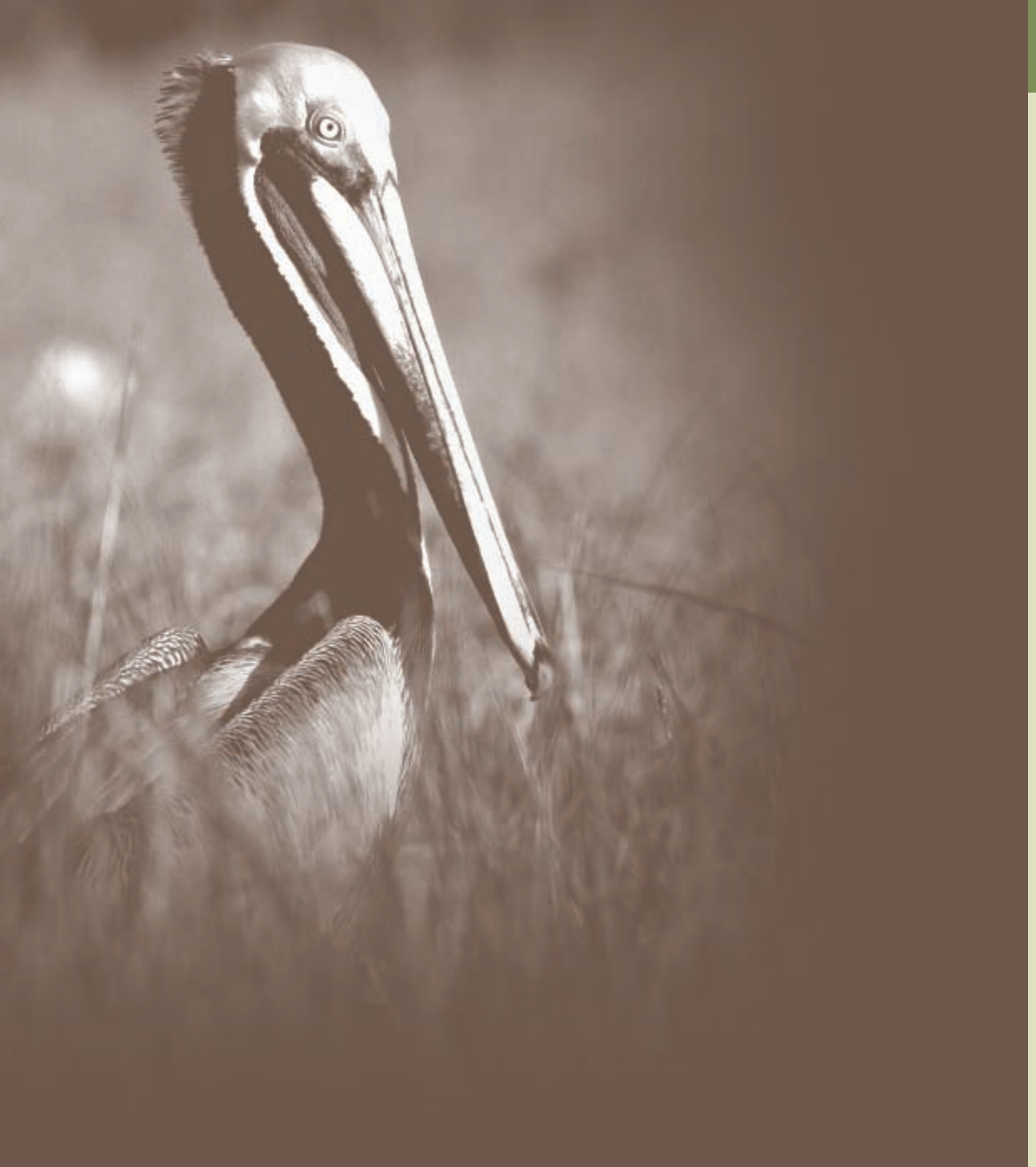
HOW'S THE WATER?

08

basin HIGHLIGHTS report



Above:
Eastern Brown Pelican (Pelecanus occidentalis)
Photo courtesy of Woody Woodrow

Cover Photo:
Little Blue Heron (Egretta caerulea) standing among exotic, non-native Elephant Ears (Colocasia esculenta)

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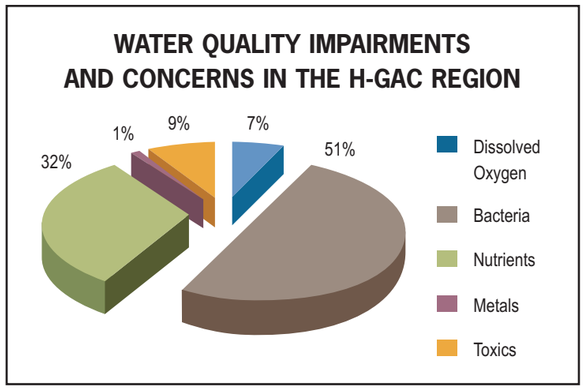
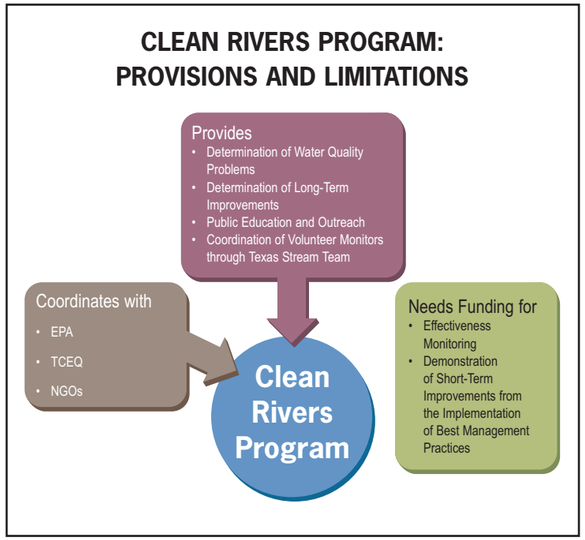
So, How's The Water?

The biggest sources of concern in the Houston-Galveston Area Council (H-GAC) region continue to be bacteria, nutrients and dioxin. The dioxin concerns are mostly limited to the Houston Ship Channel (HSC) and Upper Galveston Bay. Bacteria impairments and nutrient concerns occur in streams throughout the entire area. Specifically, the TCEQ recently released Draft 303(d) List of Impaired Water Bodies shows the following information for the H-GAC region:





Improving our water quality will not be easy. It will not be cheap. And, it will not only be the responsibility of our local, state and federal agencies. It will take the voluntary efforts of everyone in our region. H-GAC's CRP is committed supporting these efforts by:

- Providing consistent and reliable data for the region's major waterbodies. H-GAC works with local agencies to coordinate and leverage resources to enhance the understanding of water quality conditions and trends.
- Conducting special studies. H-GAC focuses Clean Rivers funding on specific areas or concerns. Especially important are those studies that can give the region a better handle on how to reduce pollution in stormwater runoff.
- Raising public awareness. H-GAC has a wide variety of programs that helps provide the region's residents with information and actions they can take to improve our water quality.

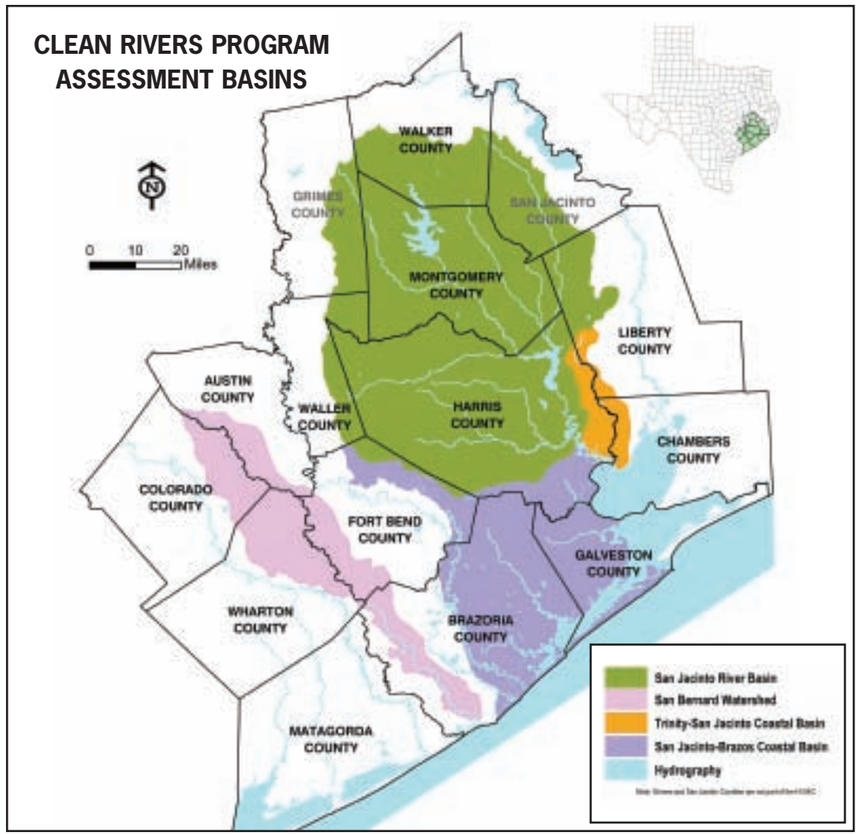
This report highlights the achievements of the H-GAC CRP during 2007 and provides a snapshot of water quality conditions and issues in the region. We you find it a useful guide to help address the challenges we have in protecting this most important resource. For more information on the CRP and H-GAC's other water quality planning activities, please go to ***www.h-gac.com/water***.

Water Quality in 2007, Year in Review

H-GAC and its CRP partners continued to make great strides in 2007, enhancing water quality data collection, strengthening quality assurance and streamlining the data management process. For the first time since the CRP began, H-GAC started collecting water quality samples. In most cases, H-GAC is sampling in rural areas in the upper portions of watersheds where no local monitoring partners existed. Local agencies conducting water quality monitoring under H-GAC's Regional Quality Assurance Project Plan (QAPP) include:

- City of Houston Department of Water Quality Control
- City of Houston Department of Health and Human Services
- City of Pearland
- Environmental Institute of Houston
- Harris County Environmental Public Health Division
- San Jacinto River Authority – Lake Conroe Division
- San Jacinto River Authority – Woodlands Division
- H-GAC

Together, these agencies collected ambient water quality samples at more than 300 sites during 2007. This sampling resulted in the collection of data in well over 3,100 separate sampling events and produced more than 69,000 individual results.



Every March, H-GAC convenes a major Coordinated Monitoring Meeting, which includes all CRP partners, other local agencies doing water quality monitoring, staff from the TCEQ and other state environmental agencies. The focus of this meeting is to maximize available dollars by reducing duplication of monitoring sites and/or parameters monitored. In 2007, this coordination resulted in more accurate placement of monitoring sites and was the basis for H-GAC's monitoring site selection process. You can find a listing of the sites and parameters monitored in the H-GAC region on the H-GAC Data Clearinghouse Web page ***www.h-gac.com/dataclearinghouse*** or go to ***http://cms.lcra.org***.

H-GAC also continued to work with its CRP monitoring partners through the Regional Monitoring Workgroup. The group meets quarterly to discuss problems found during monitoring runs or difficulties encountered with various sampling methods or equipment. The workgroup also serves as a forum to convey new information from the TCEQ regarding quality assurance or data management issues.

H-GAC has forged ahead and adopted Statistical Analysis Software (SAS) as the tool to be used for data management and analysis. While there have been some challenges in getting the system implemented, it has paid off in the amount of time it takes to manipulate and quality assure data from local agencies.

In addition to coordination and quality assurance, H-GAC's CRP continued several initiatives in 2007 that added significant value to local water quality monitoring. H-GAC and its partner agencies continue to include field-filtered

Keep your next seafood dinner clean! Galveston Bay produces more than 4 million pounds of shrimp per year and takes in 60 percent of Texas' wastewater. Don't put chemicals in the stormdrain.

See *kprc.envirocast.net* for more information on the Going Green program.

Orthophosphate and Chlorophyll-*a* in their sampling. Measuring these parameters, along with new protocols for laboratory analysis, will provide a much better picture of nutrient levels in the region's waterbodies.

H-GAC is also continuing to collect detailed information on priority waterbodies by conducting a number of special studies throughout the region, which include: a water quality and biological characterization study in the Cotton Bayou and West Fork Double Bayou Watersheds. Both watersheds drain to Trinity Bay, which is in the northernmost section of the Galveston Bay system. The limited data that are available for these streams indicate some possible water quality concerns for low DO. The study was designed to collect data in streams that have historically had very little data collection. The final report for this study will be completed in August 2008.

