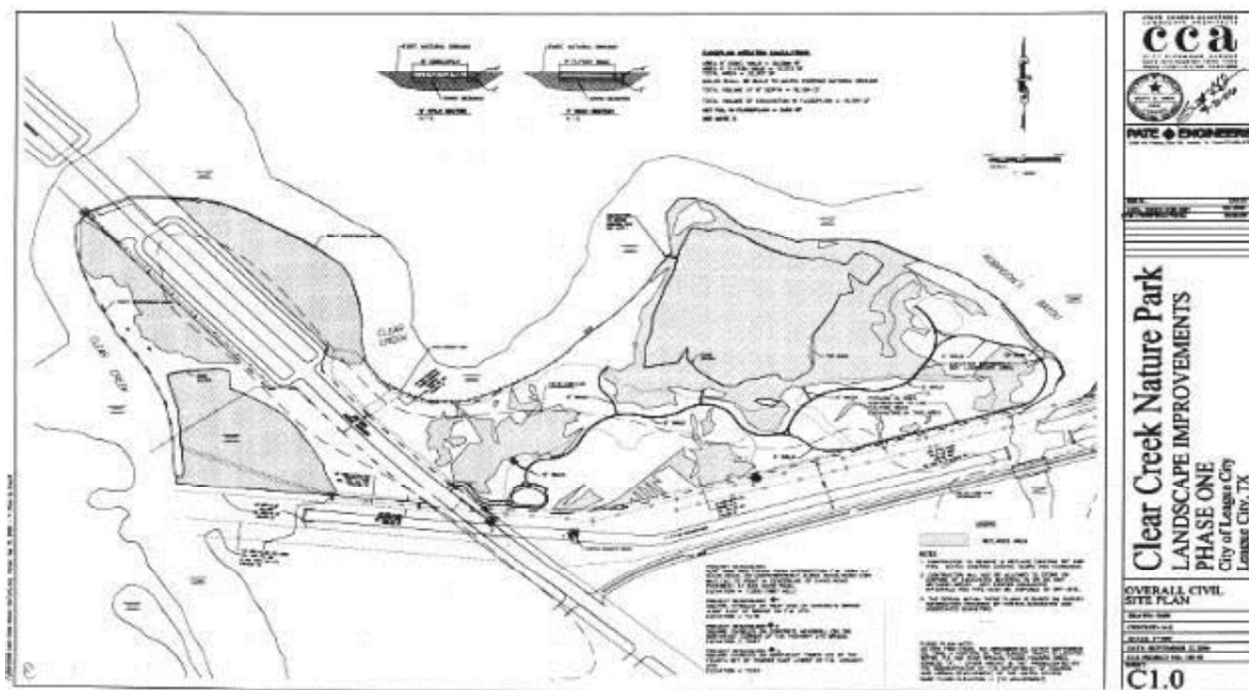


Figure 12. The Nature Center's land acquisition Phase I plans.

This Management Plan will coordinate long term resource management, maintenance, and public access activities at the Nature Center. Long term maintenance activities may require routine mowing, brush-hogging, maintenance of trails, removal of invasive species, maintenance of berms and culverts, maintenance of bird viewing areas, and restoration of native plant communities.

The Management Plan will also serve as the basis for future consultation with stakeholders and project partners to evaluate the success of completed projects and plan future improvements. Physical and biological characteristics of the Nature Center are described in this Management Plan, as well as specific challenges and implementation strategies.



The public access and education component of this Management Plan addresses appropriate public access improvements for coastal natural resource appreciation and education intended to promote habitat and living resource conservation.

Combining the two components into one Management Plan ensures that public access improvements enhance the natural resource management and habitat restoration efforts that are coordinated for the best outcomes. This Management Plan may be updated as needed to allow for changes in management and maintenance strategies as identified through monitoring and evaluation of implemented natural resource management or public access projects at the Nature Center.

C. Natural Resource Management Plan

Introduction

The acquisition of the Nature Center perpetually conserves 148 acres in League City with several ecologically sensitive and regionally significant habitats. Conservation of these habitats throughout the Nature Center contributes to meeting the goals of several local and regional plans addressing conservation of coastal natural resources. The acquisition of property for conservation purposes meets a growing need for the protection of natural resources in Texas. An expanding urban population stresses our State's water resources, wildlife habitats, and overall biodiversity. However, simply purchasing land and preventing future land conversion will not fully accomplish regional objectives of providing habitat for native wildlife species and maintaining water quality.

Long term stewardship of the Nature Center embodies the responsible use and protection of the natural environment through conservation and sustainable practices. Planning and management of the environment is a responsibility shared across volunteers and staff who take action, financial agents such as governmental agencies who provide the funding, and natural resource experts and scientists. The contributions of these three groups help keep the ecosystem running healthy.

The intention of long term wildlife management and property maintenance strategies is to enhance wildlife value, restore and preserve native plant communities, and maintain functional infrastructure of the Nature Center. The management plan will continue the implementation of measures to preserve, enhance, and restore existing habitat as well as maintain trails and infrastructure in a non-intrusive manner. Specific projects for long term focus are: future restoration of natural functions to areas impacted by human use; facilitate future erosion control through non-structural means to preserve its value as habitat for wildlife; and allow for the creation of additional habitat such as islands or terraces suited for bird nesting and feeding in embayment areas. This plan is intended to serve as a reference for future habitat management and property maintenance objectives.

