

Institutional Framework

Very few laws exist that directly protect and regulate usage of wetlands and natural areas. However, several federal and state laws provide some degree of protection for natural resources. Pertinent laws and implementing agencies are described in their respective sections below.

The Phase II Plan will build on the Phase I Plan to address implementation of the Armand Bayou Watershed Partnership's (Watershed Partnership) goals toward accomplishing its mission and realizing its vision of a protected and enhanced watershed. In developing the Phase II Plan, the Watershed Partnership will work to establish priorities, create a detailed plan of management options, and implement improvement projects. Thus, the Phase II Plan will include specific action items to achieve the Watershed Partnership's goals, and these actions may involve recommendations to change the institutional framework within which watershed actions are currently taken.

Federal Legislation

Many federal statutes regulating natural resources, for example the National Environmental Policy Act, are primarily designed to provide a process by which the impacts of federally funded actions to public resources can be assessed and considered with respect to overall public benefits prior to the action. A few, such as the Clean Water Act, regulate specific actions with impacts to natural resources.

Clean Water Act

The Clean Water Act (CWA) is the cornerstone of surface water quality protection in the United States. Section 404 of the Clean Water Act specifically regulates the discharge of materials into "waters of the U.S.," which have historically been interpreted to include wetlands. Filling of any waters of the U.S. requires a permit and mitigation to replace the function and value of the affected waters. However, in the aftermath of the 2001 SWANCC case,²³ almost all of the prairie pothole depressional wetlands in the watershed are currently without 404 protection, according to local regulatory interpretation.

²³In the SWANCC case, the Supreme Court ruled that the Corps exceeded its authority in asserting CWA jurisdiction over many non-navigable, intrastate waters. These wetlands had been regulated since 1986 under the "Migratory Bird Rule," under the premise that discharging materials into these wetlands, many of which serve as habitat for migratory birds, impacts interstate and foreign commerce. In 2003, the Bush Administration issued a memorandum to the EPA and the Corps, ordering the removal of non-navigable, intrastate waters from their jurisdiction under the CWA where the Migratory Bird Rule provides the sole basis for asserting jurisdiction.

The Clean Water Act also established the National Pollutant Discharge Elimination System (NPDES) permit program to control water pollution by regulating discharge of pollutants into waters of the United States. Industrial, municipal, and other facilities must obtain NPDES permits if their discharges go directly to surface waters. In Texas, the permit program is administered by the Texas Commission on Environmental Quality. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to water quality.

Coastal Zone Management Act

Though the Coastal Zone Management Act (CZMA) of 1972, Congress recognized the value of the Americas coastal "natural, commercial, recreational, ecological, industrial, and esthetic resources of immediate and potential value to the present and future well-being of the Nation." It called for the development of coordinated, comprehensive state coastal management programs with public input, to help protect coastal resources in the face of competing human uses and increasing pressure from coastal development. CZMA established funding programs for coastal enhancement projects. It established the National Estuarine Research Reserve Program to authorize the designation of selected estuaries as sanctuaries and to promote research in relatively unspoiled areas. Finally, the CZMA requires federal agencies or licensees to carry out their activities in such a way that they conform to the maximum extent practicable with a state's coastal zone management programs.

Endangered Species Act

The Endangered Species Act provides protection of "Critical Habitat" for threatened and endangered species under the jurisdiction of the U.S. Fish and Wildlife Service. Federal actions in areas designated as Critical Habitat must be evaluated to determine their impacts on the species of concern.

Magnuson-Stevens Act

The Magnuson-Stevens Act gives NOAA Fisheries the authority to regulate nearshore waters and substrate necessary for fish spawning, feeding, and growth, or Essential Fish Habitat (EFH), of which a significant amount occurs in Armand Bayou. Although regulatory authority is limited, EFH must be considered in activities within nearshore waters, especially with respect to federal projects.

National Environmental Policy Act

National Environmental Policy Act (NEPA) ensures that all branches of government give proper consideration to the environment prior to undertaking any major federal action that



significantly affects the environment. NEPA requirements are invoked when airports, seaports, highways, parkland purchases, and other federal activities are proposed. Environmental Assessments and Environmental Impact Statements, which are assessments of potential impacts from alternative courses of action, are required from significant federally funded projects.

Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act regulates placement of structures within navigable waters, under supervision of the Army Corp of Engineers. This section regulates any development that would impact the channel of Armand Bayou and any of its tributaries.

National Flood Insurance Act

The National Flood Insurance Program (NFIP) is a federal program, established by the National Flood Insurance Act of 1968,

enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

Federal Agencies and Programs

Environmental Protection Agency

The Environmental Protection Agency (EPA) works to develop and enforce regulations that implement environmental laws enacted by Congress, such as the Clean Water Act and Clean Air Act. EPA is responsible for researching and setting national standards for a variety of environmental programs, and delegates to states and tribes the responsibility for issuing permits and for monitoring and enforcing compliance. Where national

standards are not met, EPA can issue sanctions and take other steps to assist the states and tribes in reaching the desired levels of environmental quality. The EPA also sponsors several initiatives and grant programs to provide assistance to organizations involved in watershed management, pollution prevention, education, and sustainable development. (<http://www.epa.gov/>)



Federal Emergency Management Administration

The Federal Emergency Management Administration (FEMA) has undertaken a massive effort of flood hazard identification and mapping to produce Flood Hazard Boundary Maps, Flood Insurance Rate Maps, and Flood Boundary and Floodway Maps. The maps identify Special Flood Hazard Areas (SFHAs), which are regulated to minimize potential loss of life and property and the economic benefits to be derived from floodplain development. Development may take place within the SFHA, provided that development complies with local floodplain management ordinances, which must in turn meet the minimum federal requirements. Flood insurance is required for insurable structures within the SFHA to protect federal financial investments and assistance used for acquisition and/or construction purposes within communities participating in the National Flood Insurance Program. (<http://www.fema.gov/>)

National Oceanic and Atmospheric Administration (NOAA)

NOAA Fisheries is a division of the National Oceanic and Atmospheric Administration. NOAA Fisheries works to restore and maintain sustainable fisheries, promote the recovery of protected species, and to protect and maintain the health of coastal marine habitats. The agency conducts research to restore and create fish habitat, reviews coastal development and water projects that may alter or destroy habitat, and recommends measures to offset development and use impacts. NOAA works to achieve its goals by its own actions in cooperation with other resource protection agencies, conservation organizations, and local communities, and by sponsoring national programs such as the Coastal Management Program and Community-Based Restoration Program. (<http://www.noaa.gov/>)

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) administers regulatory programs and issues permits under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. In addition to its military role, it leads efforts in planning, designing, building, and



operating water resources and other civil works projects, such as navigation, flood control, environmental protection, and disaster response. Locally, the Galveston District of the Corps of Engineers leads the Interagency Coordination Team, which was created to address key environmental issues and concerns associated with the widening and deepening project for the Houston-Galveston Navigation Channel. The Beneficial Uses Group is a subcommittee of the Interagency Coordination Team and identifies environmentally and economically responsible

ways to utilize the material dredged from the ship channel expansion project. Efforts include several recent and ongoing efforts to create new islands and restore historic islands that provide important upland, intertidal, and submerged habitats for waterbirds and aquatic species. (<http://www.usace.army.mil>)

U.S. Department of Agriculture

The U.S. Department of Agriculture is active in natural resource management, particularly through the Natural Resource Conservation Service and the U.S. Forest Service. Both organizations provide resources for natural resource conservation, public land management for conservation purposes, and educational programs. (<http://www.usda.gov>)

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS), part of the Department of the Interior, protects America's diverse fish and wildlife resources. Locally, its Texas Coastal Program focuses on restoring and protecting economically, recreationally and ecologically important coastal fish and wildlife habitats through partnerships. By sharing biological knowledge, offering technical assistance in identifying and designing restoration projects, identifying habitat protection opportunities, and providing federal matching funds to implement projects, USFWS Texas Coastal Program biologists play a vital role in supporting and implementing coastal conservation initiatives that succeed through partnerships. USFWS: (<http://www.fws.gov/>)
Texas Coastal Program: <http://texascoastalprogram.fws.gov/TCPinfo.htm>

