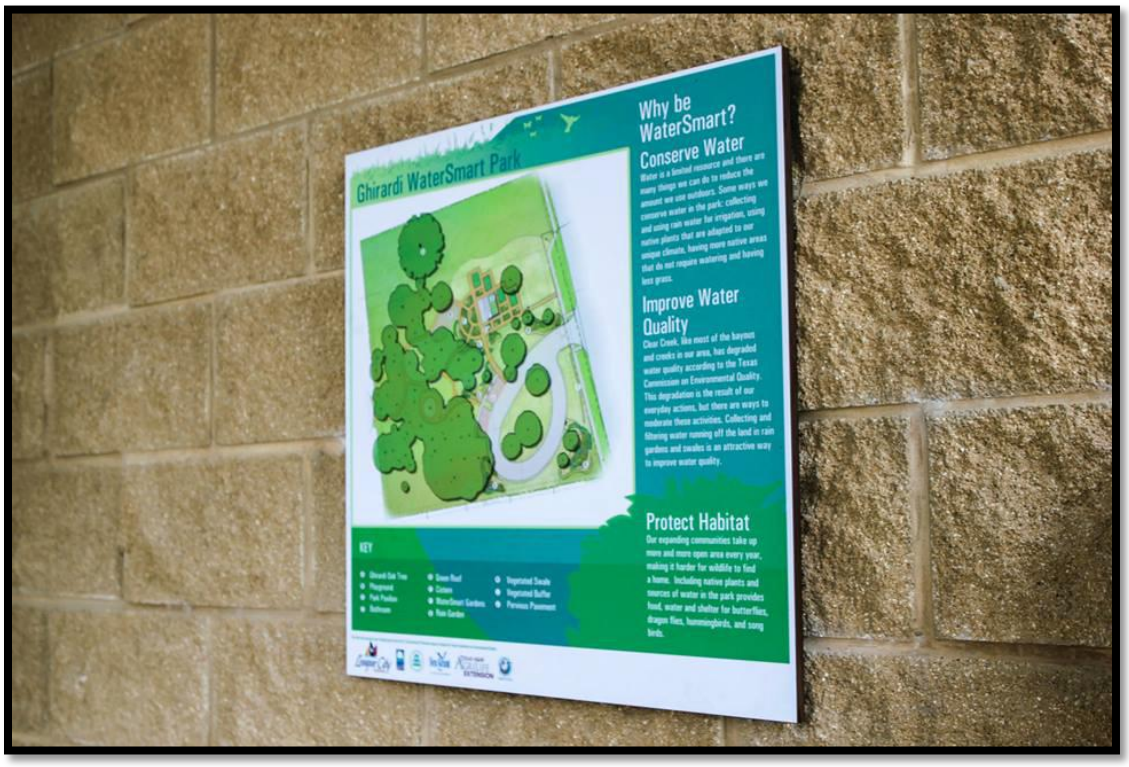
WATERSHED PLANNING AND IMPLEMENTATION IN GALVESTON AND BRAZORIA

COUNTIES



Final Report
February 2014

TCEQ Contract No. 582-11-13415

GALVESTON BAY ESTUARY PROGRAM
A PROGRAM OF THE TCEQ

TEXAS A&M AGRILIFE EXTENSION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Project Element 2: Highland Bayou Regional Watershed Protection Phase II

Task 2 Objective: To develop the first five elements (A-E) of a watershed protection plan (WPP) for Highland Bayou in accordance with Environmental Protection Agency (EPA) guidelines for a successful nine-element watershed protection plan using characterization data and information collected under Phase I. Phase I was funded under the American Recovery and Reinvestment Act.

Task 2 Summary

Galveston and Brazoria counties drain to the lower Galveston Bay watershed. This watershed is bordered on the east by the Interstate 45 causeway to Galveston Island and extends to the western edge of the Austin-Bastrop Bayou sub- watershed in eastern Brazoria County. It is bordered on the south by the waters of West and Christmas Bays and extends north to the upper reaches of Chocolate Bayou. Highland and Mustang Bayous lie within the area. Alvin, Angleton and Santa Fe are the few municipalities in the sub-watershed with populations of greater than 10,000 people. This watershed is the least developed area on the western side of Galveston Bay. Water and sediment quality is generally meeting water quality standards except in Highland Bayou, which is listed on the 303 (d) List of Impaired Waters for low dissolved oxygen and high bacteria concentration. The bacteria impairment is classified as Category 5a and the dissolved oxygen impairment is classified as Category 5c.