Coastal Flatwoods Management

Approximately 51 acres of coastal flatwoods habitat, including 4.9 acres of freshwater forested wetlands, make up the coastal riparian forest of the Nature

Center. This habitat type is dominated by Willow Oak, *Quercus phellos*, Water Oak, *Quercus nigra*, Cedar Elm, *Ulmus crassifolia*, and Sugar/Hackberry (*Celtis occidentalis*) that function as a bottomland hardwood forest. This forest type is increasingly becoming rare due to tree removal and urban development in the Clear Creek Watershed. Control of invasive species and reforestation is addressed in this Management Plan.

Invasive Species

The Chinese Tallow, *Triadica sebifera*, a known invasive tree species, is observed throughout the Nature Center in every habitat type. Although infestations of this species in the brackish marsh and prairie areas are easily identified, Chinese Tallow is more difficult to locate and control in the coastal flatwoods adjacent to Clear Creek and the Nature Center.

Trifoliate Orange, *Poncirus trifoliata*, is an introduced shrub that can grow over 25 feet tall and is characterized by green stems with long, sharp spines and small orange fruits. Often used as root stock for citrus, this plant has invaded the eastern region of Texas. The plant is known to be present in forested areas, fence rows, and pastures, and, if left untreated, local populations can rapidly increase. Severe infestations should be considered a high priority for eradication to improve the habitat for wildlife.

Chinese and Japanese Privet, *Ligustrum sp.* is common to all Gulf Coast states and present in all counties of the Galveston Bay watershed. Chinese and Japanese Privet form dense thickets, and can dominate the understory of native forests, competing with native herbaceous plants.

Since the time of acquisition, Chinese Tallow and Trifoliate Orange have continued to encroach into forested habitat without specific management controls. Control of these and other invasive species into the native forest are targeted in this management plan and for future coastal forest restoration efforts.

FOREST GOAL 1: Work with conservation partners to develop invasive species control project proposal and submit proposals to relevant sources of funding.

FOREST GOAL 2: Treat and remove invasive species when funding is acquired by the City and/or its partners.

FOREST GOAL 3: Monitor success of invasive species treatments. Monitor annually and take appropriate actions to control recolonization of invasives.

Forest Restoration

The winds and storm surge from Hurricane Ike resulted in extensive damage to the forest canopy. Removal of invasive species will open areas for re-establishing native habitat tree species such as previously identified on site. Herbivory by deer and other small mammals may damage or destroy natural seedlings from surviving to reforest these areas. Supplemental planting within existing forestry stands will enhance and restore natural forest structure and composition. In areas that have been depleted of native trees, efforts will be made to cultivate stands of native hardwoods. Specific areas will be planted with native hardwood tree and understory species to enhance areas for wildlife and increase aesthetics of the Nature Center. Measures should be taken to prevent herbivory by deer, squirrels and rabbits such as using predator guards and fencing. The guards can be recycled plastic bottles, drain pipes, and hardware cloth. Appropriate tree and understory species can be found under the Exhibits Section of this Management Plan.



FOREST GOAL 4: Work with partners such as the Texas Forest Service, NRCS, Master Naturalists, etc., to plant native hardwood and understory species in the Coastal Flatwoods Habitat.

FOREST GOAL 5: Monitor planting efforts and remove guards when plants are no longer subject to mortality from herbivory.

Coastal Prairie Management

Coastal prairie is native grassland found along the coast of Texas and Louisiana. Over nine million acres of prairie once existed as a grassland paradise for Native Indians and early settlers. Today, less than 1% remains as a refuge for rare and endangered birds, mammals, reptiles, insects and plants. Remnants of Coastal Prairie in Texas are dominated by Little Bluestem, Brown-Seed Paspalum, and Indian Grass. Common wildflowers found here are the Prairie Coneflower, White Heath Aster and Yellow Puff. Prairie habitat provides benefits to wildlife and to the surrounding community. Grassland dependent birds, which are in decline, will benefit as well as butterflies and other pollinators. Pollinators are essential to production in local gardens and fruit trees. A local prairie habitat can support a wide range of pollinators including native bees and butterflies. Prairie restoration is also attracting widespread interest with the general public.



Prairie Restoration

Only 24 acres of the original coastal prairie are barely discernible along the southern border of the property. At the time of land acquisition, this area was negatively impacted by cattle grazing and minimally affected by the presence of Chinese Tallow, *Triadica sebifer*. However, without a management plan to control non-grass species from invading this area, this habitat type was invaded by Chinese Tallow, Yaupon, Privet, and Alabama Supplejack. Mechanical measures using brush-hogs or other heavy equipment will be required to remove non-grass species to restore the area to its original condition. Once grassland habitat is achieved, routine management actions will be required to maintain this habitat. Routine mowing, defined by the grassland conditions, is required at least once a year to every three years at an appropriate time. Invasive species control of non-native herbaceous, as well as trees, will be an on-going management requirement for this

habitat type. Restoration of native herbaceous and grass species into the restored grassland may be accomplished by seeding or transplanting native species.

PRAIRIE GOAL 1: Work with conservation partners to develop a prairie restoration project proposal to remove invasive species of trees and submit proposals to relevant sources of funding.

PRAIRIE GOAL 2: When funds become available, implement clearing non-native species with brush hog or other mechanical equipment at specific locations for restoring native prairie habitat.

PRAIRIE GOAL 3: Monitor and identify locations of invasive species within the Coastal Prairie habitat and take appropriate steps toward controlling these species with minimum ground disturbance methods and/or using approved and appropriate chemicals.

PRAIRIE GOAL 4: Initiate an annual mowing strategy to maintain native prairie grasses and reduce encroachment of invasive species.