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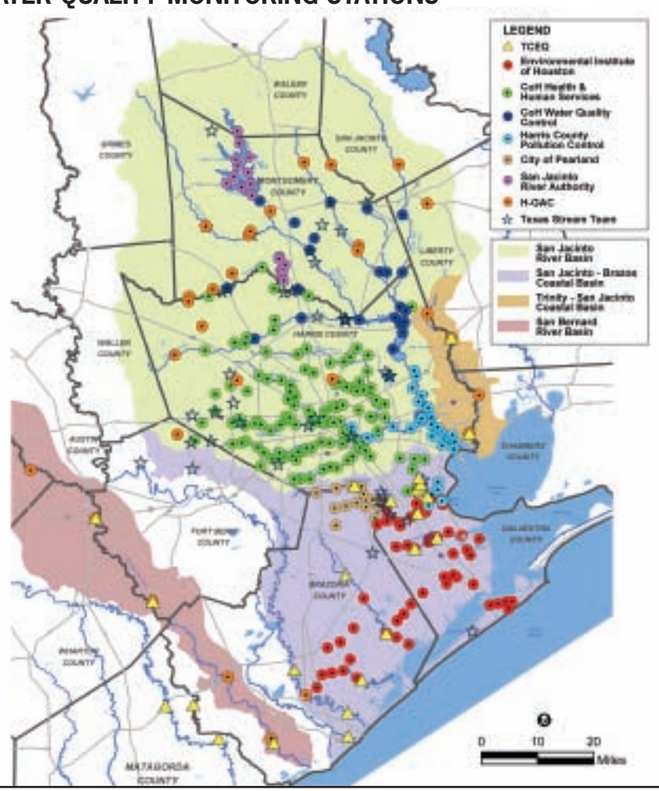
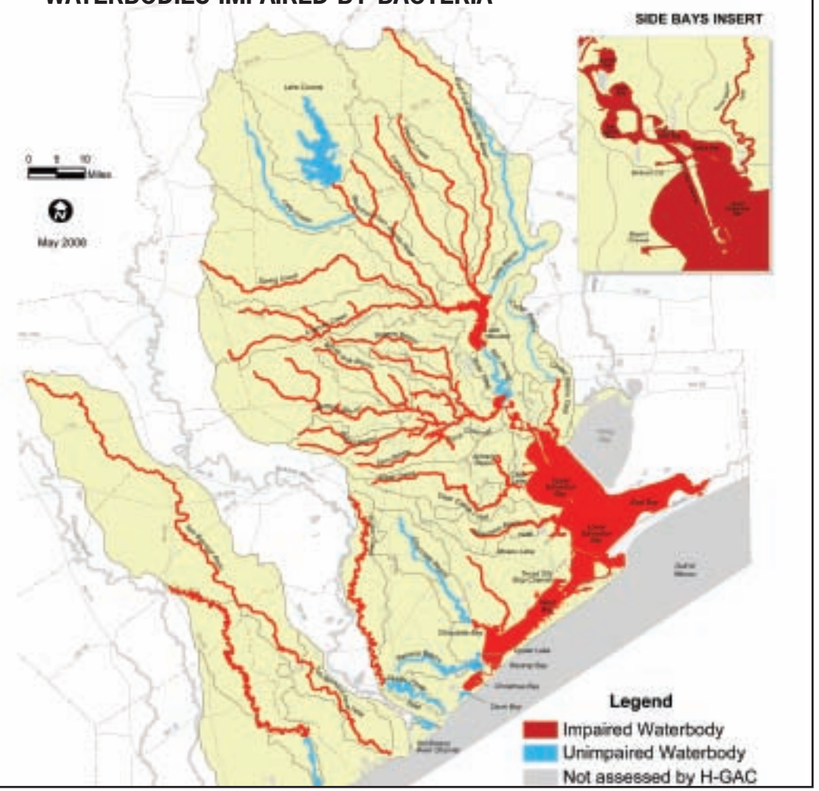
H-GAC and the TCEQ have partnered with local stakeholders to install a continuous monitoring station. Data from the station are being made available in "real time" to the Web. The station collects data on conductivity, DO, pH and temperature. Water quality samples collected by agency staff show only a snapshot in time. Having a monitoring station that is operating 24 hours a day gives water quality managers better insight into the hourly fluctuations in water quality.

WATER QUALITY MONITORING STATIONS



WATERBODIES IMPAIRED BY BACTERIA



Avoid adding bacteria to the source of your drinking water! Our region produces dog waste enough to fill 60 dump trucks each day. Bag it up and throw it in the trash.

See *kprc.envirocast.net* for more information on the Going Green program.

A water quality and biological characterization study in the Highland Bayou and Marchand Bayou Watersheds. Both watersheds drain to West Bay, which is in the westernmost section of the Galveston Bay system. The limited data that are available for these streams indicate some possible water quality concerns for low DO and elevated levels of bacteria. The study was designed to collect data in streams that have historically had very little data collection.

H-GAC began a study to determine the sources and amount of total suspended sediments being carried down the West Fork of the San Jacinto River. H-GAC has received numerous calls from citizens complaining about the turbidity of the waterbody.

Special Studies

Projects ranging from 18 to 24 months are conducted by H-GAC in cooperation with the TCEQ and other local partners for several reasons:

- To collect baseline water quality, biological and habitat data in areas of the region where little or no data have been collected before.
- To address specific issues or problems identified through previous assessments or local stakeholder concerns.
- To address water quality standards or permit issues.

The following section provides a brief summary of the projects that H-GAC completed, conducted or planned during 2007.

Cotton Bayou and West Fork Double Bayou Special Study

In 2006, the H-GAC partnered with the U.S. Geological Survey (USGS), the Trinity River Authority (TRA) and the TCEQ to collect data on Cotton Bayou and West Fork Double Bayou. Data describing physical, chemical, and biological characteristics was collected so the DO patterns and the aquatic life use in the fresh water portion of both waterbodies could be assessed in more detail. Data collection began in the summer of 2006 and was completed in September 2007. The data are being compiled and summarized so a final report can be completed by August 2008.

The Cotton Bayou watershed is located east of Houston with a drainage area of 16.5 square miles. With headwaters located north of Mont Belvieu, Cotton Bayou extends 6.6 miles to the southeast and drains into Cotton Lake, which empties into Trinity Bay (Segment 2422). The watershed is largely rural. Inputs to Cotton Bayou include runoff from unused land, agricultural fields, small municipalities and municipal wastewater treatment plants. The principal tributary to Cotton Bayou is Hackberry Gully and has similar land-cover and inputs. The TCEQ

Is your storm drain overflowing? If everyone in our region poured one teaspoon of grease down the drain weekly for a year, it could fill two Olympic - sized swimming pools. Put it in a can, and throw it in the trash.

See *kprc.envirocast.net* for more information on the Going Green program.

determined that DO within Cotton Bayou is impaired; however, this assessment was based upon only one set of samples, and those measurements were collected in the tidal portion of the bayou only. The City of Mont Belvieu requested more site-specific data that included the freshwater portion of the waterbody. Sites were established on Cotton Bayou and Hackberry Gully, the principal tributary to Cotton Bayou with similar landcover and inputs for comparison.

Preliminary results indicate that Hackberry Gully and Cotton Bayous have an intermediate aquatic life use.

The mean DO level in Hackberry Gully is 1.5 mg/L. While the mean DO level in Cotton Bayou is just below 5 mg/L.

The West Fork Double Bayou watershed is also located east of Houston near the City of Anahuac and has a drainage area of 35.1 square miles. With headwaters that extend into the Anahuac oil field east of the City of Anahuac, West Fork Double Bayou flows southwest approximately 14 miles to Trinity Bay. The watershed is mostly rural and, like the Cotton Bayou watershed, contains unused land, agricultural fields, small municipalities and municipal wastewater treatment plants. The TCEQ has determined that DO levels within West Fork Double Bayou are impaired. This study provides information that may be used to determine the current environmental status of the waterbody.

Preliminary results indicate that portions of West Fork of Double Bayou have an intermediate aquatic life use, while other areas have a high aquatic life use. The mean DO level in West Fork Double Bayou is 2 mg/L.

Highland Bayou and Marchand Bayou Special Study

In 2006, the H-GAC teamed up with the USGS and the TCEQ to conduct systematic data collection for assessment of Highland Bayou and Marchand Bayou. Data describing physical, chemical and biological characteristics was collected so the DO patterns and the aquatic life use in both waterbodies could be assessed in more detail. Another project goal was to identify the distribution and frequency of the bacterial contamination in these bayous. Data collection began in the summer of 2006 and was completed in September 2007. The data are being compiled and summarized so a final report can be completed by August 2008.

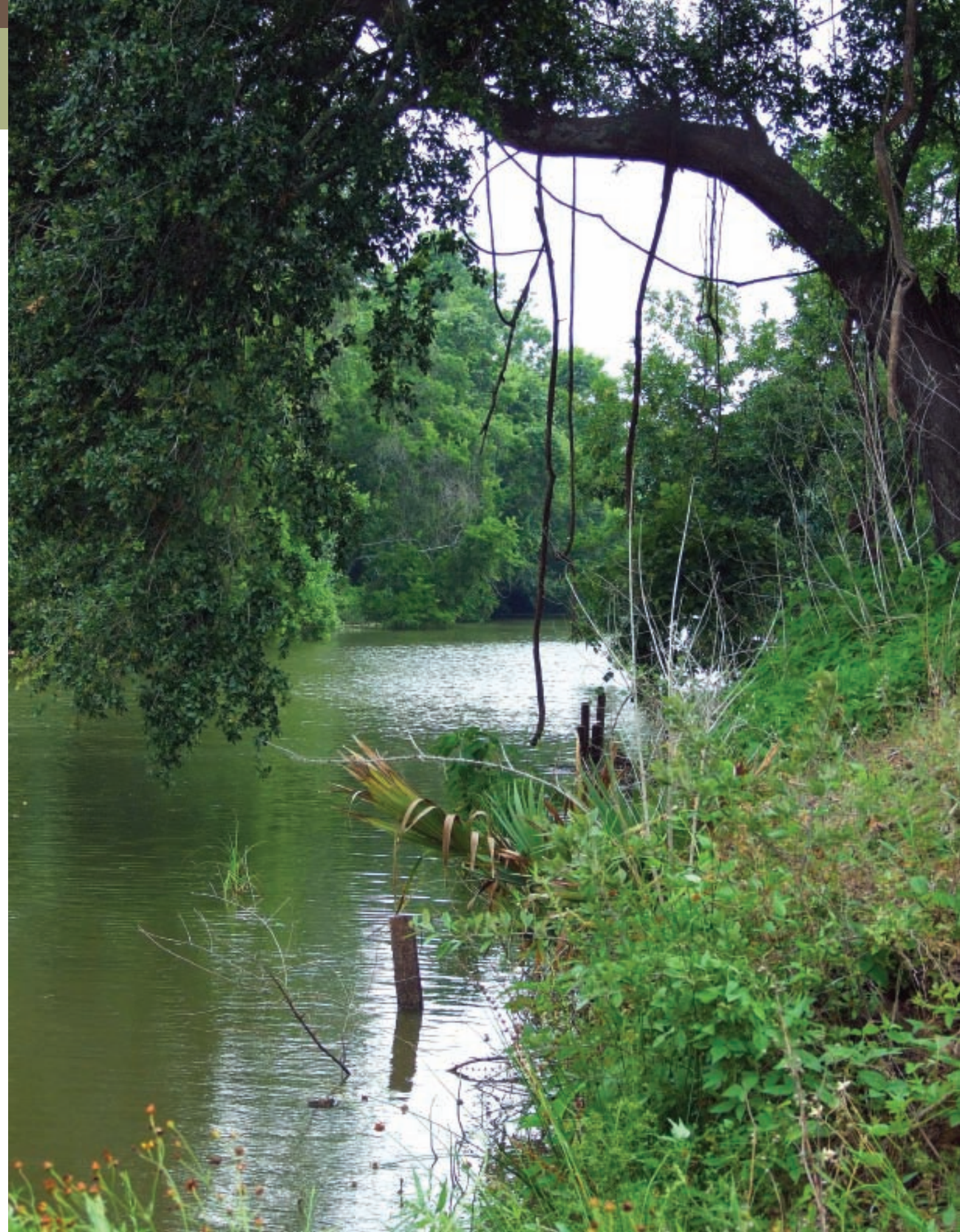
The Highland Bayou watershed is located southeast of Galveston County and has a drainage area of 34.8 square miles. With headwaters located near the town of Santa Fe, TX, Highland Bayou extends approximately 12.6 miles to the southeast and drains into Jones Bay, which empties into West Bay (Segment 2424). The watershed contains rural areas as well as highly-developed subdivisions and municipalities. Currently, the cities of La Marque and Hitchcock are the major urbanized communities in the watershed; however, urban density is increasing. Marchand Bayou is a smaller waterbody that drains into Highland Bayou near the middle of its course and shares similar land use characteristics with Highland Bayou. The TCEQ determined that both Highland and Marchand Bayous are not meeting designated water quality standards for DO and bacteria. Consequently, they have been placed on the 303 (d) List of Impaired Waters in the State of Texas. Assessment of environmental quality will provide information to determine the current status of these watersheds and provide a baseline to aid in recognition of emerging problems and water quality trends.

Preliminary results indicate that Highland Bayou has a limited aquatic life use while Marchand Bayou has an intermediate aquatic life use. Mean DO levels in Highland Bayou range from 1.7 mg/L in the uppermost portion of the stream to 7 mg/L further downstream. The mean DO level in Marchand Bayou is 7.1 mg/L.

Total Suspended Sediments Study on the West Fork of the San Jacinto River

A growing concern that has been identified locally and throughout the state is the impact of sand and gravel mining operations on water quality and aquatic habitat. Routine water quality monitoring rarely identifies high levels of Total Suspended Solids (TSS) because sediments fall out of the water column very rapidly. Unfortunately, unless field monitoring staff are present during a sediment release, high TSS levels may not be detected.

A recent investigation into the status and trends of selected contaminants in Lake Houston and its in-flows suggests that both the eastern and western portions of the San Jacinto River Basin above Lake Houston have differing water quality characteristics – including suspended sediment concentrations. Understanding the short-term and long-term temporal changes in the suspended sediment concentrations of in-flows into Lake Houston will assist in evaluating the effectiveness of watershed management plans and Best Management Practices (BMPs) utilized to protect downstream drinking water reservoirs and fisheries.



The purpose of this study is (1) to complement current and past studies conducted by the City of Houston, San Jacinto River Authority and the US Army Corps of Engineers in the San Jacinto River basin to develop a real-time water quality monitoring network to track changes in water quality on a daily basis. The proposed study will benefit area managers and decision makers through improved understanding of the relationship between sediment and turbidity, and possibly, other real-time data, and the influences land use and land management practices have on surface water chemistry.

The existing USGS stream flow gages to be used during this study are located above Lake Houston in the San Jacinto River Basin. Real-time specific conductance and turbidity data will be available to the collaborative partners and the public on the USGS Web site home page. Additionally, mean daily values and results of chemical analysis will be made available upon peer review and approval of results. The redefined or newly developed surrogate relations and load estimates will be published in a USGS Scientific Investigations Report (SIR) sometime in FY 2010.

City of Houston Habitat Evaluation

There is a crucial need for TCEQ assessors to have accurate habitat data available when making water quality assessments. Habitat data include stream depth, stream width, angle of banks, whether or not the stream is natural, channelized or lined with concrete. It also includes the type and amount of vegetation along the banks of the stream. H-GAC is working with the City of Houston to do habitat assessments at 60 sites on tributaries of the HSC. Each of these sites is located in an area that has shown decreased DO levels and in some cases high levels of bacteria.