This grant supported watershed-based water quality management initiatives including continuing development of a watershed protection plan for Highland Bayou and demonstrating application of best management practices to reduce nonpoint sources (NPS) of pollution for local governments and communities to implement. Upon completion and approval of the WPP, project results will be shared with the regional community of developers, planners, local governments and special districts as well as local communities within the watershed.

Task 2.1 Water Quality (WQ) Data Analysis

Texas AgriLife/Texas Coastal Watershed Program (AgriLife) will update the analysis of trends and spatial patterns using water quality data acquired during the data monitoring program of the Characterization Phase I completed under the American Recovery and Reinvestment Act, August 2011. AgriLife will perform a summary analysis for major waterway segments in the project area, and an in-depth evaluation for the 303 (d) segments in the project area. The in-depth analysis will include an analysis of trends and spatial patterns in water quality. Data will be compared to both regulatory and toxicologically significant endpoints where appropriate. The analysis will follow assessment methodologies described in an approved Quality Assurance Project Plan (QAPP) for the project.

Existing water quality data was reviewed and tabulated for the watershed through collaboration with the Texas Water Resources Institute. Tabulated values were further broken down into catchments to better understand where in the watershed the best and worst values

were observed. This analysis of water quality data provides a picture of the frequency, variation, and significance of observed values for each pollutant of concern.

Task 2.2 QAPP. AgriLife will update/amend the Highland Bayou Regional Watershed QAPP to address work and schedule of deliverables outlined in this Scope of Work

A Quality Assurance Project Plan was developed and executed for this phase of the project on June 5, 2012. A three month extension of the QAPP was approved by EPA to allow continued work until the end of the contract period. A new QAPP will be developed for work continuing into FY2014

Task 2.3 Identify Likely Pollutant Sources (Element A of EPA Guidelines). Using the water quality data analysis and other relevant data, AgriLife will identify and describe water quality problems, possible sources and source areas within the watershed

Both point sources and NPS will be considered for pertinent pollutants of concern as noted on the 303(d) list for this water body. The identification will describe sources that are affecting watershed conditions and provide a guide for which sources need to be addressed by the watershed protection plan. The sources will be described at a detail that will result in effective control and improvement. The analysis will identify sources and land use classifications that are likely to factor into the Model Analysis (Task 2.4).

Likely pollutant sources in the Highland Bayou watershed include urbanization and impervious surface cover, household and commercial behaviors, landscape practices, feral hogs and wildlife, failing septic systems and municipal infrastructure. Through stakeholder meetings and discussions with local residents other sources were identified such as illegal discharges from boats and RVs, and litter from dumping. Agricultural uses and ranching have been declining over time, but it is still understood to be a contributing source in the watershed. The area's high water table and flat topography makes the region prone to flooding, and sewer overflows have been observed after heavy rains. Map layers showing land use, impervious surface cover, and soil types were used to characterize and define contributing NPS areas in the watershed.

Task 2.4 Model Analysis and Pollutant Load Estimate (Element A & B of EPA Guidelines)

AgriLife will utilize a model recommended in Task 2.5 Model Analysis of Phase I of the project. AgriLife will identify appropriate parameters and data to be utilized in the model. Recorded data and model outputs will be compared and used to calibrate the model. Modeling will estimate potential pollutant loads for each pollutant of concern for 303 (d) listed segments in the watershed. Pollutants of concern include Bacteria, Nitrogen, Phosphorus, and Total Suspended Solids. The model will help plan restoration strategies, target load reduction efforts, and project future loads under new conditions. The model outputs will be used, in part, to determine load reductions to achieve pollution reduction goals and to identify possible pollution and NPS management measures (Task 2.5).