PRAIRIE GOAL 5: Seed or re-introduce native grasses and wildflowers on an annual or bi-annual basis.

Monarch Butterfly Waystations

In 1995, the Monarch Butterfly was designated as Texas' state insect. Unfortunately, this beautiful insect is drastically on the decline due to loss of habitat and the deadly OE, *Ophryocystis elektroscirrha*, a protozoan parasite only infecting Monarch populations. To counteract the decline, a number of initiatives, including a major effort by the U.S. government are underway to create, conserve, and protect Monarch habitat. In May 2015, the Pollinator Health Task Force outlined its strategy to restore stressed bee and Monarch populations by creating more Milkweed buffers for traveling Monarchs. As the Nature Center lies within the two-way migratory path from Mexico to Canada and back, locating a Monarch Waystation here will provide necessary habitat for the five generations of Monarchs necessary to make this annual trip. It will also provide an educational opportunity for all visitors to the Nature Center. A decline in pollinator abundance and diversity can result in a loss of pollination services that could significantly affect the maintenance of wild plant diversity, wider ecosystem stability, crop production, food security and human welfare.



Portions of the former coastal prairie habitat that lie adjacent to the Nature Center parking lot may be the optimum location for installing a Monarch Waystation and restoring native grassland dotted with wildflowers. The combination of a native plant community and the interaction of insects and plants is an optimum location that visitors will enjoy as they enter the main trail of the Nature Center.

PRAIRIE GOAL 6: Create Monarch Waystations near prairie habitats.

Specific Considerations for Herbicide Management

The Texas Commission on Environmental Quality, specifically, the Galveston Bay Estuary Program, Texas Parks and Wildlife Department, as well as other natural resource agencies are excellent sources of guidance on how to treat and eradicate invasive species of the Clear Creek Watershed. Recently, U.S. Fish and Wildlife banned the use of neonicotinoid pesticides which are shown to be highly toxic to bees. A major court victory for bees resulted in Sulfoxaflora, neonicotinoid pesticide shown to be highly toxic to bees, being removed from the market in the United States. For best management practices within the Nature Center, alternative herbicides and pesticides (not containing neonicotinoids) will be utilized in removal of invasive species.

PRAIRIE GOAL 7: Monitor and identify locations of invasive species within the Coastal Prairie habitat and take appropriate steps toward controlling these species with minimum ground disturbance methods and/or using only approved and appropriate chemicals.

PRAIRIE GOAL 8: Monitor success of invasive species treatments. Monitor annually and take appropriate actions to control recolonization of invasives.

Estuarine Wetland Management

Previously described, estuarine wetland habitats are important to marine fishes and invertebrates as they provide important nursery habitat. They are also important to many birds and mammals as forage and resting habitat. The eastern embayment is particularly important because it requires protection and maintenance of the berm surrounding a water control structure that maintains critical water levels for growth and survival of estuarine wetland habitat and fish and wildlife species that utilize this habitat. This water control structure ensures that the embayment is hydrologically connected to Clear Creek via the tide but always maintains a minimum volume of water during extremely low tide events.

Eastern Embayment Management

The integrity of the eastern embayment was damaged during several storm events when storm surge, currents, and corrosion caused the tidal culvert connecting the embayment and Clear Creek to fail (see Figure 13 below). Restoration of the structure that supports a stable habitat within the embayment for fish and aquatic invertebrate species is a top priority.



Figure 13. Eastern Embayment's breached levee and culvert adjacent to Clear Creek.

Repairs to the culvert and surrounding levee are planned with engineering design and specifications currently under development by League City, and coordinated with U.S. Fish and Wildlife and Texas Parks and Wildlife Department restoration biologists. Once the culvert is restored to an appropriate elevation, the ecological functions and values of estuarine wetland habitat should be restored and maintained within the eastern embayment.

ESTUARINE GOAL 1: Restore the culvert/water control structure in the eastern embayment to restore bank stability and maintain wetland habitats.

ESTUARINE GOAL 2: Institute periodic or annual checks of the integrity of the berms and water control structure in order to anticipate and plan for any future maintenance required responses.

ESTUARINE GOAL 3: Coordinate with Galveston County and City of League City to implement a no wake zone along the boundaries of the Nature Center.

Aquatic Invasive Species Control

Common Water Hyacinth, *Eichhornia crassipies* continues to spread via the aquarium plant trade and by boat traffic dispersing fragments. It's a severe problem for fish and wildlife, recreation, water quality and water management. It is a floating plant and now has colonized the eastern embayment. The City of League City under the assistance, direction and guidance of the Texas Parks and Wildlife Department is presently coordinating herbicide treatment. Salinities normal to Clear Creek usually do not allow the plant to survive for any length of time, however, the plant has been observed to tolerate some level of salinity due to its persistence in a tidal waterway.

Elephant Ear, *Colocasia esculenta* is another ornamental plant observed spreading along wetland fringes as well as bayous, ditches, canals and in residential and urban areas within the Lower Galveston Bay watershed. It invades wetland areas and out-competes native species, thus altering natural habitat and ecosystem processes, reducing biodiversity. The shoreline of the eastern embayment is now colonized with this plant. It's hoped that herbicide efforts by Texas Parks and Wildlife will remove this plant from the embayment, and once the culvert is restored it will not allow this aquatic plant to float into the embayment.

ESTUARINE GOAL 4: Work with conservation partners to control aquatic invasive plants in estuarine wetlands.