In addition to the habitat assessment, City of Houston investigators will look at the area of the watershed immediately upstream of the sampling site to determine if there are any visible sources of bacteria or pollutants that may negatively impact DO levels. Any pollutant sources found during the field work will be reported to the appropriate city department to be further investigated and corrected. A final report for the habitat assessment will be completed in August 2009.

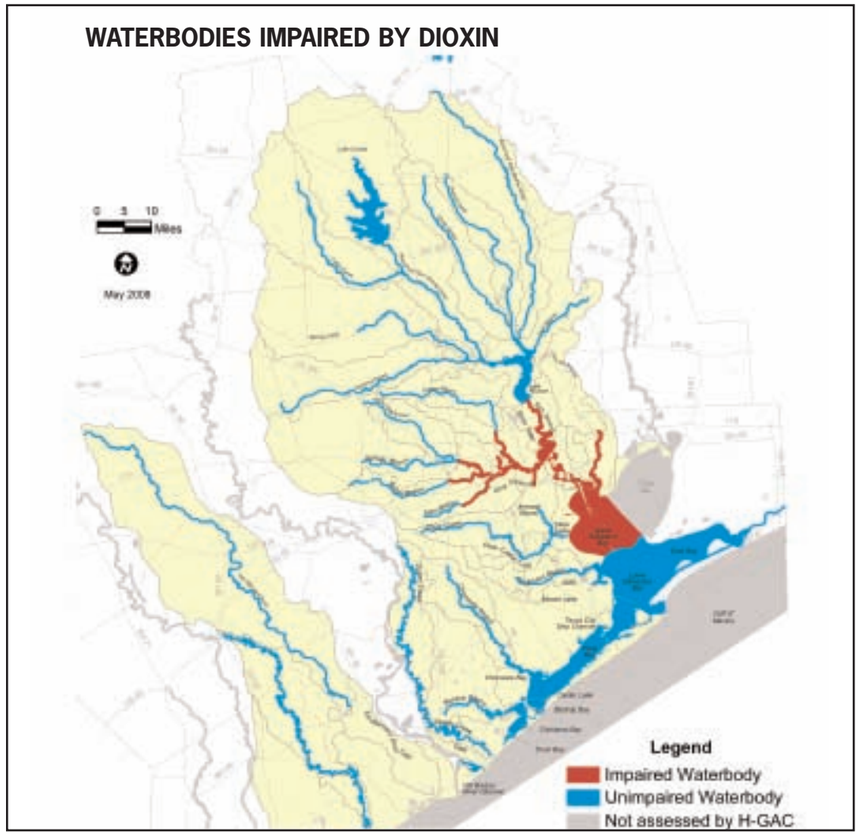
Flow Studies 2007

Knowledge of the chemical constituents in surface water is very important; however, the entire picture cannot be interpreted until "flow" information is included in the evaluation. For example, a pollutant will have a much greater impact on the stream if its concentration is elevated during high flow conditions as opposed to low flow conditions. Currently, only two of H-GAC's local partners are able to collect flow data. Numerous locations are sampled during each day's sampling run, and time becomes critical in getting samples to the lab. To maintain their current schedules without major modifications, a flow monitoring method had to be devised, which would allow one person to quickly and efficiently collect the required information in the field. Flow information could then be extrapolated at a later date.

Previously, the USGS developed a "ratings curve" method that could be applied to several sites in the H-GAC region. In 2004, the USGS identified five sites for which to complete "ratings curves." Between 2005 and 2007, USGS collected flow data from all stages of flow to make the most accurate ratings curve possible for each site. The curves were completed in the summer of 2007 and will be updated periodically to ensure their continued use by CRP partners.

Bastrop Bayou Watershed Protection Plan

Located along the Texas Coast and 50 miles south of Houston, Bastrop Bayou is a popular recreational destination. Water that falls within the Bastrop Bayou watershed eventually makes its way to Christmas Bay, a pristine coastal estuary that is home to some of the last remaining seagrass beds along the upper coast of Texas. Much of the watershed is currently used for agriculture (primarily rice farming, cattle-grazing, and aquaculture), and residents typically live in small cities and towns (i.e., Angleton, Danbury, Richwood), rural subdivisions or homes along Bastrop Bayou. Although much of the watershed is rural, forecasted population growth for the Houston-Galveston region indicates that urban areas within and immediately adjacent to the watershed will undergo substantial growth over the next 30 years. In addition to local growth, H-GAC forecasts that the Houston area will add more than 3.5 million people by 2035. This regional growth will exert increased pressure on natural resources, especially outdoor recreational opportunities along coastal bays and bayous. In 2004, residents in the watershed began voicing concerns about threats to water quality that could be posed by the land spreading of sludge, failing septic systems, illegal dumping and storm water discharge. Specific concerns included potential bacteria, turbidity, pesticide and nutrient loading of Bastrop Bayou and Christmas Bay and how these loadings may adversely affect public health, natural resources and local economies. In response to these complaints and in an effort to determine the presence or absence of water quality impacts within the Bastrop Bayou watershed, the Galveston Bay Estuary Program, H-GAC and the Texas CRP launched a watershed risk assessment project during 2004. The Risk Assessment was completed in 2006.



Water quality monitoring results indicate that Bastrop Bayou and its main tributaries contain elevated concentrations of bacteria that occasionally exceed the state's water quality standards for contact recreation. While several potential sources of bacteria are present within the watershed (cattle grazing, migratory bird flyways, wildlife and failing septic systems), the location of bacteria "hot spots" seems to indicate that cattle grazing and failing on-site septic systems are the largest contributors to bacterial nonpoint source loading.

As a direct result of the risk assessment, H-GAC applied for and received 319 grant dollars from TCEQ to develop a Watershed Protection Plan (WPP) and BMPs implementation. The Bastrop Bayou WPP project began in 2007. H-GAC formed a local stakeholder group comprised of local homeowners, cattle ranchers, rice farmers, elected municipal officials, county health district and environmental enforcement representatives and watershed residents who provide valuable input regarding local drainage features, potential sources of pollution, recreational uses, public access locations and effective approaches to educating local residents and watershed visitors.

Committees have been formed to address:

- Education and Outreach
- Water Quality and Habitat
- Agriculture / Ranching Nonpoint Sources
- Wastewater and Septic Systems
- Urban Nonpoint Sources

To date, H-GAC has conducted seven public meetings in the watershed to introduce the Watershed Protection Planning concept to local stakeholders as well as receive input about their concerns.

watershed STUDIES

In addition H-GAC has developed and distributed Bastrop Bayou Watershed Brochures and a series of watershed stickers for school children. H-GAC, in partnership with Brazoria County has manufactured and is installing watershed signs throughout the watershed to develop public awareness.

H-GAC in partnership with Texas AgriLife will provide Texas Watershed Steward Training to interested stakeholders in May 2008. The training will give attendees an overview of the watershed planning process and help stakeholders become more comfortable with concepts and terminology.

H-GAC has also developed the following plans and documents that will eventually be part of the overall WPP for Bastrop Bayou:

- Outreach and Education Plan
- Monitoring Plan
- Causes and Sources of Pollution
- Data Inventory and Data Summary
- Loading Estimates Plan

H-GAC has chosen to use the SELECT model to conduct load-reduction estimates for this project. The model has been used in the Plum Creek WPP with great success.

When stakeholders approve the final WPP, H-GAC will begin the implementation of BMPs in several areas of the watershed. BMPs may include, excluding cattle from streams, the use of pervious surfaces, filter strips etc. for urban runoff and the repair or construction of alternative septic systems.

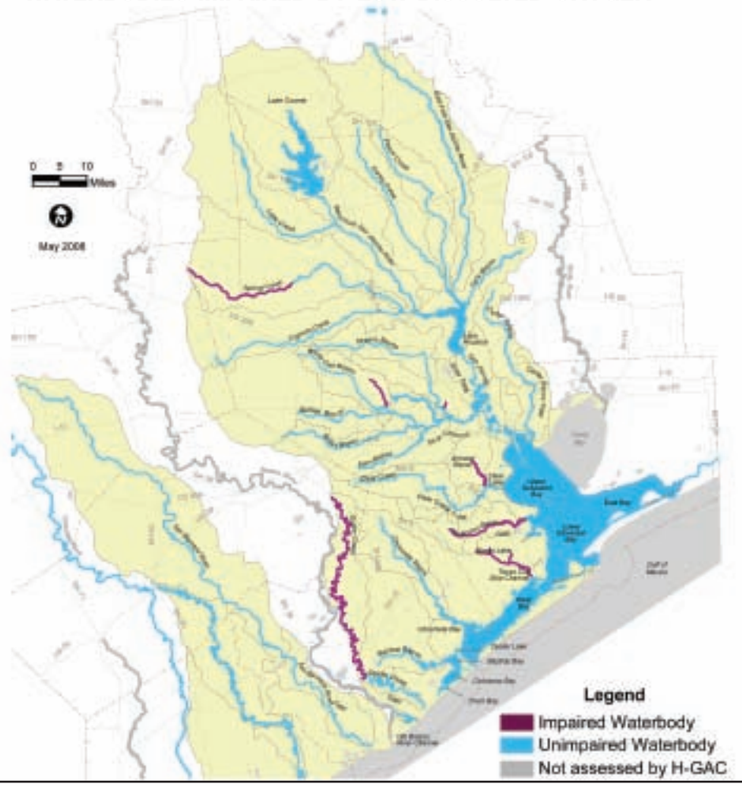
Stakeholder Participation and Public Outreach

Participation and outreach by local stakeholders is the cornerstone of the CRP. H-GAC not only looks to inform and educate local stakeholders about water quality issues, but we also hope to learn about water quality problems and get help in resolving those problems by listening to local stakeholders. H-GAC has developed many ways to reach out to the public:

- Interactive Web site
- Watershed Brochures
- "What Watershed Do You Live In" Brochures and Maps
- Videos and DVDs
- Texas Stream Team Partnership
- Nonpoint Source Watershed Models
- Watershed Signs
- Steering Committee Meetings
- Technical Advisory Group Meetings
- Regional Monitoring Workgroup Meetings

Several of the Public Outreach elements are highlighted next.

WATERBODIES IMPAIRED BY LOW DISSOLVED OXYGEN



LAND COVER FOR THE H-GAC REGION

Web Site

H-GAC has an interactive Web site, which gives the public access to all of the station locations and monitoring data that is collected locally under the CRP. It also provides access to all reports and studies that H-GAC has produced under the CRP. If you go to the Clean Rivers page, you will also find information related to current and past QAPPs, the current two year CRP workplan and budget, as well as summaries of all steering committee meetings.

Production of Statewide Clean Rivers Program Video/DVD

H-GAC, in partnership with TCEQ, produced a video that helps explain the history of the CRP, highlights some of the many successes and reaches out to get a broad range of stakeholders involved in the program. The DVD is intended to be used by CRP partners across the state at stakeholder meetings or other public forums to invigorate stakeholder interest in the CRP. The program is available on DVD as well as on the Web sites of H-GAC and many other CRP partners.

Texas Stream Team Water Quality Monitoring Program

Texas Stream Team (formerly Texas Watch) is designed to facilitate environmental stewardship by empowering a statewide network of concerned volunteers, partners and institutions in a collaborative effort to promote a healthy and safe environment.

As a Texas Stream Team partner since 1992, H-GAC shares the goals of the Texas Watch program – to improve

water quality through public education and participation. H-GAC supports the Texas Stream Team program as a full partner and has a dedicated part-time staff who coordinates the certified Volunteer Water Quality Monitors in our 13-county area. Our Texas Stream Team program includes training and support for individual monitors, coordinating group monitoring projects and disseminating information on water quality and nonpoint source pollution through public education forums.

Volunteer Monitoring Sites are selected with the volunteer's safety and access in mind and in conjunction with CRP staff to support current professional monitoring sites with additional data. Volunteer monitoring data are not just for educational purposes. Strategic site selection allows data to be an important part of the watershed analysis utilized by the state for water quality management decisions.

Maintaining a consistent group of certified water quality monitors can be a challenge. To maximize environmental stewardship and provide the best volunteer management, we maintain a manageable level of volunteers considering their needs for training, quality assurance, supply distribution and recognition. Based on the premise that volunteers who are more involved with an effort will remain active over a longer time, we provide opportunities beyond monitoring for our Texas Watch volunteers. Volunteers are involved as Trainers, Quality Assurance Officers and Data Managers and assist in public outreach and education through community presentations. Implementing this strategy also ensures the necessary continuity of our Texas Watch program in the event of employee turnover.

H-GAC continues to be committed as a full partner with the Texas Stream Team program. The dedication and enthusiasm of our region's Certified Water Quality Monitor Volunteers is commendable and is a vital part of promoting environmental stewardship in our region. For more information or to find out how can be part of the Texas Stream Team, contact Gayla Stock at ***gayla.stock@h-gac.com***.

Steering Committee Meetings

H-GAC's CRP Steering Committee is composed of a diverse group of stakeholders, who represent the interests of cities, counties, state federal and local agencies, business, industry, environmental groups and concerned citizens. The Steering Committee generally meets twice a year to provide guidance on future workplans, to review and approve special studies, provide feed back on reports and give input on water quality issues that are a concern for the region.

H-GAC's CRP Steering Committee met twice in 2007. The main items of interest in those meetings were to approve the *2007 Basin Highlights Report*, to approve the FY08 coordinated monitoring schedule and to give comments on and approve the FY08-09 CRP workplan and budget. The committee also received presentation and status reports on several special studies.

H-GAC has several other public education and outreach programs that are not funded by the CRP but are related to water quality.

River, Lakes, Bays 'N Bayous Trash Bash®

Once a year thousands of Trash Bash volunteers gather along the waterways of the Galveston Bay watershed to do their part in cleaning up the environment. On Saturday, March 31, 2007, despite torrential rain, crashing lightning, gusting winds and rising water, over 1,000 courageous volunteers showed up to pick up 4 tons of trash and approximately 200 tires from the clean-up locations that were able to operate. These dedicated volunteers from schools, citizen groups, local businesses, industry, local governments and state agencies have made the River, Lakes, Bays 'N Bayous Trash Bash a success since 1994. Trash Bash is regionally coordinated through the H-GAC Solid Waste program and has been the recipient of several state and national awards since its inception. To learn more about Trash Bash and to become a volunteer, visit the Web site at ***www.trashbash.org***.