U.S. Geological Survey

The U.S. Geological Survey (USGS) is a bureau of the Department of the Interior. The USGS serves the nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life. The Water Resources Discipline (WRD) provides reliable, impartial, timely information needed to understand the water resources of the United States. Locally the WRD provides routine monitoring of surface- and groundwater resources, collects site-specific data, and conducts hydrologic investigations for Federal, State, and local agencies. These investigations provide managers with valuable information for decision-making. They also provide data for water-resource modeling and information related to land-surface subsidence, flood-warning systems, freshwater inflows, water and sediment quality, and coastal ecology. Through the USGS cooperative funding program the USGS is able to provide some matching funds for scientific studies, create local partnerships, and provide real-time information available on the Internet at (<http://tx.usgs.gov>).

Texas State Legislation

Much of Texas' state regulation consists of rules promulgated to implement or augment federal legislation. However, the few

unique pieces of legislation with direct implications for the Armand Bayou watershed are described below.

Texas Estuaries Act

In 1999, the Texas Legislature passed the Texas Estuaries Act (HB 2561), making Texas Estuary Programs official programs of the State of Texas. The Texas Estuaries Act recognized the significance of Texas' estuaries, appointed the Texas Commission on Environmental Quality as the lead state agency for estuary programs, instructed other relevant state agencies to participate in the development and implementation of comprehensive conservation management plans for its estuaries, and established the authority of estuary programs to grant and receive state and federal aid in estuary management activities.

Senate Bill 1576

Senate Bill 1576 established the authority of the Houston-Galveston Coastal Subsidence District to regulate groundwater withdrawals in the region to control subsidence induced by excessive groundwater use. Groundwater regulation has been instrumental in curbing the devastating effects of subsidence, of which Armand Bayou provides a dramatic example.

Senate Bill 1

Senate Bill 1, passed in 1997, created a comprehensive state water plan comprised 16 regional water plans under the guidance of the Texas Water Development Board. The state plan will be updated every five years and will serve as a guide for water resource and management policy. The plan will address drought planning, state water project financing, groundwater and surface water management, water use and conservation and funding mechanisms.

Senate Bill 2

Senate Bill 2, passed in 2001, established the Texas Water Policy Council to address Texas water policy issues, to advocate implementation of features within the State Water Plan, and to consider in stream flows and estuary inflow needs. Senate Bill 2 also provides for conjunctive management of surface water and groundwater management, and it ratified groundwater conservation districts created in previous legislation.

Texas State Agencies and Programs

Much of Texas's state regulation consists of rules promulgated to implement or augment federal legislation.

Coastal Coordination Council

The Coastal Coordination Council (CCC) is the policy board for the Coastal Management Program (CMP). The Council is made up of representatives from state resource agencies, local governments, small business, citizens, agriculture, as well as gubernatorial appointees. It adopts uniform goals and policies to guide decision-making by all entities regulating or managing natural resource use within the Texas coastal area. The Council

reviews significant actions taken or authorized by state agencies and subdivisions that may adversely affect coastal natural resources to determine their consistency with the CMP goals and policies. In addition, the Council oversees the CMP grants program and the Small Business and Individual Permitting Assistance Program. (<http://www.glo.state.tx.us/coastal/cc.html>)

Coastal Texas 2020

Coastal Texas 2020, a GLO initiative is developing a strategic plan to address the challenges to coastal resource management. The process is developing suggestions for legislative changes as well as proposed mechanisms and sources for securing funds to address coastal erosion and other coastal issues. To develop strategies, the Texas General Land Office is seeking input from citizens, business leaders and government officials at the local, state, and federal levels.

(<http://www.glo.state.tx.us/coastal/ct2020/index.html>)

Galveston Bay Estuary Program

The Galveston Bay Estuary Program of the TCEQ coordinates efforts to implement The Galveston Bay Plan, the Comprehensive Conservation and Management Plan for Galveston Bay. The Estuary Program works with local stakeholders to develop projects and programs to protect and restore Galveston Bay habitats, ensure adequate freshwater inflows to maintain a healthy estuarine system, manage fish and wildlife species, control invasive species, protect and improve water quality, particularly through addressing non-point source pollution, compile and analyze resource data to determine ecosystem health, conduct necessary research, and conduct public outreach and education to promote conservation of bay resources. The Galveston Bay Council, a management committee made up of representatives of state and federal agencies, local governments, citizens, commercial and recreational fishing interests, business and industry, and conservation organizations, is charged with guiding Estuary Program activities to ensure the best use of available resources in implementing The Galveston Bay Plan. (<http://gbep.state.tx.us>)