Shoreline Protection and Management of Clear Creek

Although the Clear Creek shoreline remains in a natural state and supports a well-established buffer of *Spartina alterniflora*, there are areas that are experiencing excessive erosion. Currents and natural wind driven waves do not appear to be the only source impacting this habitat type. Erosion may, in this case, be caused by boats traveling at high speeds repeatedly along the same shoreline, and to a lesser extent by flood events. Water skiing or jet skiing enthusiasts may be generating repeated waves in the same areas of the shoreline that has removed vegetation and caused sloughing of the banks. Jump ramps have been observed in areas of Clear Creek where repeated wake impacts are taking place along the same area of shoreline.

There may be many actions available to League City that would reduce these types of impacts from recreational boat wake-induced erosional wave forces along Clear Creek. One approach may include controlling vessel speeds by implementing no wake zones, and increasing law enforcement presence to reduce recreational boat wakes. Other measures may include installation of wave reduction devices or barriers such as a living shoreline along the banks of Clear Creek.

The Clear Creek Environmental Foundation, working with the Galveston Bay Foundation, recently planted Smooth Cordgrass, *Spartina alterniflora* along the shoreline just west of the boat ramp to curtail erosion from motor boat and jet-ski activity in this area. However, despite these recent marsh plantings by Clear Creek Environmental Foundation, there are many areas along Clear Creek that continue to erode and may require similar restoration efforts. Control or amelioration of human impacts is needed to maintain existing estuarine wetland habitat along Clear Creek. In addition, the shoreline should be monitored at least annually for erosion from motor boat traffic, and periodically in the wake of natural disasters or unusual weather or tidal events.



ESTUARINE GOAL 5: Implement regulatory or infrastructure mechanisms that minimize erosion and protect intertidal wetland habitats.

ESTUARINE GOAL 6: Institute periodic or annual monitoring of Clear Creek shoreline in order to anticipate and plan for any future maintenance required responses.

Western Embayment Management

The western embayment is deeper water habitat than the eastern embayment and does not support the growth of intertidal wetland plant species. Presently, the shoreline surrounding this cove is lined with Eastern Baccharis and various emergent grasses. However, like many coves along Clear Creek, there may be opportunities to restore herbaceous emergent wetlands lost to historical groundwater withdraw related subsidence. Implementation of a non-structural living shoreline protection plan may provide habitat enhancement to the existing shoreline, and prevent conversion of this habitat to open water through loss of sediments from erosion. Although this area requires no immediate management considerations, planting Smooth Cordgrass in the shallow water areas of this embayment would add value and protection to this area of the Nature Center.

ESTUARINE GOAL 7: Work with project partners and local resource organizations to explore non-structural methods through use of living shoreline stabilization techniques to minimize erosion and protect existing wetland habitats.

D. Public Access Plan

Introduction

Recreational fishing, boating, birding, and various other forms of eco-tourism are more important to the economy of the Galveston Bay region now than ever. The growing industries of nature-based recreation and eco-tourism contribute significantly to the regional economy. Many communities in the Galveston Bay watershed are investing in nature tourism for economic growth and stability for their communities.

League City is well positioned to expand existing and develop new nature-based recreational opportunities for a wide range of outdoor interests. The presence of the nearby Nassau Bay Peninsula, upstream Heritage Park, Walter Hall Park, undeveloped Myrtle Park, and Lynn Gripon Park at Countryside create a greenway along Clear Creek. This greenway supports an abundance of wildlife, and offers visitors an opportunity to observe and interact with nature via hiking or paddling. Access to the waters of Clear Creek, adjacent tributaries of Clear Lake, Galveston Bay, and ultimately, the Gulf of Mexico afford plenty of potential to provide the general public with quality outdoor recreational activities.

The public access and education component of this Management Plan addresses appropriate public access improvements for coastal natural resource appreciation and education intended to promote habitat and living resource conservation. Within the region, a plethora of dedicated, enthusiastic non-profit conservation organizations, a high profile presence of local, state, and federal resource protection agencies, a well-educated local citizenry, and an engaged scouting community offer eager volunteers and experts to implement the priorities for public access improvements and education.

Short Term Public Access Management

Currently there are no specific management controls established for human impacts from off-trail activities in sensitive areas within wetlands in the Nature Center. Management controls should be developed for preventing jet skis in the eastern or western embayment's, ATV's or mountain bicycles on trails, humans hiking through wetlands, and unleashed pets accessing all types of habitats without human restraints. Damages to estuarine wetlands has occurred in the eastern embayment due to uncontrolled access by humans and pets (See Figure 14 below).



Figure 14. Uncontrolled human and pet access has created damage to estuarine wetlands in the eastern embayment.

Initial public access projects implemented during the early development of the Nature Center fulfilled four objectives of the land acquisition: provide outstanding recreational and educational opportunities for local residents and visitors; witness wildlife use of the property in conjunction with demonstrating the tremendous value of preserving habitat; provide easily accessible, low-impact recreational opportunities in concert with nature; and offer public shoreline access.

The main access road provides easy access off FM 270 into the main parking area and adjoining trail head. The access road and trail system is professionally designed and constructed in a manner that avoids disturbance to natural plant communities and is minimally invasive to the biodiversity of the Nature Center. Visitors walking the trail system are in near proximity to the shorelines of Clear Creek and Robinson Bayou.

The parking lot is constructed of permeable surface and demonstrates low-impact development. The main concrete trail is 1.3 miles in length and connects to two fly ash trails. Boardwalks are incorporated to span wetland areas along the trail

system. Four bird blinds, and the trails, provide opportunity to witness wildlife use of the property. Educational signage and a notice board focus attention on the background of the Nature Center, the wildlife encounters possible during a visit, trail etiquette, and general park rules.