ENVIROCAST®

Thanks to a partnership of H-GAC, Texas State Soil and Water Conservation Board and EPA, along with media partner KPRC-TV Channel 2, a new effort to raise the environmental IQ of the Region is here, and its name is Envirocast. Envirocast was developed by StormCenter Communications, Inc. to raise the environmental IQ of America, and it is now running in a number of cities across the United States including Dallas. A combination of live environmental newscasts and an accompanying Web site make environmental information available and useful to the general public.

A Steering Committee provides general direction for the project. The Committee contains representatives of H-GAC, Galveston Bay Estuary Program, Citizens Environmental Coalition, Bayou Preservation Association, Harris County, City of Houston, Harris County Flood Control District and Waste Management, Inc. The committee works with StormCenter Communications, Inc. to update the Web site, identify content providers, select experts who may be interviewed, and refresh a calendar of events.

Envirocast officially launched in May. Regional dignitaries, H-GAC Board members and other local elected officials attended. Envirocast prompted increased awareness of water issues associated with the Trinity River in north Texas. KPRC Channel 2 is our regional host for the Envirocast at ***http://kprc.envirocast.net/.*** For additional information, contact Carl Masterson at ***carl.masterson@h-gac.com*** or ***713-993-4561.***

TMDLs

What is TMDL?

Total Maximum Daily Load (TMDL) is like a budget for pollution. The Clean Water Act and the EPA require that all states identify waterbodies that do not meet, or are not expected to meet, applicable water quality standards for designated uses. These waterbodies are listed and prioritized in order to schedule TMDL development.

TMDL Studies

A TMDL study is a technical analysis that determines maximum loadings of a pollutant of concern that a waterbody can receive and still meet water quality standards and allocates this allowable loading to point and nonpoint pollutant sources in the watershed.

H-GAC's Role in TMDLs

H-GAC conducts TMDL public participation activities to gain local input. By forming individual stakeholder groups and conducting public meetings, H-GAC can ensure that local perspectives are considered during TMDL development.

Currently H-GAC is involved with TMDLs for two particular pollutants of concern, dioxin and bacteria.

Dioxin TMDL Studies

Elevated levels of dioxins in the lower portion of the HSC and upper Galveston Bay led the Texas Department of Health (now the Texas Department of State Health Services or DSHS) to issue a seafood advisory for the HSC and upper Galveston Bay in 1990. The advisory states that no one should consume more than one seafood meal per month (8 ounces/month), and women of child-bearing age and children should not consume any sea catfish or blue crab from the area. The advisory remains in effect.

Phase I of this study included assessments of existing data, major sources as well as fate and transport of dioxin in the environment. The assessment revealed limited sediment data, no water quality data and very little source data.

Phase II of the study included additional data collection, refining a conceptual model, developing a steady-state water quality model and performing sensitivity analyses. This phase showed that concentrations of dioxin in the water exceeded Texas Surface Water Quality Standards more than 80 percent of the time. Although there are no standards for dioxin in sediment, sediment samples have revealed high concentrations of dioxin in certain areas relative to concentrations found in others. Of tissue samples collected, 96 percent exceeded the health-based standard. Interestingly, dioxin concentrations measured during Phase II were as high as or higher than historical levels. The estimated load from storm water runoff was about twice the load estimate from wastewater treatment facilities, which may be an indication that dioxins are coming from nonpoint sources rather than wastewater discharges from specific facilities.

Loading from domestic wastewater treatment facilities was estimated to be about twice that from industrial facilities. Loading from industrial wastewater was much reduced during the early 1990s, after the advisory but before the TMDL project began, as permit limits and national program encouraged industries to examine and change their processes. The estimated load from domestic WWTPs is now larger than that from industrial because of much larger flow volume than industrial discharges. An implementation plan to reduce dioxin concentrations from nonpoint sources will be much more complex than controlling dioxin coming from known-point sources.

Phase III (draft report writing), the final phase of the project, is nearing completion. The draft report is expected in December 2008. In 2005 high levels of dioxin were found in the Lower San Jacinto River at IH 10. Investigations uncovered an old McGinnes waste disposal site. On September 19, 2007, EPA recommended this site for the National Priorities List (NPL). A final determination was made and the McGinnes waste disposal site was placed on the NPL. Elevating the disposal pits to superfund status will start the process of cleaning up what may be one of the largest single sources of dioxin in the project area. Additional information on the dioxin TMDL and related public participation activities will be found at ***www.h-gac.com/tmdl.***

Bacteria TMDL Studies

Many Bacteria TMDLs are underway in the following watersheds: Buffalo and White Oak Bayous; Clear Creek; Dickinson Bayou; Houston Metropolitan Area (Brays, Sims, Greens, Halls and others); and Lake Houston (Cypress Creek, Spring Creek, East and West Forks of the San Jacinto River and others). The TMDL studies that are nearing completion are the Buffalo/White Oak Bayous and Clear Creek projects. Both of these projects are finalizing their loading calculations and are ready to enter the Implementation Phase. H-GAC is currently working with stakeholders in all the Bacteria TMDL watersheds to establish a Bacteria TMDL Steering Committee, which will then identify issue-based working groups to begin preparation of an Implementation Plan. Work on the other bacteria TMDLs, including Implementation Plans are anticipated to continue through the end of State Fiscal Year 2011. The implementation process for all TMDLs involves consultations with stakeholders, as well as state and federal agencies. Examples of implementation plan elements include possible changes in wastewater and storm water permit requirements, storm water management plans, and BMPs programs. No regulatory actions will take place until the TMDL is determined and an Implementation Plan is in place. Potential bacteria sources that will be dealt with in the Implementation Plan include:

WATER QUALITY PROGRAM ACTIVITIES IN THE H-GAC REGION

- Inadequate/incomplete disinfection of Waste Water Treatment Plant (WWTP) discharges
- Wastewater collection system leaks and overflows
- WWTP bypasses
- Unpermitted discharges to storm sewers
- Bacteria from upstream sources (Buffalo Bayou)
- Failed septic systems
- Nonpoint sources from wildlife, urban areas and stream sediment

Continued evaluation is needed to ensure that the plan is effective in helping to reduce bacteria levels throughout each watershed. This will include continued monitoring and adaptive management to make changes to the plan based on monitoring results. Copies of the work completed, stakeholder meeting information, etc. can be found at ***www.h-gac.com/tmdl.***

NELAC

The National Environmental Laboratory Accreditation Conference (NELAC) has developed a set of standards for the accreditation of environmental laboratories that perform testing and analysis of environmental samples of any matrix. Prior to NELAC, the existing state programs varied widely in scope and requirements. The NELAC Standard provides uniform requirements for accreditation of environmental laboratories and facilitates mutual recognition among laboratory accreditation programs. The TCEQ offers accreditation to the NELAC Standard as a voluntary option for environmental laboratories. Any laboratories conducting analysis for use in regulatory decision making must be NELAC-accredited.

H-GAC's role

H-GAC is taking a leadership role in the accreditation process. H-GAC has been working with our local monitoring partners and their laboratories to ensure that local laboratories receive all the help they need in meeting their accreditation requirements. The past four years have been very busy for our partners, and the hard work has finally borne fruit this year. All of our partners have submitted their applications for accreditation ahead of schedule and are awaiting TCEQ review. Congratulations are in order for Harris County, which is now accredited for all parameters related to the CRP. H-GAC will continue to track laboratory performance by using PT samples. The cost of which is wholly funded by the CRP.

Evaluating Water Quality in Texas

The TCEQ evaluates the condition of the state's waterbodies on a periodic basis under the Clean Water Act (CWA) Section 305(b). The results are contained within the Texas Water Quality Inventory and 303(d) List and are comprised of a complete listing of all water quality issues in the state. As required by the act, the inventory is updated every two years and consists of a review of the past five years' worth of data collected by many organizations statewide including local agencies working with H-GAC. The 2008 Water Quality Inventory and 303(d) List, on which the following information is based, provides an assessment of water quality results using the most recent five years' worth of data. This inventory is available on the TCEQ Web site at ***www.tceq.state.tx.us/compliance/monitoring/water/quality/data/08twqi/twqi08.html.***

The term "impairment" is assigned to a portion of a waterbody when certain water quality constituents reach threshold concentrations as specified in the Texas Surface Water Quality Standards and the Texas Drinking Water Standards, based either on the number of exceedances or the mean concentration over the threshold. This designation indicates that the water quality "uses" of the waterbody (e.g. water supply, contact recreation, aquatic life and fish consumption) may be degraded. In other words, the water may not be fit to be used as a public water supply, the fish may not be able to get enough oxygen to survive swimming in the water may cause the swimmer to be exposed to disease-producing organisms or fish tissue data indicate that consumption of fish may cause deleterious effects. Waterbodies that are shown to have an impairment for one or more constituents are included in the TCEQ's CWA Section 303(d) List.

Once a portion of a stream is placed on the list, a series of actions may be taken by the TCEQ to restore water quality, including, but not limited to: denial of increases in wastewater permit effluent limits; conducting a Total TMDL study to allocate pollutant loads to certain sources and instituting a strategy for reducing loads from all sources.

The term "concern" is assigned to a portion of a waterbody under less rigorous requirements for number of measurements exceeding the threshold, sample frequency, etc. If only limited data or a few samples not meeting the stream standards are available, then the stream cannot be assessed as impaired with sufficient confidence. Therefore, the waterbody may be identified as having a concern for a certain constituent.

Concerns are also identified for nutrients and Chlorophyll-*a*, toxic substances in fish tissue and sediment for which no stream standards have been developed but are otherwise useful in identifying water quality problems. During 2007, additional data collection under the CRP has been targeted for waterbodies with concerns.

The next section of this report contains water quality assessment information about each of the major watersheds within H-GAC's CRP assessment area. It is presented as a result of TCEQ and H-GAC screening. Note that the information presented represents a snapshot in time and that water quality conditions are dynamic. Also note that a segment identified as having "no known problems" may actually have certain problems. However, data may have simply been limited or unavailable or all uses may not have been assessed.

Local Water Quality Review

This section gives a brief summary and review of water quality in each designated stream segment in the basins for which H-GAC is responsible. The terms "list" or "listed" are used throughout this section and refer to the "List of Impaired Waters" also known as the "303(d)" List. Streams are included on the 303(d) List if they do not meet the water quality standard for a certain parameter. Streams can be on the list for one or more parameters at any given time.

Ranking Key

1 Frog = Significant water quality impairment and/or concerns have been identified.

2 Frogs = Some water quality impairments and/or concerns have been identified.

3 Frogs = No known water quality impairments or concerns have been identified.

Trinity-San Jacinto Coastal Basin

(Watersheds are listed alphabetically.)

Cedar Bayou Above Tidal (0902)
Major tributaries:
Adlong Ditch,
Buck Gully

Recently, TCEQ removed the listing for depressed DO for this waterbody. The current assessment lists a possible concern for bacteria for the entire segment. In addition, there is a listing for an impaired macroinvertebrate community.

H-GAC began monitoring and collecting conventional chemical parameters along with bacteria in the Above Tidal portion in September 2007. In addition, a Texas Stream Team volunteer began monitoring the upper reaches of the bayou in 2007.

Cedar Bayou Tidal (0901)
Major tributaries:
Cary Bayou,
McGee Gully

The tidal portion of Cedar Bayou is currently listed as not meeting its fish consumption use due to elevated levels of dioxin in catfish and crab tissue. The segment is also listed as impaired due to elevated levels of bacteria. In addition, PCBs in edible tissue were added to the Draft 303(d) List in 2008.

In response to a seafood advisory issued for the area by the DSHS in 1990, a TMDL was initiated for dioxin. Researchers are investigating the extent and level of dioxin contamination in sediment and tissue in the HSC and Upper Galveston Bay.

The ongoing dioxin TMDL study was divided into three separate phases. The first phase focused on assessing current conditions, the second on data gathering for all media types in order to quantify dioxin levels and the third is currently focusing on model development and load allocation.

H-GAC began monitoring and collecting conventional chemical parameters along with bacteria in the tidal portion of the bayou in September 2007.

San Jacinto River Basin

(Watersheds are listed alphabetically, upstream to downstream.)

Buffalo Bayou Above Tidal (1014)
Major tributaries:
Bear, Langham, Mason,
Rummel, South Mayde,
Spring Branch and
Turkey Creeks;
Neimans Bayou

Buffalo Bayou is divided into several segments due to the constructed nature of the HSC into which it flows. The eastern portion of the watershed is densely developed, while the western portion along the I-10 corridor between Houston and the City of Katy is one of the most rapidly growing areas in the region. Addicks and Barker Reservoirs, which are floodwater retention basins, sit at the headwaters of the Bayou, with two major parks, Bear Creek Park and George Bush Park, positioned on either side of the reservoirs.

The entire segment and all sub-segments of Buffalo Bayou Above Tidal are listed on TCEQ's list of impaired waterbodies due to elevated levels of bacteria. Bacteria impairments and nutrient concerns are found throughout the main stem and occur with a high frequency. Elevated bacteria levels may stem from the usual sources such as overflows of municipal wastewater systems, failing septic systems, pet waste, naturally occurring wildlife and avian populations.

In order to address the bacteria issue, TCEQ conducted a TMDL project to understand the reasons for high bacteria levels and to determine possible sources of bacteria. Load allocations are being finalized, and the project is moving into the implementation stage.

An additional concern for nutrient enrichment exists because of elevated levels of ammonia and phosphates, which could lead to algal blooms. Elevated nutrient levels often occur because of excessive use of fertilizers. There was a concern about these nutrients providing a food source for warm-blooded animal *E. coli*, which find their way into streams. However, recent studies reveal that no relationship between bacteria and nutrients exists, refuting the idea that nutrient-rich waters enhance bacteria survival. In the future, bacteria and nutrient levels will be closely monitored for any exceedances or trends.

Previous investigations on listed sub-segments show either an impairment or concern due to depressed DO. However, recent DO grab sample results indicate compliance and DO was removed from the 303(d) List.