Texas Coastal Management Program

The Texas Coastal Management Program (CMP), administered by GLO, provides a framework for coordinating state, local, and federal programs for the management of Texas coastal resources. The CMP was created in the late 1980s to provide for a more coordinated, comprehensive approach to coastal resource management. (<http://www.glo.state.tx.us/coastal/cmp.html>)

Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) is responsible for regulating the discharge of contaminants to surface water, groundwater, soil, and air through a wide variety of programs, and conducts public outreach and education in support of these programs. The TCEQ also conducts monitoring and assessment of surface waters to determine compliance with water quality standards. TCEQ conducts Section 401 certification reviews

of U.S. Army Corps of Engineers Section 404 permit applications for the discharge of dredged or fill material into waters of the U.S., including wetlands. These certification reviews determine whether a proposed discharge will comply with state water quality standards. TCEQ also administers the Supplemental Environmental Project Program, an innovative approach to resolving enforcement actions and improving environmental quality. Supplemental Environmental Projects are comprised of a wide variety of activities including wetland protection and restoration. TCEQ hosts the Galveston Bay Estuary Program and also provides extensive outreach materials. (<http://www.tceq.state.tx.us/index.html>)

Texas General Land Office

In Texas, nearshore waters below the mean high-tide mark belong to the state. Texas state law delegates regulation of activities conducted in coastal areas on state-owned lands such as the construction of marinas, piers, docks, etc., to the Texas General Land Office (GLO). Although federal regulations also apply in most of these circumstances, GLO review provides an additional level of scrutiny of impacts to state waters and the public. Any lands that accumulate as a result of activities within waters over state-owned lands generally revert to the State. The General Land Office administers several coastal conservation programs, including the Coastal Management Program and the Coastal Erosion Planning and Response Act Program. (<http://www.glo.state.tx.us/>)

Texas Parks and Wildlife Department

Texas Parks and Wildlife Department (TPWD) provides outdoor recreational opportunities by managing and protecting fish and wildlife, and their habitat, and acquiring and managing parklands and historic areas. Responsibilities include hunting and fishing, wildlife management areas, law enforcement, state parks and historic areas, conservation and resource protection, and hunter and boater education. In the Galveston Bay watershed, TPWD operates several state parks, historic sites, and wildlife management areas, and has coordinated several large habitat restoration projects. Locally, TPWD leases the Armand Bayou Coastal Preserve from the General Land Office. Also of local interest is TPWD's Recreation Grants Program, which offers matching funds for communities wishing to construct recreational facilities. The Private Lands Initiative and the Wildscapes Program are available to assist landowners in managing their property in an ecologically friendly manner. (<http://www.tpwd.state.tx.us/>)

Texas Sea Grant College Program / Texas Cooperative Extension

County and marine agents associated with both the Texas Sea Grant College Program (TSG) and Texas Cooperative Extension (TCE) are active in the Armand Bayou area and available to assist with a variety of water quality education programs and demonstrations in the watershed. The Texas Coastal Watershed Program (TCWP) is a regional program of TSG and TCE and has an active watershed education program in the area. (<http://www.urban-nature.org>)

Regional/Local Entities and Programs

Clear Lake City Water Authority

Clear Lake City Water Authority is a special utility district that provides water and wastewater treatment services to the Clear Lake City area. Its area of responsibility is about 16,000 acres.

Floodplain Administrators

Floodplain Administrators perform duties to minimize flood damages, with responsibilities including but not limited to:

- Reviewing development permit applications to determine whether proposed building site, including the placement of manufactured homes, will be reasonably safe from flooding;
- Reviewing, approving or denying all applications for development permits;
- Reviewing permits for proposed development to assure that all necessary permits have been obtained from those Federal, State or local governmental agencies (including Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1334) from which prior approval is required;
- Interpreting the exact location of the boundaries of the areas of special flood hazards (for example, where a conflict appears to exist between a mapped boundary and actual field conditions);
- Notifying, in riverine situations, adjacent communities and the State Coordinating Agency which is the Texas Commission on Environmental Quality, prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Emergency Management Agency; and
- Assuring that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained.