Two pollutant load modeling tools (STEP-L and the SIMPLE Model) were selected and used to model pollutant loading rates within the Highland watershed. Both models rely on land use data, impervious surface cover, and soil information to predict runoff loads. Mapping data was

either directly utilized by the model (SIMPLE) or summarized for use in the model (STEP-L). Together with precipitation and loading rates (Even Mean Concentrations, EMCs), the models calculated load values for each defined catchment in the watershed. EMCs were gathered from reported literature values from around the country, with a strong emphasis placed on EMCs that correspond to the conditions of the Texas Coast. The modeling results were tabulated and compared to observed values. Modeled concentration values were consistent with observed values in the watershed, although inputs will be further calibrated. Modeling outputs will be used to determine the load reductions and to identify appropriate NPS management measures. The modal can also be used as a predictive tool for anticipating loading rates based on future land use scenarios.

Task 2.5 Develop Management Measures (Element B, C, & D of EPA Guidelines)

AgriLife will develop watershed protection plan management measures by completing the following sub-tasks:

- *Set Overall Goals and Management Objectives. AgriLife will identify preliminary goals for water quality improvements on the basis of the water quality data analysis, modeling, and issues identified in the public participation process. Management objectives will incorporate watershed goals to focus on specific processes that can be managed.*
- *Develop Indicators. AgriLife will work with the public and stakeholders to identify indicators that link pollutants of concern to environmental conditions in the Project Area.*
- *Develop Load Reduction Targets and Identify Management Measures to Achieve Targets. Using data analysis and model results, AgriLife will determine the load reduction targets for pollutants of concern. AgriLife will work with stakeholders to propose potential management practices to achieve these reductions. AgriLife will identify the possible range of load reduction to be achieved from each proposed management measure. The locations or areas where the management measures are proposed for use will be identified.*
- *Identify Technical and Financial Assistance Needed to Implement Measures. AgriLife will gather information about the financial costs for the preferred management measures, and will share with stakeholders to obtain feedback and to rank preferences for management measures. Information about possible funding sources for implementation will be provided. In partnership with stakeholders, AgriLife will identify the need for technical assistance or resources to implement the management measures.*
- *Evaluate and Select Preferred Management Measures. Preferred management measures will be identified through a stakeholder process and in consideration of location, reductions to be achieved, regulatory requirements, property ownership, site access, secondary benefits, physical factors, infrastructure, and upkeep. Responsibility for implementing each management measure will be identified.*

The Highland Bayou WPP outlined the broad actions and management measures necessary to guide the development of the eventual recommendations. Commonly used best management practices (BMPs), planning tools, and land development practices were summarized. Potential state and federal funding opportunities for Highland Bayou communities were also researched and tabulated. Factsheets on these resources were created and posted to the project website.

Load reductions will be developed in the next phase of the planning process, enabling the project to develop reduction targets, identify indicators and recommendations. Engagement with the public and stakeholders will be ongoing and essential for fleshing out the details of the watershed protection plan, and preferred management measures will be developed through this dialogue and in consideration of location, reduction targets, funding sources, physical factors, and upkeep.

Task 2.6 Develop Information Education Component (Element E of EPA Guidelines)
AgriLife will develop, in partnership with the stakeholder group, a public participation work plan that includes an information and education component to enhance public understanding of the project and encourage early and continued participation in selecting, designing, and implementing the NPS measures. The public participation plan will set forth goals and objectives, identify target audiences, and propose actions to engage those audiences.

Online public outreach is maintained through a Facebook page and a site at the Texas Coastal Watershed Program main website, hosted by Texas A&M University. The Highland Bayou WPP effort is continually seeking how to summarize and package information for use by stakeholders and the public. Many aspects of a watershed protection plan- funding sources and BMPs have been prepared as fact sheets and are also accessible online. Press releases for events were publicized through local media outlets. Annual events in the watershed have been positive venues for talking one-on-one with residents and businesses about the watershed and related issues.

AgriLife initiated a Highland Bayou volunteer water quality monitoring group in Fall 2012. This was coordinated through trainings with the Texas Stream Team. AgriLife purchased and distributed water quality monitoring kits to monitoring volunteers. Monitoring is intended to identify emerging issues and changing conditions on the bayou.