Buffalo Bayou Tidal (1013)
Major Tributary:
Tidal portion of Little
White Oak Bayou

Buffalo Bayou Tidal is completely urbanized, encompassing downtown Houston, the theater and entertainment districts, residential development, high-volume, mixed-commercial development and light industry. Several parks and natural areas are located along the banks of the Bayou.

A major portion of the Houston metropolitan area is drained by Buffalo Bayou. In addition to a large number of municipal and industrial wastewater discharges, the Bayou receives a significant amount of urban stormwater runoff. The entire segment and two sub-segments 1013A and 1013C were listed on TCEQ's list of impaired waterbodies due to elevated levels of bacteria.

Sub-segment 1013A was listed in 2008 for depressed levels of DO.

An additional concern for nutrient enrichment exists because of elevated levels of ammonia and phosphates, which could lead to algal blooms. Elevated nutrient levels often occur because of excessive use of fertilizers. There was a concern about these nutrients providing a food source for warm-blooded animal *E. coli*, which find their way into streams. However, recent studies reveal that no relationship between bacteria and nutrients exists, refuting the idea that nutrient-rich waters enhance bacteria survival. In the future, bacteria and nutrient levels will be closely monitored for any exceedances or trends.

In order to address the bacteria issue, TCEQ conducted a TMDL project to understand the reasons for high bacteria levels and to determine possible sources of bacteria. Load allocations are being finalized, and the project is moving into the implementation stage.

Caney Creek (1010)
Major tributaries:
Camp, White Oak,
Little Caney, McRae
and Dry Creeks;
Spring and West Fork
Spring Branches

The watershed is undeveloped for the most part except for several small towns along the perimeter of the watershed. A small portion of the Sam Houston National Forest is in the uppermost reach. Caney Creek feeds into the northern fork of Lake Houston, a major drinking water supply for the City of Houston and surrounding communities.

Portions of the watershed are listed on TCEQ's list of impaired waterbodies due to elevated levels of bacteria.

In 2004, a systematic watershed monitoring special study was completed on Caney Creek. The watershed was assessed for various biological attributes and indicators. Fish and benthic community data collected during the study was used to determine an Ecoregion-specific Index of Biotic Integrity (ECO-IBI) score. Higher IBI scores equate to higher aquatic life use. The IBI scores for the two sites on Caney Creek, in downstream order, are high and intermediate, indicating a healthy creek for aquatics and fish.

In September 2007, H-GAC began monitoring and collecting conventional chemical parameters along with bacteria in Caney Creek.

Cypress Creek (1009)
Major tributaries:
Dry, Little Cypress, Live Oak, Mound, Pillot and Seals Creeks; Dry, Faulkey, Lemm and Spring Gullies

The eastern portion of the watershed is dominated by residential development within forested lands while the western portion is dominated by grasslands used for cattle grazing and is also experiencing rapid residential growth.

The entire segment and sub-segments of Cypress Creek appear on the 2008 303(d) List as not supporting contact recreation use due to bacteria levels which exceed the state standard. Bacteria may come from several different sources including; failing septic systems, illicit stormwater connections and stormwater runoff from yards, parking lots, parks, farms and ranches.

A source identification study was conducted along the entire length of Cypress Creek; the study revealed that high bacteria levels come from the rural, upper portion of the watershed. However, the highest concentration of bacteria levels were found coming from ornamental ponds that drain directly to Cypress Creek.

Cypress Creek is one of 14 waterbodies to be included in the Lake Houston TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently, work is being done to establish load allocations for each of the waterbodies in the project.

An additional concern for nutrient enrichment exists because of elevated levels of ammonia and phosphates, which could lead to algal blooms.

East Fork San Jacinto River (1003)
Major tributaries:
Orange Branch, Miller Creek, Whiskey Branch, Winters Bayou

This watershed is primarily undeveloped forested land except for the lower portion, which is populated by the small cities of Plum Grove and Cleveland. Part of the City of Huntsville is located in the far northern portion along with a large part of the Sam Houston National Forest.

Three sections of the East Fork San Jacinto River appear on the Draft 2008 303(d) List as not supporting contact recreation use due to bacteria levels which exceed the state standard.

East Fork San Jacinto River is one of 14 waterbodies to be included in the Lake Houston TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently, work is being done to establish load allocations for each of the waterbodies in the project.

In 2007, H-GAC began monitoring and collecting conventional chemical parameters along with bacteria on the East Fork.

Greens Bayou Above Tidal (1016)
Major tributaries:
Garners Bayou, Williams Gully

Above Tidal portions of Greens Bayou experiences similar issues associated with urban watersheds. Beltway 8 runs through the middle of the watershed with large, high intensity developments and businesses found adjacent to and at intersections with major highways – I-45, US 59 and SH 249. Bush Intercontinental Airport is located in the north-central portion of the watershed.

This entire segment, its major tributaries and its sub-segments are listed as not supporting contact recreation use due to elevated levels of bacteria. There is also a listing of depressed DO for sub-segment 1016D an unnamed tributary to Greens Bayou.

Greens Bayou is one of 27 segments or sub-segments to be included in the Houston Metro TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently, work is being done to establish load allocations for each of the waterbodies in the project.

An additional concern for nutrient enrichment exists because of elevated levels of ammonia and phosphates, which could lead to algal blooms.

Houston Ship Channel/Buffalo Bayou (1007)
Major tributaries:
Berry, Brays, Country Club, Hunting, Keegans, Little Vice and Vince Bayous; Plum and Berry Creeks, Pine Gully

This very urbanized watershed includes the HSC and more than 70 miles of tidal and non-tidal tributary streams, which ultimately flow into Galveston Bay. The HSC watershed includes the cities of Pasadena, Galena Park and Houston as well as large petrochemical complexes. Numerous permitted wastewater and stormwater discharges are located throughout the watershed.

Buffalo Bayou and the main stem of HSC do not meet state standards for fish and crab consumption use due to presence of dioxin in their tissues. DSHS issued a seafood advisory for the area in 1990. In addition, the main stem is also listed on the 303(d) List as not meeting standards for PCBs in edible tissue.

A three-part TMDL study was initiated because of dioxin levels in fish tissues. First part of the TMDL focused on assessing current conditions and determining sources. The second, gathered data for all media types in order to quantify dioxin levels. The current third phase, focuses on model development and load allocation.

Overall, bacteria impairments and nutrient concerns are found throughout HSC/Buffalo Bayou prohibiting safe contact recreation use in non-tidal portions of tributaries within the watershed. Sources for both bacteria and nutrients are usually associated with municipal rather than industrial activities. Elevated bacteria levels most likely stem from the usual sources such as, intermittent municipal collection system overflows, failing septic systems, pet waste, naturally occurring wildlife and avian populations.

The HSC/Buffalo Bayou is one of 27 segments and sub-segments to be included in the Houston Metro TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently work is being done to establish load allocations for each of the waterbodies in the project.

An additional concern for nutrient enrichment exists because of elevated levels of ammonia and phosphates, which could lead to algal blooms.

Several sub-segments of the HSC, 1007D, 1007G, 1007K and 1007O, appear on the TCEQ list as a concern due to depressed DO.

Beginning in 2008, the City of Houston Health and Human Services will begin conducting habitat surveys on Brays, Hunting, Sims and Berry Bayous along with Pine Gully and Plum Creek.

Houston Ship Channel (1006)
Major tributaries:
Boggy, Carpenters and Patrick Bayous, Goodyear and Halls Creek, Tidal portion of Greens Bayou

The whole watershed is heavily developed and receives discharges from several permitted wastewater and stormwater outfalls. The lower portion of the watershed includes the heavy industrial complexes that line both sides of the Channel including the cities of Deer Park, Channelview, Houston, Pasadena and parts of unincorporated Harris County.

The main stem of HSC does not meet state standards for fish and crab consumption due to the detection of PCBs and dioxin in their tissues. The DSHS issued a seafood advisory for the area. In addition, the main stem is also listed on the 303(d) List as not meeting standards for pesticides – Chlordane, Dieldrin and Heptachlor Epoxide in fish tissue.

Overall, bacteria impairments and nutrient concerns are found throughout the HSC prohibiting safe contact recreation use in non-tidal portions of tributaries within the watershed.

The HSC is one of 27 segments and sub-segments to be included in the Houston Metro TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently work is being done to establish load allocations for each of the waterbodies in the project.

An additional concern for nutrient enrichment exists because of elevated levels of ammonia and phosphates, which could lead to algal blooms.

Houston Ship Channel/San Jacinto River (1005)
Major tributaries and bays: Black Duck, Burnet, San Jacinto, Scott and Tabbs Bays, Goose Creek, Old River, Barbours Cut

This watershed includes the cities of Baytown and Highlands located on the eastern shore of the HSC and the San Jacinto River, with the heavily industrialized cities of Channelview, Deer Park and La Porte situated along the western shoreline.

The main stem of the HSC and sub-segments are listed as not meeting their fish consumption use due to dioxin and PCBs in fish and crab tissue. In 2001, the DSHS issued a fish consumption advisory for the portion of HSC above the Lynchburg Ferry crossing. The DSHS determined that there was an unacceptable risk to human health due to elevated concentrations of organo-chlorine pesticides, PCBs and dioxin. After studying the fish tissue data in more detail, DSHS rescinded the advisory for the 14 pesticides identified in the original advisory. These contaminants are considered legacy pollutants and persist in the environment; however, concentrations found in fish tissue do not pose a significant risk to consumers.

One section (1005-02) of HSC/San Jacinto River is listed for not meeting the contact recreation standard for bacteria.

Lake Conroe (1012)
Major tributaries: Caney, East Sandy, Lewis, Little Lake, McDonald, McGary and West Sandy Creeks; West Fork San Jacinto River

The watershed is mostly undeveloped with tracts of large forested land and grasslands. Lake Conroe itself encompasses the majority of land cover, with significant development along its shores. The central portion of the watershed is located in the Sam Houston National Forest. The City of Huntsville is the major development located in the northeastern section of the watershed.

Lake Conroe is a public drinking water source for the region and provides a broad scope of recreational activities.

The current Water Quality Inventory list Chlorophyll–*a* as a concern in six areas of the lake. H-GAC and local monitoring partners will continue monitoring for nutrients throughout Lake Conroe. No other known water quality issues exist for the Lake.

Lake Creek (1015)
Major tributaries: Caney Creek, Fish Creek, Garretts Creek, Landrum Creek, Little Caney Creek, Mound Creek

The watershed is rural in nature and is dominated by forested land and grassland with the major land cover used as pastureland or for hay. However, residential development is occurring rapidly in the watershed increasing the possibility of negative impacts on water quality.

In 2007, H-GAC began monitoring and collecting conventional chemical parameters along with bacteria on Lake Creek. Texas Stream Team volunteers currently monitor four stations in the Lake Creek watershed for conventional parameters (temperature, DO, pH, and conductivity). Two stations are monitored for bacteria. Exceedances above the state criteria occur in less than 20 percent of reported results.

Lake Houston (1002)
Major tributaries: East Fork San Jacinto River, Luce Bayou, March Branch, Tarkington Bayou, West Fork San Jacinto River

Lake Houston is the major drinking water supply for the city of Houston and surrounding communities. Residential development is increasing at a rapid rate with most of the heavily developed areas around the lake itself.

Eight watersheds drain into Lake Houston. These include: Cypress Creek, Spring Creek, Lake Creek, Lake Conroe,

Caney Creek, Peach Creek and both East and West Forks of the San Jacinto River. Water quality of these watersheds has a tremendous impact on the public water supply.

A sub-segment, starting from the confluence with Spring Creek to West Lake Houston Parkway is listed on TCEQ's list of impaired waterbodies due to elevated levels of bacteria.

Lake Houston is one of 14 waterbodies to be included in the Lake Houston TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently work is being done to establish load allocations for each of the waterbodies in the project.

Additional concern for nutrient enrichment exists because of elevated levels of nitrates Chlorophyll–*a* and phosphates, which could lead to algal blooms. Nutrient levels will be closely monitored for any exceedances or trends.

Peach Creek (1011)
Major tributaries: Boggy, Duck, Jayhawker, Lawrence and Mare Creeks; Gully, Gum, Waterhole and Bee Branches

This watershed is dominated by forested land with the Sam Houston National Forest in the upper reach. Several small communities including Splendora and Woodbranch are located in the lower reaches of the watershed.

One section of Peach Creek is included on the draft 2008 list for not meeting contact recreation standards due to elevated levels of bacteria.

Peach Creek is one of 14 waterbodies to be included in the Lake Houston TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently work is being done to establish load allocations for each of the waterbodies in the project.

In 2007, H-GAC began monitoring and collecting conventional chemical parameters along with bacteria on Peach Creek.

San Jacinto River Tidal (1001)
Major tributary: Gum Gully Creek

The lower portion of the watershed is heavily developed, with industrial activity along the HSC as its major land use.

The San Jacinto River is listed as not meeting its fish consumption use due to dioxin and PCBs in fish and crab tissue. In 2001, the DSHS issued a fish consumption advisory for the portion of the San Jacinto River Tidal from the Lake Houston Dam to I-10. The DSHS determined that there was an unacceptable risk to human health due to elevated concentrations of PCBs and dioxin. Dioxin and PCBs in catfish and crab tissue prevent fish consumption. In 2005 high levels of dioxin were found in the Lower San Jacinto River at I-10. Investigations uncovered an old McGinnes waste disposal site. On September 19, 2007, EPA recommended this site for the NPL. A final determination was made and the McGinnes waste disposal site was placed on the NPL. Elevating the disposal pits to superfund status will start the process of cleaning up what may be one of the largest single sources of dioxin in the project area.

A three-part TMDL study was initiated because dioxin levels in fish tissues. First part of the TMDL focused on assessing current conditions and determination of sources. The second gathered data for all media types in order to quantify dioxin levels. The current third phase is focused on model development and load allocation.

Spring Creek (1008)
Major tributaries: Three Mile, Walnut, Willow, Birch, Brushy, Dry and Mill Creeks; Bear, Mill, Mink, Panther and Sulfur Branches, Lake Woodlands

The Spring Creek watershed is currently experiencing rapid growth. The city of Tomball and extreme northern portions of Houston border the southern edge of the watershed. The smaller communities of Magnolia and Pinehurst located in the central portion of the watershed are also experiencing rapid growth while the western portion remains undeveloped.