Trail and Boardwalk Maintenance and Improvements

Presently, three different types of trails are in place at the Nature Center: Fly Ash Trails, Concrete Trails, and raised, wooden Boardwalks. The terminus of several of these trails is a bird viewing area or bird blind. Maintenance along the concrete trails entails mowing and debris removal, monitoring and adaptation of sheet flow from heavy rainfall or storm events, and occasional removal of graffiti.

The condition of the original fly ash trails require immediate attention, potentially the correction is to repave these trails. As the most southerly fly ash trail nears Robinson Bayou, frequent inundation from rainfall or tidal fluctuations of Robinson Bayou may require a solution for year-round access. The wooden boardwalks are periodically monitored for damage from storms, vandalism, or normal wear and tear. Annual trail maintenance shall include a combination of efforts to control vegetation and repair any trail surface issues.

Public access to both the concrete and fly ash trails requires periodic mowing and debris removal. The mowing distance from trail to natural landscape is designed with the goal of bringing nature into close contact with visitors without disrupting pedestrian movement or interference with normal animal behavior. Trimming or pruning trees and shrubs with hand tools will be a primary annual control effort for trails in forested areas. All trails should be walked regularly to inspect for issues with erosion, fallen trees, and other damage or hazards.

Fallen limbs and trees are typically removed from the trails, but within the non-accessible natural areas trees and limbs are left to the natural process of decomposition providing bird and insect habitat and soil enhancement. Opportunity exists to gather the fallen leaves, limbs, cut grass clippings, and other organic matter from the trails to create a compost facility. The compost will be used within the Nature Center or other City Parks for various plantings like the Monarch Waystation. If properly placed, the compost site presents an educational opportunity for visitors.

PUBLIC ACCESS GOAL 1: Provide signage indicating regulations to access recreational areas within all habitats, including no jet skis, ATVs, motorbikes, bicycles, no hiking through wetlands, and no pets without leashes allowed.

PUBLIC ACCESS GOAL 2: Create a compost facility re-using trail maintenance debris to generate natural fertilizer for use in the park(s) and provide an educational opportunity for visitors.

PUBLIC ACCESS GOAL 3: Establish proper mowing and clearing distances along trails to enhance nature viewing for visitors and maintain corridors for wildlife movement.

Bird Blind Maintenance

The construction of four bird blinds was completed as part of the initial public access improvements. Structures were constructed in high interest areas for wildlife observation and scenic viewpoints associated with prairie and freshwater wetland habitats. Two bird blinds offer observation of wildlife utilizing the eastern embayment. The first bird blind was chosen for its proximity to the eastern embayment and is placed at shoreline level. The second bird blind is constructed at the end of the boardwalk overlooking the eastern embayment and is surrounded by the scrub/shrub wetlands. The elevated boardwalk approaching the bird blind at its terminus allows visitors of all physical abilities to enjoy unobstructed views of the many migratory and resident wildlife species attracted to the wetlands and adjacent embayment.

The remaining two bird blinds are in need of repair or relocation since the initial placement, as the landscape has changed over time and vegetation has encroached on the view. Vandalism of bird blinds and boardwalk railings has occurred. Periodic monitoring deters these activities and allows for prompt corrective action.

The most westerly blind could also be improved as a bird viewing platform, elevating the observer above the shrubs and allowing open view of the embayment at a distance which does not interfere with foraging and resting behavior of birds or disturb other wildlife utilizing this area.



PUBLIC ACCESS GOAL 4: Repair and provide proper placement of bird blinds for wildlife observation and scenic viewing.

Addition of Bird Viewing Platform

Nearby the eastern embayment, an elevated platform/scenic viewing platform, would improve nature center visitors opportunity to view wildlife and natural areas from a unique perspective. Presently, a ground level bird blind is installed at the terminus of the most westerly fly ash trail for wildlife observation of the eastern embayment. American White Pelican and various species of waterfowl spend the winter here. Wading birds such as Egret, Herons, and Roseate Spoonbill may be observed year round. The construction of a viewing platform will enhance the public access improvements to the Nature Center. The structure will be built at the present location of the first bird blind. The viewing platform should have stairs, ascend 12-15 feet above ground level, and provide benches, safety railing and a level surface to facilitate the use of spotting scopes. The platform should be constructed with high quality materials to withstand harsh coastal environmental conditions. Design of the platform should consider feasibility for access to visitors of all physical abilities.



PUBLIC ACCESS GOAL 5: Construct a raised scenic viewing platform at the eastern embayment for enhanced wildlife viewing and recreational enjoyment, while limiting direct contact with wildlife.

Long Term Public Access Management and Maintenance

Manage Public Access and Signage

The Nature Center parking lot, access roads and trails on the east side of Egret Bay Blvd. are currently managed to limited all-terrain motorized vehicle usage, while maintaining routine public access to the Parks Department for property maintenance, emergency vehicles, and law enforcement presence. Trails on this side of the Nature Center are limited by signage to only pedestrian traffic. Composting restrooms are also available near the parking lot on the east side of the Nature Center. Undocumented human and pet traffic occurs through the wetlands surrounding the eastern embayment and may indirectly impact estuarine wetlands and the wildlife utilizing them.