Task 2.7 Public Meetings and Stakeholder Engagement.
In spring 2012, AgriLife initiated outreach to municipalities through presentations at city council meetings. The presentations introduced each municipality to the Highland Bayou initiative, its goals, and closed with a request to collaborate with city staff on the WPP. Five meetings were held with local municipalities, one each in Bayou Vista, Hitchcock, Santa Fe, La Marque, and Texas City. A follow up meeting was held in La Marque with the city manager and the city department heads. In support of engagement with local officials, a binder containing information about the Highland Bayou initiative and watershed concepts was prepared and handed out. The Highland Bayou initiative also presented at the Galveston County Stormwater Collaborative, which was a chance to introduce the project to Water Control and Improvement Districts (WCIDs), drainage districts, and the County Health District.

In February 2012, AgriLife sponsored Texas Water Resources Institute's day long Watershed Stewards Course, which was attended by 25 residents and land owners in the watershed. AgriLife also set up information booth at two community-based events in the watershed. AgriLife set up a booth in at the Texas City Trash Bash and the Hitchcock Good Ol' Days Festival.

Visitors were asked to sign a pet waste pick up pledge and conduct a brief survey of issues on the Bayou. Brochures and factsheets were distributed. These events were also an opportunity for one-on-one conversations with local residents.

Task 2.8 Draft Watershed Protection Plan.
AgriLife will begin drafting the watershed protection plan. The draft plan will contain a table of contents and will note sections that are incomplete or pending future work. The draft plan will document all deliverables required under Task 2 and include the first five elements (A-E) of EPA's nine minimum elements for a watershed protection plan.

Though Elements A–E were addressed through this agreement and the previous ARRA agreement, the FY2014 contract will fund additional updates of elements A–E and development of elements F-I. It is anticipated that the WPP will be submitted to the Texas Commission on Environmental Quality (TCEQ) around the spring of 2015. The project has been expanded to include waters from Moses to the Karankawa Bayous.

The anticipated schedule provided at the end of this contract period is as follows:

<u>2014-2015</u>
- Revise and execute Quality Assurance Project Plan
- Update of elements A-E of the EPA's guidelines for a successful nine-element WPP;
- Develop elements F-I;
- Continue implementation of education and outreach program; and
- Identify and apply for two grant funding opportunities to implement aspects of the draft WPP.

Notable Deliverables for 2014-2015:
1. Interim draft of Highland WPP: April 2015
2. Website and Facebook page for publicity and public education purposes: May 2015
3. Volunteer water quality monitoring report: March 2016
4. Stakeholder meetings among local officials for each of the five municipalities in the watershed (minimum 3): January 2016
5. Two draft grant applications to implement aspects of the WPP: April 2016
6. Revised draft of WPP: May 31, 2016

Project Element 3: Storm Water Wetland in Brazoria County

Project Element Objective

Plan, design, and install a wetland to improve the quality of storm water runoff. Wetlands can be created in an existing storm water drainage way or detention basin specifically retrofitted to treat storm water.

Task 3.1: Site Selection and Project Working Group Development

Inquiries for potential sites in Brazoria County began immediately after filling the Storm Water Wetland Program coordinator position in December 2012. However, in order to make the March 2013 closing date for all contract expenses, two project sites were selected (with the approval of the TCEQ Project Manager at the time) with which AgriLife had a level of ongoing development. These sites are in the Lower Galveston Bay watershed, as is much of Brazoria County, and contribute to the awareness of storm water BMPs in the area and to the water quality of Galveston Bay.

Project 1: Floating Wetlands Demonstration Project at Clear Creek Independent School District's (CCISD) Education Village in League City, TX