The entire segment of Spring Creek is listed as not meeting contact recreational use due to elevated bacteria levels. The TCEQ removed the listing for depressed DO for the entire segment; however, the listing is still in effect for a small portion from Field Store Road to SH 249. There is also a nutrient enrichment concern for orthophosphorus, total phosphorus and nitrates for the sub-segment between SH 249 and I-45.

Spring Creek is one of 14 waterbodies to be included in the Lake Houston TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently, work is being done to establish load allocations for each of the waterbodies in the project.

An additional concern for nutrient enrichment exists because of elevated levels of nitrates and phosphates, which could lead to algal blooms.

One section of Spring Creek 1008-03 is listed as a concern for impaired habitat.

In 2007, H-GAC began monitoring and collecting conventional chemical parameters along with bacteria on Spring Creek and its tributaries.

West Fork San Jacinto River (1004)
Major tributaries: Camp, Crystal, East Fork Crystal, Caney, Egypt, Lake, Little Caney, Stewarts, West Fork Crystal, White Oak and Woodsons Gully Creeks; Harpers Horsepen, Rice and Sand Branches

The watershed is primarily undeveloped forested land except for the city of Conroe. The Sam Houston National Forest occupies the northern section. There are several small communities located in the watershed that have the potential to affect water quality.

Overall, bacteria impairments and nutrient concerns are found throughout the San Jacinto River Basin prohibiting safe contact recreation use in non-tidal portions of tributaries within the watershed. Elevated bacteria levels most likely stem from sources such as intermittent municipal collection system overflows, failing septic systems, pet waste, naturally occurring wildlife and avian populations.

The West Fork of the San Jacinto River is listed for not meeting its contact recreation use due to elevated levels of bacteria.

The West Fork is one of 14 waterbodies to be included in the Lake Houston TMDL project. One round of public meetings has been held to get local stakeholders involved. Currently work is being done to establish load allocations for each of the waterbodies in the project.

An additional concern for nutrient enrichment exists because of elevated levels of nitrate and phosphates, which could lead to algal blooms.

H-GAC started a special study in 2007 to help determine the sources and amounts of suspended sediment being carried downstream from different types of Land cover/Land use.

White Oak Bayou (1017)
Major tributaries: Brickhouse Gully, Cole Creek, Little White Oak Bayou, Vogel Creek

This watershed contains widespread development, with the densest population found in the lower reaches inside Loop 610. Heavy commercial development occurs along the Highway 290 corridor with residential and less dense mixed developments adjacent to the corridor.

White Oak Bayou and its tributaries are listed for not meeting contact recreation use due to elevated bacteria levels. In order to address the bacteria issue, TCEQ conducted a TMDL project to understand the reasons for high bacteria levels and to determine possible sources of bacteria. Load allocations are being finalized and the project is moving into the implementation stage.

In addition, a small unnamed tributary is listed as a concern for depressed DO.

Several sub-segments are listed as a concern for nutrient enrichment due to elevated levels of nitrates and phosphates, which could lead to algal blooms.

San Jacinto-Brazos Coastal Basin

(Watersheds are listed alphabetically)

Armand Bayou (1113)
Major tributaries:
Big Island Slough, Horsepen Bayou, Middle Bayou, Mud Lake, Spring Gully, Willow Spring Bayou

A majority of the watershed is densely developed with the city of Houston (Clear Lake City) in the south, the city of La Porte in the east and parts of the cities of Deer Park and Pasadena in the north. High and low intensity residential and mixed commercial developments are the dominant land uses, but large industrial facilities are scattered throughout the northern portion of the watershed.

Armand Bayou is listed as not meeting its contact recreation use due to elevated bacteria levels. The segment remains on TCEQ's list for depressed DO.

In response to the elevated bacteria levels in the bayous, TCEQ initiated a Bacteria TMDL to determine measures necessary to support recreational uses in these waterbodies. Several Bacteria TMDLs are currently underway on various waterbodies throughout the Houston region. Lessons learned from these projects will be applicable to Armand Bayou for facilitating restoration of water quality.

Armand Bayou is also listed as a concern for Chlorophyll–*a*.

Bastrop Bayou (1105)
Major tributaries:
Austin Bayou, Brushy Bayou, Flores Bayou

The main stem of Bastrop Bayou originates near SH 288 south of Angleton and contains a mix of agricultural, wooded areas and coastal wetlands. The watershed is mostly rural, with urban development primarily limited to the cities of Angleton and Danbury. Abundant wetlands are located along the lower reaches of the watershed. In the past, the primary industry was dominated by agriculture with rice fields and cattle grazing. While rice farming remains active in the watershed, most of the aquaculture industry is related to the production of shrimp and crawfish. In addition, farmers are raising koi to support the local water garden and goldfish pond industry.

Bastrop Bayou has an extensive freshwater wetland habitat and is home to endangered and threatened shorebirds, waterfowl, grassland species and birds of prey. Bastrop Bayou is part of the Texas Coastal Preserve, which is home to one of the last assemblages of submerged aquatic vegetation on the Upper Texas Coast. Brazoria National Wildlife Refuge (NWR) is rich in ecology, freshwater sloughs, salt marshes and native bluestem prairies. This habitat is important to the many species of birds that can be found each season. The Great Texas Coastal Birding Trail was completed through the cooperation of private citizens, land managers, conservation groups, businesses, government agencies and communities.

H-GAC is currently developing a WPP for the Bastrop Bayou Watershed in partnership with the TCEQ, Galveston Bay Estuary Program, Texas State Soil and Water Conservation Board, Brazoria County, and concerned citizens. The WPP is a result of complaints from local residents of the watershed concerned about elevated levels of bacteria being found in Bastrop Bayou. A public education and outreach program has begun, which includes six public meetings, the installation of watershed signs, distribution of watershed brochures and the creation of a Web site. H-GAC in partnership with Texas Agrilife extension will offer Texas Watershed Steward Training during the spring of 2008. For more detailed information on the WPP, please look in the "Special Studies Section" of this report.

While residents have shown concern about rising bacteria levels, Bastrop Bayou has not been listed as having any water quality concerns.

Chocolate Bayou Above Tidal (1108)
Major tributaries:
Hayes Creek, West Fork Chocolate Bayou

This watershed is largely undeveloped with the exception of small urban centers dispersed across its northern and eastern reaches. Towns within the watershed include Manvel, Arcola, Iowa Colony and the western portion of Alvin. Agriculture is a major land use in the watershed and many large farms are found throughout. A system of canals distributes surface water for irrigation purposes. Stretches of riparian forests cut through farms and prairie grassland.

Currently, no listing exists for impairments for Chocolate Bayou. However, possible concerns exist for depressed DO and impaired habitat.

Chocolate Bayou Tidal (1107)
Major tributaries:
Corner Bayou, Cottonwood Bayou, Pleasant Bayou

The majority of the watershed is rural, with the community of Liverpool as the only urban area in the watershed. Agriculture is the major land use, which contains large systems of irrigation canals. Riparian forests cut through tracts of prairie grasslands along the length of the watershed. A large industrial complex comprised of several major petrochemical plants is located in the southeast. Duck Lake and Monsanto Reservoir are used as water impoundments by these industries.

Nutrient concerns exist for Chocolate Bayou Tidal due to elevated levels of Chlorophyll–*a*.

Clear Creek Above Tidal (1102)
Major tributaries:
Cowart Creek, Hickory Slough, Mary's Creek, Turkey Creek, Mud Gully

The watershed is experiencing rapid growth with a mixture of residential and commercial development. Most of the high intensity development is located along FM 518 which runs from League City in the eastern end, through Friendswood west of SH 288, and near the I-45 and Beltway 8 intersection.

The main stem is included in the TCEQ list of impaired waterbodies due to elevated bacteria. In addition, tributaries Cowart Creek, Mary's Creek, Hickory Slough, Turkey Creek, and Mud Gully are also listed as impaired due to elevated bacteria levels. One section of Clear Creek has been listed for having an impaired fish community. Nutrients and DO have also been listed as a concern for the main stem and its tributaries.

A TMDL project is currently underway for Clear Creek and its tributaries due to elevated levels of bacteria. A public meeting is anticipated for June to discuss the results of the TMDL.

Clear Creek Tidal (1101)
Major tributaries:
Chigger Creek, Magnolia Creek

The watershed is experiencing rapid growth with mixed residential and commercial development; however, large tracts of grassland and forested land still exist in the watershed. Most of the high intensity development is located near I-45 and the Johnson Space Center and Bay Brook Mall complexes located in the northeastern section. The main segment of Clear Creek is included in the TCEQ list of impaired waterbodies due to elevated bacteria levels. Also, tributaries Chigger Creek and Robinson Bayou are listed for having elevated bacteria levels.

A TMDL project is currently underway for Clear Creek and its tributaries due to elevated levels of bacteria. A public meeting is anticipated for June to discuss the results of the TMDL.

A possible nutrient enrichment concern exists for nitrates, phosphates and Chlorophyll–*a* due to levels exceeding the state screening criteria. H-GAC will closely monitor nitrate results for any trends or exceedances. Robinson Bayou is listed as a concern for DO.

Following a fish-consumption advisory issued in 1993, portions of Clear Creek exhibited elevated concentrations of the pesticide chlordane, in response to the advisory TCEQ initiated a TMDL. Chlordane is considered a legacy pollutant, a chemical that has been banned or severely restricted, but still remains in the environment. Since no new significant sources exist, gradual declines are expected to occur through natural attenuation processes.

Dickinson Bayou Above Tidal (1104)

The watershed includes portions of the cities of Alvin, Friendswood, League City and Santa Fe. Rapid growth is occurring throughout the watershed. Residential, mixed commercial development and agriculture are the

predominant land uses with high intensity developments and business districts at the intersections and along SH 6, SH 35 and FM 528.

Dickinson Bayou appears on the 303(d) List as not meeting its contact recreation use due to bacteria. In response to the bacteria problem the TCEQ initiated a TMDL study to determine measures necessary to support recreational uses in these waterbodies. Low DO levels are a result of a combination of natural processes and anthropogenic influences. With increasing residential and commercial development in the watershed, greater pressure will be placed on the Bayou to process additional loading from point and nonpoint sources.

Dickinson Bayou Tidal (1103)
Major tributaries:
Bordens Gully,
Cedar Creek,
Geisler Bayou,
Gum Bayou

The watershed is heavily developed with the cities of Dickinson, Santa Fe, and League City. Low intensity residential and mixed commercial developments are the predominant land uses.

The entire segment and sub-segments are on the 2008 Texas 303(d) List for depressed DO and elevated bacteria levels. In addition, Bensons Bayou, Bordens Gully, and Geisler Bayou are listed for elevated levels of bacteria.

In response to the elevated bacteria levels in the bayous, the TCEQ initiated a Bacteria TMDL to determine measures necessary to support recreational uses in these waterbodies.

A TMDL for DO was initiated in 2000 after the impairment was verified. Depressed DO was removed from all sub-segments during the most recent assessment. H-GAC conducted a special study to determine the extent and severity of the impairment in the bayou. TCEQ removed the DO concern for all subsegments of Dickinson Bayou; however, the listing remains for the main stem. Currently, Texas Sea Grant is facilitating a stakeholders group, which will help determine the best strategies for addressing the problems and eventually assist in developing a watershed management plan.

Old Brazos River Channel (1111)

This small watershed comprises what was once the mouth of the Brazos River, in southern Brazoria County. Beach-front residential development along with water recreational activities are observed in the lower reaches of the watershed with large expanses of wetlands surrounding the watershed.

While no impairments are listed for this segment, there is a concern for nitrate for the entire segment.

Oyster Creek Above Tidal (1110)

Although there is scattered development in the towns of Missouri City, Fresno, Arcola, Bailey's Prairie, Bonney Village, Angleton, Holiday Lakes and Lake Jackson, most of the watershed is either undeveloped or rural. The greater portion of the watershed is bottomland forest, grassland or wetland habitat. Oyster Creek is very sinuous with numerous oxbow lakes, typical of the Texas Gulf Coast region.

Oyster Creek Above Tidal is on the TCEQ's list of impaired waterbodies due to elevated levels of bacteria.

The segment is also listed as a concern for nutrients and DO.

Oyster Creek Tidal (1109)

The watershed lies in a region of fertile alluvial soil, which has supported cotton and sugarcane plantations since the days of the Texas Republic. Development is largely limited to the northwest section of the watershed including the cities of Lake Jackson, Richwood, Clute and Oyster Creek Village while most is covered by natural forest and grass-land. Oyster Creek is very sinuous with numerous oxbow lakes, typical of the Texas Gulf Coast region. There are large expanses of coastal wetlands at the southern and eastern edges of the watershed.

No current water quality concerns exist in Oyster Creek Tidal.

San Bernard River

San Bernard River Above Tidal (1302)
Major tributaries:
Coushatta, East Bernard,
Little San Bernard,Peach
and West Bernard Creeks;
Middle Bernard River

The watershed is predominantly undeveloped with the small communities of East Bernard and Kendleton located in the middle of the watershed. Rice and cotton farming dominate the landscape. The segment is listed as not supporting contact recreation use due to elevated bacteria levels in the lower 50 miles.

A 50-mile section of the segment has been listed as a concern for depressed DO levels.

Beginning in 2007, H-GAC began routine monitoring and conventional chemical parameter collection including bacteria.

San Bernard River Tidal (1301)
Major tributaries:
Halls Bayou,
Mound Creek

The watershed is predominantly undeveloped with the exception of small towns including West Columbia, Wild Peach Village, Sweeny, Brazoria and Jones Creek Village. West Columbia was the first capital of the Republic of Texas; a museum chronicles the town's historical significance. The watershed consists mainly of forest or grasslands with large areas of wetlands located in the southern end at the mouth of the San Bernard River. Agriculture is the main economic activity in the watershed.

The entire segment is listed as impaired for elevated levels of bacteria for not meeting the state standards set for contact recreation.

The entire segment has been listed as a concern for Chlorophyll–*a*.