Only limited trail access is available on the west side of the Nature Center property. Parking is limited to Texas Department of Transportation (TxDOT) Right of Way and the existing Galveston County Boat Ramp parking lot adjacent to Clear Creek. The Parks Department's recent placement of bollards along the edge of the parking lot and TxDOT Right of Way on Egret Bay Blvd. have effectively curtailed unauthorized use of all-terrain vehicles and most foot traffic through this side of the Nature Center. Previous off-trail intrusion by all-terrain vehicles throughout this area has often resulted in damage to the natural habitats. Previous damage to the scrub shrub and forested habitats in this area may require some restoration of native trees and vegetation. Prior to habitat degradation west of Egret Bay Blvd., small freshwater depressions or potholes were present in the understory areas. Currently new growth vegetation conceals the former dirt paths and crude roads created by recreational and all-terrain vehicles. This area also contains a mixture of high and low wetland habitats which likely suffered degradation when there was uncontrolled access. Previously damaged areas are now protected from intrusion by unauthorized vehicles and there may be opportunities to re-establish native tree and shrub species and correct negative impacts from previous all-terrain vehicle alterations.

As public access facilities are maintained and improved, wildlife signage will be needed to contribute to the environmental education aspect of the Nature Center.

Content for signage should include information on flora and fauna at the Nature Center, and emphasize the importance of ecological management and restoration of the Park. The number and placement of signs shall respect the overall aesthetics of the Nature Center.

Long term management goals for public access that may improve and or enhance the visitor experience include:

PUBLIC ACCESS GOAL 6: Maintain control of public access trails through coastal flatwoods and scrub shrub habitats through signage and permanent structures to prevent off-road accessibility to these sensitive areas.

PUBLIC ACCESS GOAL 7: Increase maintenance, and improve signage with conservation goals of the Nature Center including human disturbance issues and or activities that are not consistent with the purpose of the park.

PUBLIC ACCESS GOAL 8: Improve and update signage as public access to habitats and educational opportunities are made available.

PUBLIC ACCESS GOAL 9: Explore opportunities to restore native plants and shrubs within the Nature Center west of Egret Bay Boulevard.

Addition of Non-Motorized Boating Access Launch Site

Clear Creek provides a wide variety of opportunities for diverse recreational interests, which include the use of motorized and non-motorized boats for fishing, nature watching, photography, water skiing, paddling, or just relaxing. These diverse interests are not always complementary. Although motorized boating has always been popular on Clear Creek, in recent years, paddling in a non-motorized boat has become an increasingly popular activity for exercise, fishing, and nature viewing. Due to increasing demand for this type of activity, the City of League City developed a Paddling Trail Plan which included five launch locations along Clear Creek. One of these launch sites was located at the existing boat ramp and considered part of the Nature Center's boating access sites. However, conflicts between paddlers and jet-skiers created an unsafe situation at the existing boat ramp, so an alternative location for a non-motorized launch site and associated parking lot is being researched. The goal of the Nature Center would be to provide

a safe and convenient boating access site in Clear Creek that is designed specifically for canoes, kayaks, and other non-motorized boats.

Currently the western embayment of the Nature Center offers a shallow water, protected area that could provide an appropriate location for kayakers and canoers to launch their vessels and adjust their equipment before entering the main channel of Clear Creek. Although recreational anglers are currently using an informal foot trail to access the western embayment along Clear Creek, there is no designated launch site for non-motorized boats. Up to three vehicles have been observed parked along the roadway and TxDOT right of way during normal use of this informal trail. However, additional parking spaces need to be developed for expansion of this trail and launch site that consider both recreational anglers and paddlers needs. In addition, recreational kayakers and canoers would still be required to carry or use a dolly to transport their vessel from the parking lot to the launch site. Additional Paddle Trail signage would also need to be installed that incorporates the goals of existing signage for limiting or controlling public access to this part of the Nature Center. Another amenity that has been considered by the Nature Center for the western embayment includes installation of mooring buoys for paddlers to tie up for resting, picnicking, or nature observing. Future planning for kayak use will be weighed with options for wetland restoration and bird nesting habitat restoration discussed for this embayment.

PUBLIC ACCESS GOAL 10: Improve recreational access to the Nature Center lands west of Egret Bay Boulevard by creating parking and a paddle trail launch site for the western embayment adjoining Clear Creek.

E. Public Education Plan

The main objective of the public education component for the Nature Center is to provide outstanding recreational and educational opportunities for individuals to witness wildlife, while also demonstrating the tremendous value of preserving habitat. A further intention is to educate the public on the value of natural resources, including preservation of the archeological heritage of the area.

Educational Programming Highlighting Environmental Features

The Nature Center was developed with public access infrastructure for passive nature appreciation and education in a manner that does not degrade the coastal natural resources, and includes interpretive signage to highlight the importance of these coastal natural resources. Educational programs at the Nature Center should be developed to promote conservation of natural habitats and the fish and wildlife resources that thrive in these habitats. The City of League City began a program entitled Wetlands Environmental Camps in the summer of 2000 through funding from the Galveston Bay Estuary Program. This program was designed to demonstrate the function and value of wetlands to children, and the importance of wetland preservation. Student field experience in local wetland areas spotlighted the diverse and abundant wildlife utilizing these areas. The Nature Center is an excellent site to conduct these same types of classes because it offers public accessibility to a variety of natural habitat types in close proximity to a local suburban community.

The Nature Center was also established to provide new educational opportunities for local residents, school children, visitors, and public groups. It's a prime example of the benefits for conserving undeveloped lands within the floodplain to improve the quality of life for the local community. Previous successful birding education programs were conducted by George Regmund, former Stewardship Biologist for nearby Armand Bayou Nature Center, through a birding walk tour of the Nature Center identifying wintering, nesting, and resident species. Woody Woodrow, now with U.S. Fish and Wildlife, also taught a birding class at the Nature Center. Future educational programs should be designed to highlight the important environmental features of the property and may include botanical, wildlife or water quality programs led by expert citizen-scientists or master naturalists.