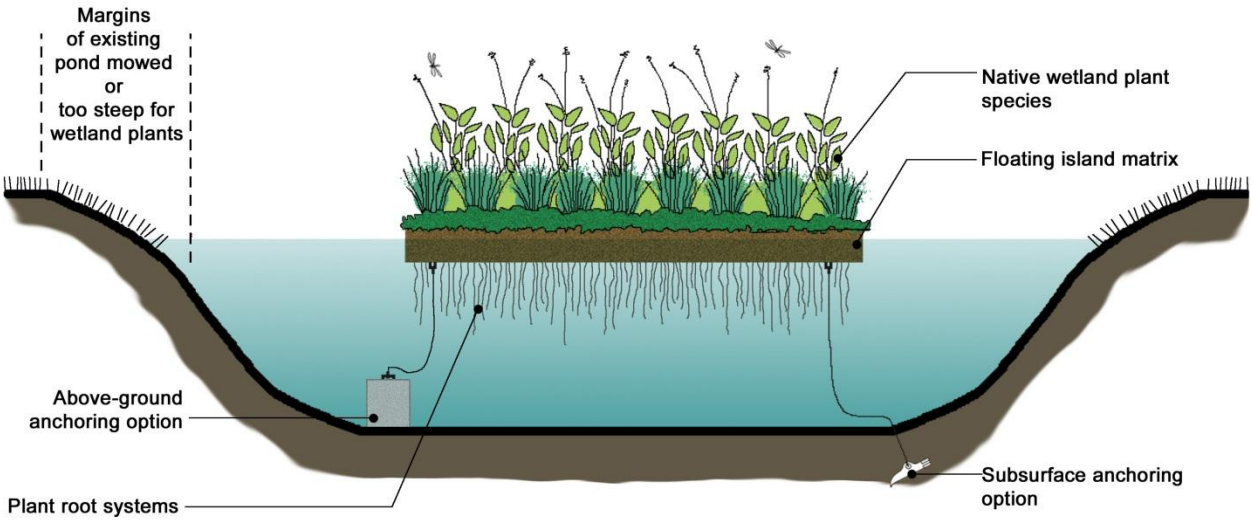
The education Village storm water detention basin in May 2013, showing the establishment of iris, spike rush, green sedge and other wetland species in the foreground, and campus buildings in the background. Source: AgriLife

The campus of the CCISD Education Village encompasses an 11-acre storm water detention basin which discharges into Gum Bayou and is in the Dickinson Bayou watershed. Approximate coordinates are 29°30'19.89"N, 95° 1'28.86"W. The basin was the site of a storm water wetland installed in 2011 with the support of TCEQ contract 582-11-94140. Populations of wetland plant species have become established on the margins and slopes of the basin. The original wetland planting plan executed by AgriLife in 2011 provided deep-water plants for the central area of the basin. However, groundwater discharges into the wetland, and nutria predation of the deep

water species, culminated in the current open water conditions. The detention basin has an approximate 3’ depth at the center and additional depth after rain events. Few wetland plant species tolerate this depth and fluctuation. The depth is not critical for floating wetlands, however, which are able to rise and fall with the water level.

Aerial view of the Education Village campus showing the detention basin prior to grading and wetland planting in 2011. Source: CCISD

A floating wetland is a raft of recycled polyethylene terephthalate (PET) plastic fibers that floats on the water’s surface and houses native wetland plants. These floating wetlands have plant, soil and root interactions similar to a natural wetland and provide substrate for beneficial water-cleansing microorganisms. Floating wetland islands are anchored to stay in one area of the basin but can rise and fall as the water level in the basin changes. These islands can be installed in an existing wet basin without re-grading the side slopes or other costly retrofits.



Typical section of a floating wetland. Source: AgriLife

AgriLife coordinated planning meetings with CCISD teachers, administration, and community members in the development of this project. CCISD teachers from all three schools at the Education Village have expressed an interest in developing the detention basin's potential as an outdoor classroom. There is a desire to reinforce class materials on ecology, the water cycle, local flora, fauna and ecotypes, etc., with direct observation and engaging lab experiments in nature. The floating wetlands project will allow for student experiences in growing, propagating, and planting with wetland species.