Beginning in 2007, H-GAC began routine monitoring and conventional chemical parameter collection including bacteria in the tidal portion.

In 2006, the mouth of the San Bernard River was completely silted in. This was caused by nearly 50 years of sediment deposition from the Brazos River being carried down the coast after of the mouth of the Brazos was relocated in 1929 to accommodate the Port of Freeport. Sedimentation rates started to accelerate after the Brazos River floods of 1992. Hurricanes Katrina and Rita further increased sediment deposition until it was finally completely silted in.

All water flowing down the San Bernard must travel through the Intercoastal Waterway to get to the Gulf of Mexico. This has caused severe currents that are very dangerous to barge traffic. It has also caused concerns in regard to flooding and declining Blue Crab populations.

Currently, a plan is in place to reopen the mouth of the San Bernard in the near future.

Bays and Estuaries

Barbours Cut (2436)

This segment is in a heavily industrialized area. Dioxin in catfish and crab tissue samples and PCBs in catfish, spotted seatrout and blue crab prevents fish consumption. Exact sources of the dioxin and PCBs are not known at this time.

The ongoing dioxin TMDL study was divided into three separate phases. First, the study focused on assessing current conditions; second, data was gathered for all media types in order to quantify dioxin levels. The third phase is currently focusing on model development and load allocation.

Bastrop Bay/ Oyster Lake (2433)

The bay and lake are in an undeveloped estuarine environment and are part of the Christmas Bay system. Oyster Lake was added to the 303(d) List of impaired waterbodies for bacteria in oyster waters in 2006.

Bayport Channel (2438)

This segment is in a heavily industrialized area.

Dioxin in catfish and crab tissue prevents fish consumption. Exact sources of dioxin are not known at this time. Also PCBs occur in catfish, spotted seatrout and blue crab.

This segment is part of the ongoing dioxin TMDL study.

The entire segment is listed as a concern for nutrients.

Black Duck Bay (2428), Burnett Bay (2430)

These segments are in a heavily industrialized area.

Dioxin in catfish and crab tissue prevents fish consumption. Exact sources of dioxin are not known at this time. Also PCBs occur in catfish, spotted seatrout and blue crab.

Both segments are part of the ongoing dioxin TMDL study. Concerns regarding nutrients are listed for both segments.

Chocolate Bay (2432)
Major tributaries: Chocolate Bayou, Cloud Bayou, Halls Bayou, Mustang Bayou, Persimmon Bayou, Willow Bayou

Elevated bacteria levels from unknown sources prevent oyster harvesting. The bay receives water from Chocolate Bayou, Halls Bayou, Mustang Bayou and Persimmon Bayou.

Both Willow Bayou and Halls Bayou Tidal have been listed as a concern for depressed DO.

Christmas Bay (2434)

Christmas Bay is a Coastal Preserve and part of the Texas General Land Office/Texas Parks and Wildlife Department Coastal Preserves Program. Christmas Bay is one of the most pristine areas in the Galveston Bay system and is home to numerous species of birds, fish, crustaceans, mollusks and several species of seagrass. The area is surrounded by undeveloped wetland habitat and is part of a larger system of smaller bays and lakes.

The area adjacent to West Bay was added to the 303(d) List of impaired waterbodies for bacteria in oyster waters in 2006.

Clear Lake (2425)

Clear Lake is home to one of the most concentrated fleets of recreational boats in Texas and the United States. Numerous marinas are located around the lake providing easy access to Upper Galveston Bay. The entire lake is a recreational playground for boaters on everything from jet skis to multi-million-dollar yachts. On the south shore of Clear Lake, the watershed encompasses the cities of League City, Clear Lake Shores and Kemah.

Jarbo Bayou feeds into Clear Lake and is listed as impaired for contact recreation use due to elevated levels of bacteria. Clear Lake is also listed as having a nutrient enrichment concern.

Drum Bay(2435)

No known water quality issues exist in Drum Bay. However, Drum Bay is included in the DSHS "restricted areas" or "closed to the taking of shellfish." Data collected between 1996 and 2003 show a potential impairment for oyster waters and concern for contact recreation due to elevated levels above the fecal coliform standard.

East Bay (2423)

The East Bay watershed encompasses East Bay, the Upper Bolivar Peninsula and portions of Chambers County which are predominantly undeveloped. Development is limited to vacation homes, fish and bait camps and small commercial businesses. Abundant wetlands, marshes and coastal prairie habitats cover most of the peninsula.

East Bay is listed as impaired for elevated levels of bacteria in oyster waters and is one of six bay and estuary segments included in the TMDL for upper coast oyster waters.

Public comment is expected for the draft TMDL in June 2008.

Lower Galveston Bay (2439)

This segment primarily receives flow from other bodies of water such as Upper Galveston Bay, East Bay, and West Bay and is influenced by tides from the Gulf of Mexico. The land portion of the watershed includes parts of the cities of Galveston and Texas City. The entire bay is a major recreational area with boating, recreational and commercial fishing and birding.

Lower Galveston Bay is listed as not meeting the State bacteria standard for oyster waters. It is one of six bay and estuary segments included in the TMDL for upper coast oyster waters.

Public comment is expected for the draft TMDL in June 2008.

In addition, the segment is listed as a concern for nutrients to to elevated levels of nitrate and Chlorophyll–*a*.

Moses Lake (2431)

The watershed, which includes much of Texas City and part of the city of La Marque, presents a wide range of environmental habitat conditions. The northeastern and northwestern portions of the watershed consist mostly of grasslands and forested lands, while the southern section is highly urbanized and includes a part of the Texas City petrochemical complex. Large tracts of undisturbed wetlands and marsh habitats surround Moses Lake and Dollar Bay an adjacent lagoon.

Recent results from routine monitoring show a possible concern for nutrients with respect to orthophosphate. H-GAC will continue to monitor for trends.

San Jacinto Bay (2427), Scott Bay (2429), Tabbs Bay (2426)

These segments are in the middle of, near or downstream from heavily industrialized areas. Dioxin in catfish and crab tissue prevents fish consumption. Exact sources of dioxin are not known at this time. There are also PCBs in catfish, spotted seatrout and blue crab.

The dioxin TMDL study has been divided into three separate phases. First, the study focused on assessing current conditions, second data gathering for all media types in order to quantify dioxin levels and the third phase is currently focusing on model development and load allocation.

Each of the segments is also listed as a concern for nutrients due to elevated levels of ammonia, nitrates and phosphorus.

Texas City Ship Channel (2437)

The majority of the Texas City Ship Channel watershed is occupied by the Texas City petrochemical complex. The Texas City Ship Channel supports heavy barge and ship traffic on a regular basis. Docks used to load and unload raw materials and finished products occupy the entire northern shoreline and the turning basin. The ship channel receives stormwater and wastewater discharges from industrial complexes.

Currently the Texas City Ship Channel is listed as having a nutrient concern due to elevated levels of Chlorophyll–*a* and phosphorus.

Upper Galveston Bay (2421)

The upper portion of the watershed contains a large amount of industrial activity, with the majority derived from barge transportation. The lower portion of the watershed is a mix of residential and commercial communities.

Dioxin and PCBs in edible tissue prevents fish consumption from Red Bluff to Morgan's Point. Exact sources of dioxin and PCBs are not known at this time.The dioxin TMDL study has been divided into three separate phases. First, the study focused on assessing current conditions, second data gathering for all media types in order to quantify dioxin levels and the third phase is currently focusing on model development and load allocation.

There is also a listing for bacteria in oyster waters for the western portion of the Bay and from Red Bluff to Morgan's Point. Upper Galveston Bay in one of six bay and estuary segments included in the TMDL for upper coast oyster waters.

Public comment is expected for the draft TMDL in June, 2008. An additional concern exists for nutrient enrichment because of elevated levels of ammonia and phosphates, which could lead to algal blooms.

West Bay (2424)
Major tributaries: Basford Bayou, English Bayou, Highland Bayou, Marchand Bayou, Offats Bayou.

The West Galveston Bay watershed encompasses the bay side of Galveston Island, a barrier island with many coastal wetlands on the landward side. West Bay system is located at the eastern end of Galveston Island and includes several small bays, lakes and bayous that drain into the bay.

Oyster harvesting is prohibited in the main part of the bay due to elevated bacteria levels. Both Highland and Marchand Bayous are listed as impaired due to elevated bacteria levels and low DO. West Galveston Bay is one of six bay and estuary segments included in the TMDL for upper coast oyster waters.

Public comment is expected for the draft TMDL in June, 2008.

There is also a nutrient enrichment concern with respect to ammonia for English Bayou and the Crash Basin.

A special project to provide additional water quality data and baseline biological data for Highland and Marchand Bayous began in 2006. Data collection efforts ended in the fall of 2007. The final report will be completed in August, 2008.

Gulf of Mexico (2501)

The only documented issue in the Gulf of Mexico is elevated mercury levels in edible tissue starting from the Jefferson-Chambers county line to Bolivar Point to San Luis Pass area to Freeport.

Summary

The biggest water quality concern throughout the region continues to be elevated levels of bacteria, which inhibit safe contact recreation and oyster harvests. Toxicity, particularly dioxin, continues to be an issue of great concern. Several TMDLs are currently underway to address these issues. Routine monitoring is being used to address some of the less severe issues, including low DO levels in small tributaries. Other special studies have been initiated to identify sources of contamination and to help in the development of reasonable remediation and control strategies.

Expanded ambient monitoring has given water quality managers data to conduct better and more efficient assessments. Monitoring in watersheds that previously had limited data has improved the knowledge of water quality conditions in more rural areas. The combination of data collection, analysis, education, stakeholder involvement and reasonable implementation strategies are key factors in watershed management and the understanding of aquatic ecological systems.

Resources

In addition to previous Basin Highlights and Summary Reports, the following publications are available through the CRP and H-GAC's Water Quality Planning Program. Reports and studies are also available for other programs such as habitat preservation and environmental enforcement. If you are interested in any of these publications, please contact H-GAC's Community and Environmental Planning Department at 713-993-2461. Many documents can be found online at www.h-gac.com.

Water Quality Reports and Guidance Manuals

Mustang Bayou Systematic Watershed Study, 2006

Bacteria Die-off Study, 2005

Cypress Creek Source ID Study, 2005

Receiving Water Assessment of Unnamed Tributary of Whiteoak Bayou, 2005

Receiving Water Assessments for Urban Water Bodies HSC Tributary, 2003

HSC Water Quality Conditions Report, 2003

Hydrologic, Water Quality and Biological Data for Three Water Bodies Texas Gulf Coastal Plain, 2000-2002

A Guidance Manual for Identifying and Eliminating Illicit Connections to Municipal Separate Storm Sewer Systems (MS4), 2002

Dickinson Bayou Pre-TMDL Data Collection, 2002

Urban Bayou Bacteria Source Identification Study, 2001

Regional Habitat Index, USGS Phase 3 Document
Dioxin Sediment and Tissue Sampling in Houston Ship Channel and Upper Galveston Bay, 2001

Gulf Coast Region Water Quality Management Planning Document, 2000

Domestic Wastewater Regionalization White Paper, 2000

Copper Water Effects Ratio Study and Trace Metals Study for the HSC, 2000

Greens Bayou Intensive Survey and Wasteload Evaluation, 1999

Water Quality Data Analysis, 1999

Characterization of Water and Sediment Quality, Christmas Bay System, Brazoria County, Texas, 2000

Characterization of Water-Quality and Aquatic-Biological Conditions in the Panther Branch Watershed, near Houston, Texas, 1999

Identifying and Eliminating Illicit Connections Within the Clear Creek, 1998-1999

Gulf Coast Region Water Quality Management Planning Document, 1998

Fish, Benthic Macroinvertebrate, and Stream Habitat Data from the H-GAC Service Area, Texas 1997-98, 1998

Nutrient Loading and Selected Water Quality and Biological Characteristics of Dickinson Bayou near Houston, Texas 1995-97, 1997

Action Guide: Erosion and Sediment Control (Construction Activities), 1997

Local Government Water Quality Protection Study, 1994

HSC Success Story, 1992

Brochures

Lake Houston Watershed Profile, 2007

Cypress Creek Watershed Profile, 2006

Caney Creek and Peach Creek Watershed Profile, 2007

Bastrop Bayou Watershed Profile, 2006

San Bernard Watershed Profile, 2003

Bacteria Brochure, 2003

Sims Bayou Watershed Profile, 2002

Bacteria in our Bayous, 2002

Greens Bayou Watershed Profile, 2001

Water Quality Data Clearinghouse, 2000

What Watershed Do You Live In?, 2000

Armand Bayou Watershed Profile, 1999

Videos

Can I Swim Here?, 2000

Clean Rivers Program Video, 2007

Legend of Water Quality Impairments and Concerns

2008 Draft 303(d) Listing **I**
2008 Draft Water Quality Assessment Concern **C**

Definition	Storet	Abbreviation
FIELD PARAMETERS		
Temperature (Centigrade)	00010	T
Dissolved Oxygen (mg/L)	00300	DO
pH (standard units)	00400	pH
Conductivity (µmhos/cm)	00094	Con
Salinity (ppt)	00480	Sal
Transparency (meters)	00078	Trnp
BACTERIA		
Fecal Coliform (#/100 mL)	31616	FC
Fecal Coliform MF Agar (#/100 mL)	31613	
Enterococcus (mpn/100mL)	31701	Ent
E. coli (mpn/100mL)	31699	EC
NUTRIENTS		
Ammonia (mg/L)	00610	NH
Nitrate (mg/L)	00620	Nt
Nitrite + Nitrate (mg/L)	00630	NN
Nitrite + Nitrate, Whatman (mg/L)	00593	
Total Kjeldahl Nitrogen (mg/L)	00625	TKN
Orthophosphate Phosphorus (mg/L)	70507	OP
Total Phosphorus (mg/L)	00665	TP
Chlorophyll-*a* (µg/L)	32211	CHLa
Total Organic Carbon (mg/L)	00680	TOC
BOD_5 (mg/L)	00310	BOD
$CBOD_5$ (mg/L)	00307	CBOD
SALTS / SOLIDS		
Chloride (mg/L as Cl)	00940	Cl
Fluoride (mg/L as F)	00951	Fl
Sulfate (mg/L as SO_4)	00945	SO