Continue Cooperative Efforts with Community Groups

The Nature Center welcomes community groups, such as the Galveston Bay Master Naturalist, to conduct volunteer maintenance, management, and restoration projects consistent with this Management Plan and in coordination with Parks Department staff. Development of additional interpretive signage, benches associated with the established trail systems, and additional projects that enhance public access to the Nature Center are gladly received. Other educational programs which extend community involvement include the construction of a Swift Tower, as an Eagle Scout project. Also underway is a bird monitoring program conducted by two different groups. David Bulliner conducts a monthly survey for Texas Audubon. Jean Booth, Sandy Parker, Liz Gearney, and Judy Anderson conduct a monthly survey for the TERN program (Texas Estuarine Resource Network) of Texas Audubon. Contact has been initiated with the Texas Stream Team to add the Nature Center as a water quality testing site to be monitored monthly. The League City Garden Club hosts an annual garden walk and included the Nature Center as one of their sites on the 2015 tour. Volunteers from Galveston Bay Master Naturalists were on hand to present programs on birding, invasive species, water quality, and butterflies to the 75 visitors on the tour. The Wildlife Center of Texas, a non-profit organization formed to provide wildlife assistance, has conducted at least two events at the Nature Center where rehabilitated Red-Shouldered Hawks were released back into the wild and witnessed by around 75 to 100 visitors.



EDUCATION GOAL 1: Publicize expert-led nature and wildlife viewing tours and other educational programming highlighting important environmental features of the property.

EDUCATION GOAL 2: Encourage citizen-scientist biological monitoring of bird populations and habitat, wildflowers, and water quality.

EDUCATION GOAL 3: Install a Monarch Waystation, a Swift Tower, a drip line for birds, and other wildlife management related structures.

EDUCATION GOAL 4: Coordinate with Master Naturalist Volunteer Education Programs.

Implement WaterSmart Best Management Practices

The award winning Ghirardi Family WaterSmart Park in League City provides education on conservation of water resources, and demonstrates best management practices such as green roofs, cisterns, permeable pavement, and native plants for water filtration and drought tolerance. These best management practices should be implemented at the Nature Center as well. The picnic pavilion provides an opportunity to capture rainfall from the roof in a cistern. The cistern can be connected to a drip line directed to a pond or trough designed for birds and wildlife to drink. The grass covered area where the access road circles in off the main entrance gathers and retains water. This area creates an opportunity for a WaterSmart solution and habitat enhancement. WaterSmart best management practices can enhance the development of the Monarch Waystation and the Coastal Prairie Restoration that utilizes the water retained in this parking area.

EDUCATION GOAL 5: Implement WaterSmart Best Management Practices by creating a drip line for a bird and mammal drinking source.

EDUCATION GOAL 6: Provide signage for water conservation within the Monarch Waystation and the Coastal Prairie Restoration areas.

EDUCATION GOAL 7: Explore WaterSmart methods to utilize stormwater runoff ponding in the entryway of the Nature Center for habitat enhancement of the Monarch Waystation and Coastal Prairie Restoration areas.

Ethnobotany

In 2009, an inaugural meeting for an ethnobotany of the Nature Center was held. The midden site is a concentrated area filled with artifacts of the Native Indians

inhabiting this region prior to the influx of European settlers. However, throughout the park, plants tell the tale of the resources utilized by the indigenous people. Ethnobotany, the scientific study of the traditional knowledge and customs of a people concerning plants and their medical, religious, and other uses, gives volunteers a challenge and will be a valuable resource for not only visitors to the Nature Center, but other similar locations, like the Armand Bayou Nature Center, along the Upper Gulf Coast region.

EDUCATION GOAL 8: Publish brochures or literature for ethnobotany of the Nature Center.

EDUCATION GOAL 9: Identify species indicative of the Native Indians for future development of an ethnobotany publication for the Nature Center.

Signage

The message board located near the trail head at the main parking lot provides information important to one-time, seasonal, or daily users to the facilities. Seasonal postings of species sightings will put visitors on the alert for these nature observations. Trail etiquette rules teach visitors on how to best avoid interference with others involved in these nature observations. Safety along the trails is important to convey as well. It includes following the leash law, as well as knowing how to identify poisonous snakes and plants. Following the requirement to pick-up pet waste improves the water quality of the embayment's, Robinson Bayou, and Clear Creek. Park rules should also be posted for public information.

EDUCATION GOAL 10: Install educational signs for conservation goals of Nature Center, description of habitats, description of trees, wetland plants, wildflowers, birds, and small mammals found in Nature Center.

Community Engagement

Residents of the area often wish to memorialize individuals by planting a tree. For the Nature Center, this practice could be considered and managed by Parks Staff and recorded in a database that is accessible at the Parks Department Office. Donations for purchase of trees for reforestation could also be made available to the 'Patrons of the Park Foundation' and properly acknowledged through established Parks Department procedures.

EDUCATION GOAL 11: Work with Parks Department Office in establishing a program for planting trees as memorial for community members.