Floating wetland island in Baltimore Harbor. Source: National Aquarium

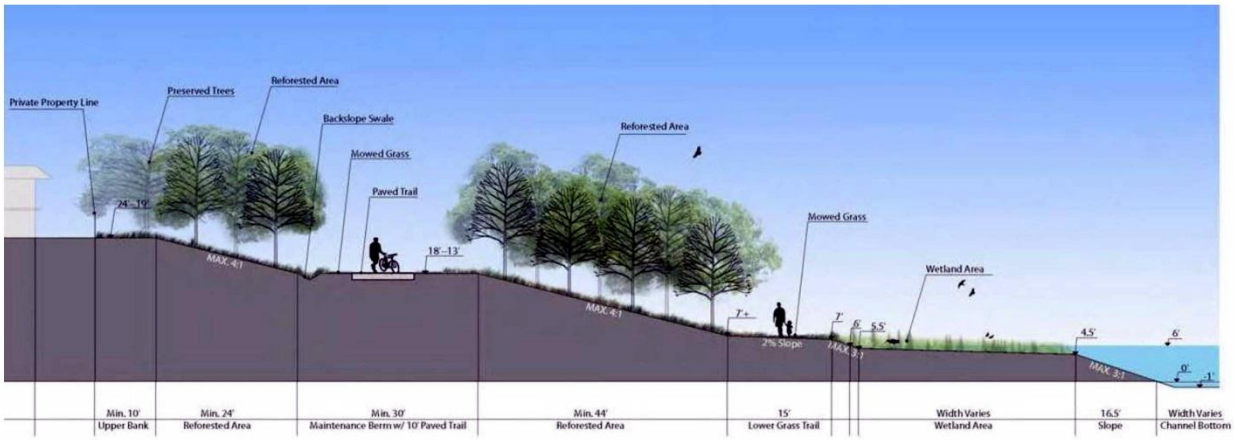
Project 2: Feasibility Study for Clear Lake City "Exploration Green" Storm Water Detention Park
The Houston suburb of Clear Lake City was developed in the 1960s around a golf course. The golf course has been defunct for a number of years, leaving a ribbon of informal green space and drainage. The park discharges to Horsepen Bayou and is in the Clear Creek watershed. Approximate coordinates are 29°33'48.10"N, 95° 7'14.08"W. The property is now under the ownership of the Clear Lake City Water Authority (CLCWA), which has developed a Master Plan for replacing the golf course with a 178 acre storm water detention park dubbed "Exploration Green". A copy of the Master Plan is available at http://clcwa.org/detentionfacs.htm.
While storm water detention is a primary goal of the conceptual design presented in the Master Plan, the sizing of the wetland areas was based on a general overall landscape plan

which also provides ecosystem services to the public that include a park and recreation activities. In order to develop the proposed wetlands based on storm water volume calculations, a feasibility study was commissioned by AgriLife as a partner in the development of the proposal for Exploration Green.

WATER STORAGE (ACRE FT)	WATER AREA (ACRE)	WETLAND AREA (ACRE)	ISLAND AREA (ACRE)	TRAIL LENGTH (MILES)
1680	38	39	2.5	6.0

Overall view of the park extracted from the proposed Master Plan. Source: CLCWA

The primary objective of the feasibility study is to optimize the size of the proposed storm water wetlands for maximum effectiveness. The ideal for the wetlands would be to retain 12" of storm water for two days to allow for improvements in water quality. Options for maximizing the acreage of wetlands to meet that goal must be weighed with other factors such as maintaining areas of open water for kayaking, inflow and outflow through existing structures. AgriLife coordinated meetings and information flow between CLCWA, their project engineers and landscape architects, and the study's engineer group.



Typical section of the park extracted from the proposed Master Plan. A generalized wetland area can be seen to the lower right. Source: CLCWA

Task 3.2: Storm water Wetland Outreach campaign

Project 1: Floating Wetlands Demonstration Project at CCISD's Education Village

AgriLife spearheaded a meeting to introduce the floating wetlands, as well as other outdoor classroom-related projects, to school staff and community and Texas Master Naturalists. Speakers included a Texas Parks and Wildlife Department urban biologist, and a Texas A&M graduate student conducting water quality tests at the detention basin. A presentation on floating wetlands was given. Twenty-two people attended the June 3, 2012 meeting on campus.

Project 2: Feasibility Study for Clear Lake City "Exploration Green" Storm Water Detention Park

The Exploration Green Master Plan was released at a public Town Hall meeting in Clear Lake City in March 2013, and AgriLife was introduced as a consultant and storm water specialist for the project. Approximately 250 residents and stake holders attended, per CLCWA's headcount.

Task 3.3: Wetland Engineering and Design

Project 1: Floating Wetlands Demonstration Project at CCISD's Education Village

No additional engineering design was required for the floating wetlands demonstration project. Three floating wetland islands, 80 square feet each, have been purchased along with the anchoring cables.