Harris County Flood Control District

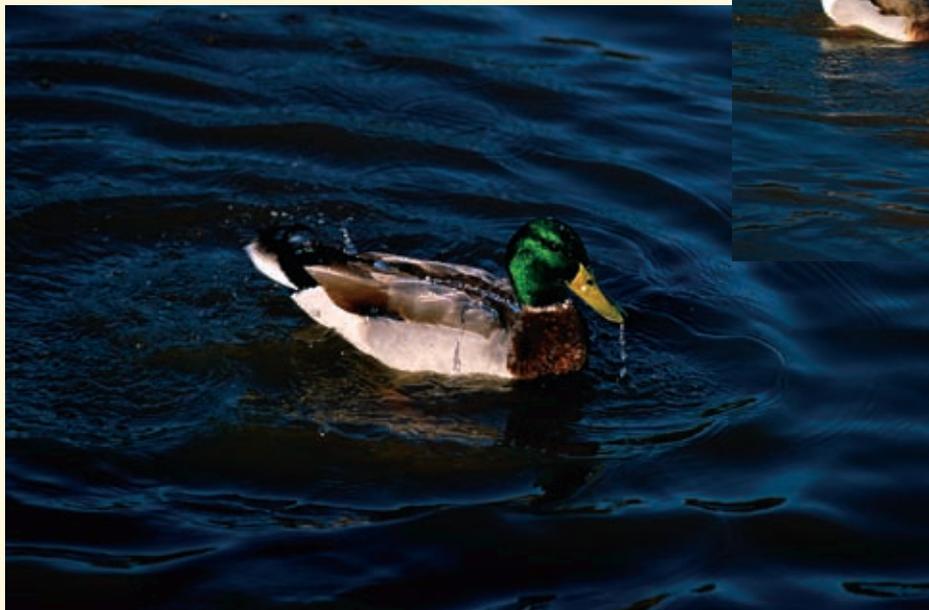
The Harris County Flood Control District (HCFCF) was charged by the Legislature to: control, store, preserve, and distribute the storm and flood waters, and the waters of the rivers and streams in Harris County and their tributaries, for various useful purposes. In addition, HCFCF was directed to reclaim and drain the overflow land of Harris County, conserve forests, and aid in the protection of navigation by regulating the flood and stormwaters that flow into navigable streams. HCFCF reviews and coordinates with developers and other agencies on projects that impact HCFCF facilities to help engineers plan, design, and build facilities that comply with HCFCF design and acceptance criteria, and that propose placement of non-flood control features in HCFCF facilities. (<http://www.hcfcf.org>)

Harris County Pollution Control

Harris County Pollution Control (HCPC) is a division of the Public Health & Environmental Services Department. The activities of the Pollution Control Division are directed toward ensuring clean air and water for the citizens of Harris County consistent with the protection of public health, enjoyment of property, and the protection of plant, animal, and marine life. The staff conducts investigations, sampling, and surveillance throughout Harris County.

Harris-Galveston Coastal Subsidence District

The Harris-Galveston Coastal Subsidence District (HGCSD) was created by the Texas legislature in 1975. It acts as a groundwater district for this region, and has developed and implemented a plan to regulate groundwater withdrawal and encourage the use of alternate sources, such as surface water. This regulation of ground water pumping has helped to significantly slow subsidence in the Armand Bayou area, one of the major contributing factors of habitat loss and degradation in



the watershed. HGSCD provides extensive water conservation educational materials. (<http://www.subsidence.org>)

Houston-Galveston Area Council

The Houston-Galveston Area Council is an association of counties, cities, and school districts in the Gulf Coast Planning Region. It is involved with community and environmental planning, land use planning, air and water quality, and quality of life issues throughout the Houston-Galveston area. (<http://www.h-gac.com/>)