F. Exhibits

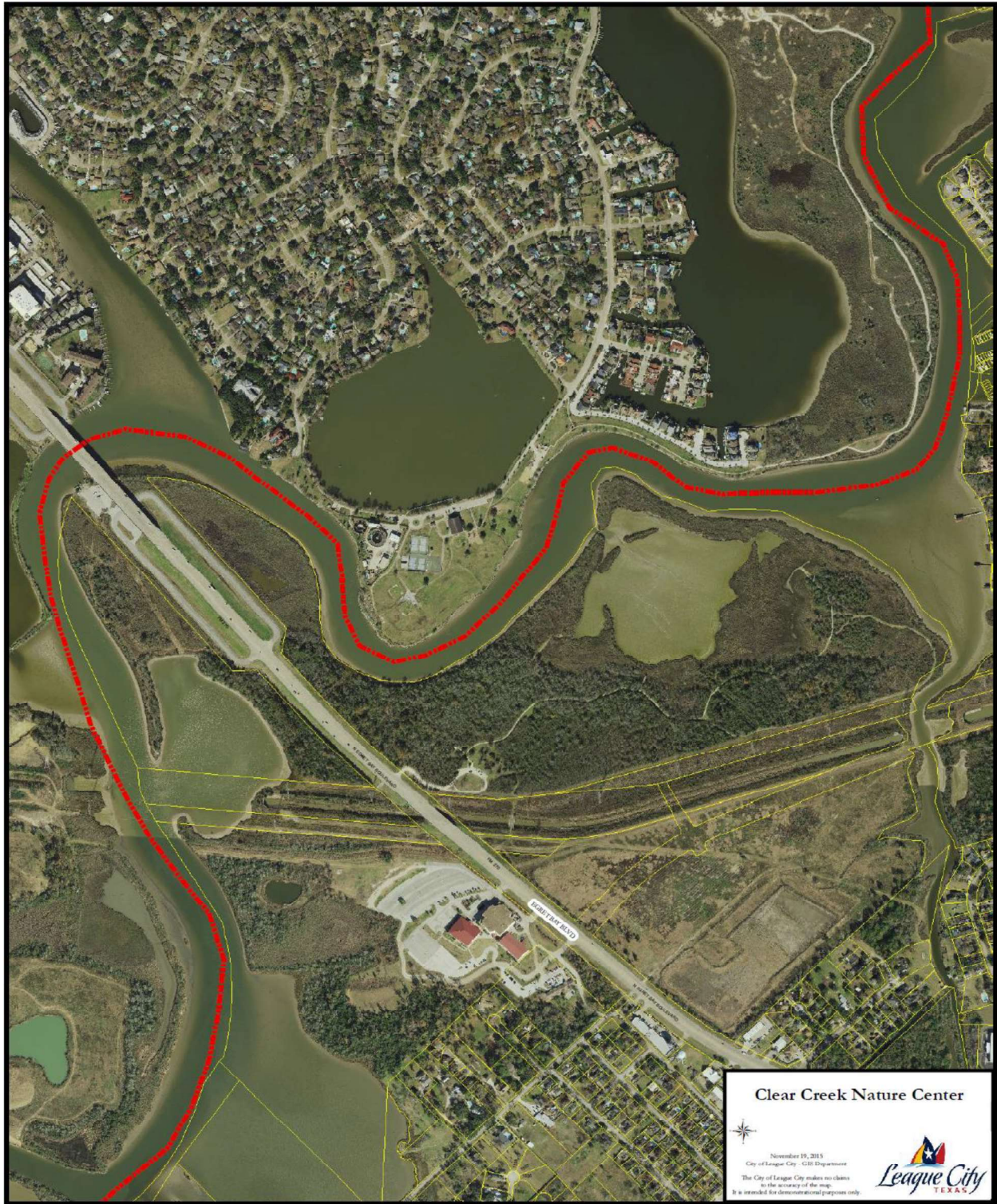


Figure 15. Nature Center Aerial Photo - 2012



Figure 16. Nature Center Historical Photo - 1943.



Figure 17. Nature Center Historical Photo - 1988.

G. Resources

National Coastal Wetland Conservation Grant Program application. Texas Parks and Wildlife Department.

List of Animals Observed or Indicated within the Nature Center.

Preliminary Ecological Assessment.

Project Narrative.

Davis Tract, Background Information.

Photos courtesy of Woody Woodrow, U.S. Fish and Wildlife Service, Texas A&M System, AgriLife Extension Service, Texas Parks and Wildlife Department, City of League City, Katie Oxford, Will Cook, Manjith Kainickara, Anthony Addison, Campbell and Lynn Loughmiller, Monarch-butterfly.com, imagejuicy.com, wiredin.cc, K. Smith Media, Hudson Geography, waymarking.com, rpt1957, and Google Earth.

Other References:

The Quiet Invasion: A Guide to Invasive Plants of the Galveston Bay Area, www.galvbayinvasives.org

Paradise Lost? The Coastal Prairie of Louisiana and Texas, U.S. Fish and Wildlife Service, U.S. Geological Survey.

The Midden, Galveston Bay Area Chapter - Texas Master Naturalists, August 2015.

The Daily News, August 1, 2015.

Native Trees and Shrubs:

Post Oak *Quercus stellate*

Cedar Elm, *Ulmus crassifolia*

Sugar/Hackberry (*Celtis occidentalis*)

Swamp Chesnut Oak, *Quercus michauxii*

Water Oak, *Quercus nigra*
Willow Oak, *Quercus phellos*
Black Gum, *Nyssa sylvatica*
Drummond Red Maple, *Acer rubrum* var. *drummondii*
Green Ash, *Fraxinus pennsylvanica*
Parsley Hawthorn, *Crataegus marshallii*
Rough Leaf Dogwood, *Cornus drummondii*
Indigo Bush or False Indigo, *Amorpha fruticosa*

For more references see the Native Plant Society of Texas – Houston Chapter web site at: www.npsot.org/houston