Project 2: Feasibility Study for Clear Lake City "Exploration Green" Storm Water Detention Park

AgriLife engaged the services of a hydrology engineer specializing in storm water management to conduct the storm water feasibility study. The objectives of the report are to:

- Estimate the detention capacity of the water and wetland areas of each of the phases based on the present design, suggest modifications where necessary,
- Design outlet structures that will maximize the treatment of the wetland design storm,
- Estimate the excavation requirement of the project, and
- Provide a cost estimate of the project.

Projections and implementation past August 31, 2013
The final results of both projects in Task 3 are pending.

Project 1: Floating Wetlands Demonstration Project at CCISD's Education Village
AgriLife has obtained approval from CCISD for the installation of the floating wetlands and a Memorandum of Understanding is being finalized (Please see an attached draft of the MOU and a copy of the project proposal to CCISD). The islands will be installed as a school and community effort in the fall 2013 semester. A school-wide planning meeting to select a date and coordinate volunteers occurred September 12, 2013. It was the first installation of floating wetlands in a public school in Texas. The installation and outreach of this project continues with the support of TCEQ contract 582-12-22870.

Although the 240 square feet total of floating wetland is expected to be too small for measurable effects in water quality, the high-profile location, future outreach materials, and broad interest already expressed in the project will contribute to raising awareness about the beneficial effects of wetlands.

Project 2: Feasibility Study for Clear Lake City "Exploration Green" Storm Water Detention Park
The final engineering report will be distributed to partners of the project, including the landscape architects and engineers, to incorporate the report's findings into the design development phase. The current projection until breaking ground on the first phase of Exploration Green is 1.5 years.

Project Element 4: Low Impact Development Demonstration – Ghirardi WaterSmart Park

Project Element Objective:
To facilitate implementation of low impact development practices in Galveston County. Texas AgriLife worked with League City and appropriate project partners to design and install storm water best management practices at a new city park.

Project Element Summary:
Construction on the Ghirardi Family WaterSmart Park began in April 2013, and faced delays due to rain, and was completed in the spring of 2014. The park is a 3.75 acre neighborhood space that has a pavilion, walking trails and a playground. It also has special features including rain gardens, a cistern to collect rain water for irrigation, a green roof on the pavilion and WaterSmart landscapes. It is also home to a 100+ year old Compton Oak tree that was moved there in 2012. The park is a collaborative effort between Texas Sea Grant at Texas A&M University, League City, the Galveston Bay Estuary Program, and The Texas Commission on Environmental Quality. The WaterSmart Park is the first of its kind in League City and one of the first of its kind in the entire state.

The Ghirardi Family WaterSmart Park design was based on the three principles of WaterSmart Landscapes: water conservation, water quality and habitat for wildlife. These three elements are seamlessly integrated with typical park features to create a unique and water-conscious park.

Water conservation strategies used in the park are: collecting rain water and using it for irrigation instead of turning on the hose, using native plants that are adapted to the unique climate of the area, and having more native areas and less lawn. Collecting and filtering water running off the land in rain gardens and swales is an attractive way to improve water quality. And by including the native plants and water sources, the park provides food, water and shelter for butterflies, dragon flies, hummingbirds, and song birds.

Monitoring the storm water Best Management Practices (BMPs) is another important aspect of Ghirardi Family WaterSmart Park. Texas Sea Grant is monitoring the effectiveness of the storm water management features with the unique soils and climate that have not been studied well in this area. Additional funding for monitoring will be provided by the TCEQ's Non-Point Source and Galveston Bay Estuary Program. This data will help quantify the benefits of features like rain gardens and swales, providing information for local decisions makers to make the use of these practices part of their codes and ordinances.

Figure 1: Ghirardi WaterSmart Park Entrance Sign

Figure 2: Vegetated swale that moves water through the park

Figure 3: Green roof on the pavilion and WaterSmart Gardens

Figure 4: Pervious interlocking concrete pavers in the parking area

Figure 5: The largest of the four rain gardens in the park

Figure 6: Curb cut that allows water from the parking area to flow into this rain garden for treatment

Figure 7: Ribbon Cutting Ceremony at Ghirardi Park held March 22, 2014