Definition	Storet	Abbreviation
SALTS / SOLIDS Cont.		
Total Alkalinity (mg/L as $CaCO_3$)	00410	Alk
Total Dissolved Solids (mg/L)	70300	TDS
Total Hardness (mg/L as $CaCO_3$)	00900	TH
TSS (mg/L)	00530	TSS
Volatile Suspended Solids (mg/L)	00535	VSS
METALS		
Aluminum, Dissolved (µg/L)	01106	Al
Arsenic, Dissolved (µg/L)	01000	As
Barium, Dissolved (µg/L)	01005	Ba
Cadmium, Dissolved (µg/L)	01025	Cd
Calcium, Dissolved (mg/L)	00915	Ca
Chromium, Dissolved (µg/L)	01030	Cr
Copper, Dissolved (µg/L)	01040	Cu
Lead, Dissolved (µg/L)	01049	Pb
Mercury, Total (µg/L)	71900	Hg
Nickel, Dissolved (µg/L)	01065	Ni
Selenium, Dissolved (µg/L)	01145	Se
Selenium, Total (µg/L)	01147	Se
Silver, Dissolved (µg/L)	01075	Ag
Zinc, Dissolved (µg/L)	01090	Zn
OTHER		
Dioxins		Dioxin
PCBs		PCB
Volatile Organic Compounds		VOC
Sediment Toxicity		STox
Pesticides		Pest
Impaired Habitat		IH
Impaired Fish Community		Fish

Summary of Water Quality Impairments and Concerns

Basin & Segment Name	Number	Field Parameters	Bacteria	Nutrients	Salts / Solids	Metals	Other	Notes
TRINITY - SAN JACINTO COASTAL BASIN								
Cedar Bayou Tidal	901		I				I	FC, Dioxin, PCB
Cedar Bayou Above Tidal	902						I	MacroB
SAN JACINTO RIVER BASIN								
San Jacinto River Tidal	1001						I	Dioxin TMDL, PCB
Lake Houston	1002		I	C				FC, EC, NH, NN, OP, TP, CHL-a
	1002B	C						DO
East Fork San Jacinto River	1003		I					EC
West Fork San Jacinto River	1004		I	C				FC, EC, NN, OP
	1004D		I					EC, FC
	1004E	C	I					DO, EC, FC
HSC / San Jacinto River and Select Bay Segments	1005		I	C			I	Ent, NN, Dioxin TMDL, PCB
HSC	1006	I	I	C		I	I	DO, Bacteria, NN, OP, TP, Hg, Dioxin TMDL, PCB, Stox
	1006D		I	C				FC, EC, NH, OP, TP
	1006F		I					FC, Ent
	1006H		I					FC
	1006I		I					FC, Ent
	1006J		I					FC, Ent
HSC Buffalo Bayou Tidal	1007		I	C			I	Bacteria TMDL, NH, NN, OP, TP, Dioxin, PCB, Stox
	1007A		I					Bacteria
	1007B		I	C				FC, NH, NN, OP, TP
	1007C		I	C				FC, EC, NH, TP
	1007D	C	I	C				DO, FC, EC, NH, NN, OP, TP
	1007E		I					FC
	1007F		I	C				FC, NH, TP
	1007G	C	I					DO, FC
	1007H		I					FC
	1007I		I					FC
	1007K	C	I					DO, FC
	1007L		I					FC
	1007M		I					FC
	1007N		I					FC
	1007O	C	I					DO, FC
	1007R	C	I	C				DO, FC, NH, NN
Spring Creek	1008	I	I	C			C	DO, EC, FC, NN, OP, TP, IH
	1008B		I	C				EC, NN, OP, TP
	1008C		C	C				EC, NN, OP, TP
	1008F	C		C				DO, NN, OP, TP
	1008H		I	C				EC, NN, TP
Cypress Creek	1009	C	I	C			I	DO, EC, NN, OP, TP, IH, MacroB

Basin & Segment Name	Number	Field Parameters	Bacteria	Nutrients	Salts / Solids	Metals	Other	Notes
SAN JACINTO RIVER BASIN *Cont.*								
	1009C		I	C				EC, NN, TP
	1009D		I	C				EC, NN, TP
	1009E		I	C				EC, NH, NN, TP
Caney Creek	1010		I					EC
Peach Creek	1011		I					EC
Lake Conroe	1012			C				CHLa
Buffalo Bayou Tidal	1013		I	C				Bacteria TMDL, NN, OP, TP
	1013A	I	I	C				DO, FC, EC, NH
	1013C		I					FC, EC
Buffalo Bayou Above Tidal	1014		I	C				FC, EC, Bacteria TMDL, NN, OP, TP
	1014A		I	C				NN, TP
	1014B		I	C				EC, NN
	1014E		I	C				EC, NN, TP
	1014H		I	C				FC, EC, NN, TP
	1014K		I					FC, EC
	1014L		I	C				FC, EC, NN, TP
	1014M	I	I	C				DO, FC, EC, OP
	1014N	C	I					DO, FC, EC
	1014O		I					FC, EC
Lake Creek	1015							USGS Study
Greens Bayou Above Tidal	1016		I	C				FC, NH, NN, OP, TP
	1016A	C	I	C				DO, FC, EC, NN, TP
	1016B		I					FC
	1016C		I	C				FC, EC, NN, TP
	1016D		I					FC, EC
White Oak Bayou	1017		I	C				Bacteria TMDL, NH, NN, OP, TP
	1017A		I	C				FC, EC, NN
	1017B		I					FC, EC
	1017D	I	I					DO, FC, EC
	1017E		I					FC, EC
SAN JACINTO - BRAZOS COASTAL BASIN								
Clear Creek Tidal	1101	C	I	C				DO, Bacteria TMDL, Nt, OP, CHLa
	1101B		I					FC, Bacteria TMDL
	1101D	C	I					DO, EC, Bacteria TMDL
Clear Creek Above Tidal	1102	C	I	C			I	DO, Bacteria TMDL, NH, NN, OP, TP, Fish
	1102A		I					Bacteria TMDL
	1102B		I	C				Bacteria TMDL, OP, TP
	1102C	C	I					DO, Bacteria TMDL
	1102D	C	I	C				DO, Bacteria TMDL, Nt, OP, TP
	1102E	C	I	C				DO, Bacteria TMDL, Nt, OP

Basin & Segment Name	Number	Field Parameters	Bacteria	Nutrients	Salts / Solids	Metals	Other	Notes
SAN JACINTO - BRAZOS COASTAL BASIN Cont.								
Dickinson Bayou Tidal	1103	I	I					DO, Ent, Bacteria TMDL
	1103A		I					Ent, Bacteria TMDL
	1103B	C	I					DO, Ent, Bacteria TMDL
	1103C	C	I					DO, Ent, Bacteria TMDL
	1103D							
Dickinson Bayou Above Tidal	1104	I	I					DO TMDL, FC
Bastrop Bayou Tidal	1105							EC, Ent, Bastrop Bayou Watershed Protection Plan (WPP)
Chocolate Bayou Tidal	1107			C				CHLa
Chocolate Bayou Above Tidal	1108	C					C	DO, IH
Oyster Creek Tidal	1109							
Oyster Creek Above Tidal	1110	I	I	C				DO, Bacteria, NH, OP, CHLa
Old Brazos River Channel	1111			C				Nt
Armand Bayou Tidal	1113	I	I	C				DO, Bacteria, CHLa
	1113A	I	I					DO, FC
	1113B		I	C				Bacteria, Nt, OP, TP
BRAZOS - COLORADO COASTAL BASIN								
San Bernard River Tidal	1301		I	C				Bacteria, CHLa
San Bernard River Above Tidal	1302	C	I	C				DO, FC, EC, NH
	1302A	C	I					DO, Bacteria
	1302B	I	I					DO, Bacteria
BAYS & ESTUARIES - GULF OF MEXICO								
Upper Galveston Bay	2421		I	C			I	FC-oyster waters, CHLa, NH, Nt, TP, Dioxin TMDL, PCB
East Bay	2423		I	C				FC-oyster waters, CHLa
West Bay	2424		I					FC-oyster waters
	2424A	I	I					DO, FC-contact rec
	2424B		I					NH
	2424C	I	I					DO, FC-contact rec
	2424D							
	2424E							
	2424F							
Clear Lake	2425			C				CHLa, Nt, NH, TP
	2425B		I					FC-contact rec
	2425C							
Tabbs Bay	2426			C			I	NH. Nt, OP, TP, Dioxin TMDL, PCB
San Jacinto Bay	2427			C			I	NH. Nt, OP, TP, Dioxin TMDL, PCB
Black Duck Bay	2428			C			I	TP, CHLa, Dioxin TMDL, PCB
Scott Bay	2429			C			I	TP, NH, OP, CHLa, Dioxin TMDL, PCB

Basin & Segment Name	Number	Field Parameters	Bacteria	Nutrients	Salts / Solids	Metals	Other	Notes
BAYS & ESTUARIES - GULF OF MEXICO Cont.								
Burnett Bay	2430			C			I	NH, Nt, OP, TP, CHLa, Dioxin TMDL, PCB
Moses Lake	2431							
Chocolate Bay	2432		I					FC-oyster waters
	2432B	C						DO
	2432C	C						DO
Bastrop Bay / Oyster Lake	2433		I					FC-oyster waters
Christmas Bay	2434		I					FC-oyster waters
Drum Bay	2435							
	2435A							
Barbours Cut	2436			C			I	NH, Nt, OP, Dioxin TMDL, PCB
Texas City Ship Channel	2437			C				NH, TP
Bayport Channel	2438			C			I	NH, CHLa, Nt, OP, TP, Dioxin TMDL, PCB
Lower Galveston Bay	2439		I	C				FC-oyster waters, Nt, CHLa
Gulf of Mexico	2501					i		Mercury in Edible Fish Tissue

Segments

Basin & Segment Name	Number
TRINITY - SAN JACINTO COASTAL BASIN	
Cedar Bayou Tidal	901
Cedar Bayou Above Tidal	902
SAN JACINTO RIVER BASIN	
San Jacinto River Tidal	1001
Lake Houston	1002
East Fork San Jacinto River	1003
West Fork San Jacinto River	1004
HSC / San Jacinto River and Select Bay Segments	1005
HSC	1006
HSC Buffalo Bayou Tidal	1007
Spring Creek	1008
Cypress Creek	1009
Caney Creek	1010
Peach Creek	1011
Lake Conroe	1012
Buffalo Bayou Tidal	1013
Buffalo Bayou Above Tidal	1014
Lake Creek	1015
Greens Bayou Above Tidal	1016
White Oak Bayou	1017
SAN JACINTO - BRAZOS COASTAL BASIN	
Clear Creek Tidal	1101
Clear Creek Above Tidal	1102
Dickinson Bayou Tidal	1103
Dickinson Bayou Above Tidal	1104
Bastrop Bayou Tidal	1105
Chocolate Bayou Tidal	1107
Chocolate Bayou Above Tidal	1108
Oyster Creek Tidal	1109
Oyster Creek Above Tidal	1110
Old Brazos River Channel	1111
Armand Bayou Tidal	1113
BRAZOS-COLORADO COASTAL BASIN	
San Bernard River Tidal	1301
San Bernard River Above Tidal	1302
BAYS & ESTUARIES / GULF OF MEXICO	
Upper Galveston Bay	2421
East Bay	2423
West Bay	2424
Clear Lake	2425
Tabbs Bay	2426
San Jacinto Bay	2427
Black Duck Bay	2428
Scott Bay	2429
Burnett Bay	2430
Moses Lake	2431
Chocolate Bay	2432
Bastrop Bay / Oyster Lake	2433
Christmas Bay	2434
Drum Bay	2435
Barbours Cut	2436
Texas City Ship Channel	2437
Bayport Channel	2438
Lower Galveston Bay	2439
Gulf of Mexico	2501

Contact Information

Todd Running
CRP Manager
Contract Administration, Special Studies Coordination, Data Analysis and Assessment
todd.running@h-gac.com

Jean Wright
Senior Environmental Planner
CRP Monitoring Coordinator,
Quality Assurance Officer, Special Studies Coordination, Data Analysis and Assessment
jean.wright@h-gac.com

Bruce Ridpath
Senior Environmental Planner
CRP Data Manager,
Data Analysis and Assessment
bruce.ridpath@h-gac.com

Om Chawla
Laboratory Quality Assurance Specialist
NELAC, Laboratory Quality Assurance
om.chawla@h-gac.com

Kathleen Ramsey
Senior Environmental Planner
Wastewater Treatment, Failing Septic Systems, and Toxicology
kathy.ramsey@h-gac.com

Gayla Stock
Texas Watch Volunteer Monitoring Coordinator
Volunteer Training and Certification
gayla.stock@h-gac.com

Ayo Jibowu
Senior Geographic Information Systems Analyst
GIS Data Development, Mapping and Geographic Analysis, Web Content Development and Interactive Mapping
ayo.jibowu@h-gac.com

Kristina Hardwick
Public Education and Outreach Specialist
kristina.hardwick@h-gac.com

Photo Descriptions and Credits

Pg 9: Oyster Creek

Pg 10: San Jacinto River Authority Professional Water Quality Monitor

Pg 14: Glenn Buckley, Texas Stream Volunteer, and student at the City of Houston Water Festival hosted by the Downtown Aquarium

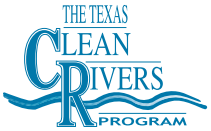
Pg 15: Student Volunteer at the River, Lakes, Bays 'N Bayous Trash Bash®

Pg 19: Shrimp Boat, photo courtesy of Woody Woodrow

Pg 25: Large Red-eared Slider (Trachemys scripta elegans) turtle, photo courtesy of Woody Woodrow

Darter (Sympetrum) Dragonfly
Photo courtesy of Woody Woodrow

This report was prepared in cooperation with
the Texas Commission on Environmental Quality under
the authorization of the Texas Clean Rivers Act.



Houston–Galveston Area Council 3555 Timmons Lane, Suite 120 Houston, TX 77027 Phone 713 627 3200 Fax 713 993 4503 www.h-gac.com