University of Houston/Clear Lake and Environmental Institute of Houston

The Environmental Institute of Houston (EIH) at the University of Houston-Clear Lake helps people in the Houston region participate more effectively in environmental improvement. Information and technology is obtained and disseminated from research supported by EIH in critical areas including pollution prevention, natural resource conservation, public policy, and societal issues. EIH seeks to expand balanced environmental education based on objective scholarship to empower the entire community to make sound decisions on environmental issues. (<http://www.eih.uh.edu/>)

Cities

Cities often play a crucial role in conserving community natural resources. The City of Pasadena was instrumental in founding the Armand Bayou Nature Center, and has been involved in efforts to protect greenspace within the watershed, as well as to help control point and non-point source pollution. It has also been active in the effort to develop this comprehensive watershed plan. Cities can offer considerable planning resources, and help with funding in some cases, as parkland acquisition, green space conservation, and pollution control is consistent with meeting the needs of people within local communities.

Non-Governmental Organizations

Armand Bayou Nature Center

The Armand Bayou Nature Center (Nature Center) is charged with maintaining and restoring the Coastal Preserve and lands associated with the Nature Center. The Nature Center also conducts a variety of outreach and educational activities, demonstrating to people of all ages the value of environmental stewardship. (<http://www.abnc.org/>)

Armand Bayou Watershed Partnership

The Armand Bayou Watershed Partnership (Watershed Partnership) is a collaborative of stakeholders from state agencies, nonprofit organizations, civic groups, academic institutions, local governments, business and industry groups, and utilities. It is developing and implementing a watershed plan for the purposes of protecting, preserving and enhancing the ecological integrity of the Armand Bayou watershed while improving the quality of life in the communities of the watershed.

Association of Bayport Companies

The Association of Bayport Companies (ABC) is a local industry association that includes 55 companies in the Bayport Industrial District, in the east-central part of the watershed (mainly along Bay Area Blvd north of Red Bluff).

Bay Area Houston Economic Partnership

The Bay Area Houston Economic Partnership is a nonprofit organization providing the leadership necessary to stimulate economic development and employment in the area. (<http://www.claedf.com/>)

Channel Industries Mutual Aid

Channel Industries Mutual Aid (CIMA) combines the fire fighting, rescue, hazardous material handling, and emergency medical capabilities of the refining and petrochemical industry in the Houston Ship Channel area. (<http://www.cimatexas.org/>)

Clear Creek Environmental Foundation

Clear Creek Environmental Foundation works to preserve and enhance the Clear Creek and Clear Lake environment to maintain its natural resources and beauty for the present and future. CCEF

provides resources and guidance for education projects around the creek, and develops projects aimed at preserving, enhancing, and returning the natural system and resources to a cleaner and healthier state. (<http://www.clearcreekcleanup.org/>)

Community Advisory Panels

A community advisory council (CAC) or panel (CAP) is generally a small group of citizens who represent their community and who have made a commitment to meet with the management of the local chemical plant or group of plants on a regular basis to discuss issues of mutual interest. It is an independent body that provides a forum for open and honest dialogue between citizens and plant management. An effort is made to bring the group to a consensus on these issues or to understand why agreement is not possible. Panel members, supported by the plants, take on projects they feel represent the public interest such as promoting 911 services in their community, and developing emergency response and shelter-in-place material and sharing them with local citizens.

Local CACs/CAPs covering interests within the Armand Bayou Watershed include the Bay Area CAP, Deer Park CAC, Houston CAP, La Porte CAC, and Pasadena CAC.

(<http://www.ehcma.com/linds.htm#cap>)

Corporate Wetland Restoration Partnership

The national Corporate Wetlands Restoration Partnership (CWRP) is a public-private partnership between the federal government, state governments, and private corporations to restore wetlands and other aquatic habitats. The CWRP's objective is to stop and reverse the degradation of America's fresh and saltwater wetlands and other aquatic habitats. In the CWRP, corporations contribute funds to a participating private foundation or state trust fund. In 2002, CWRP opened a chapter in Texas, and has begun to assemble partners and funding to develop and implement conservation projects. (<http://www.coastalamerica.gov/http://www.texascwrp.org>)

Council for Environmental Education

The Council for Environmental Education (CEE) is a national non-profit educational organization with headquarters in Houston. It provides environmental education programs and services that promote stewardship of the environment and further the capacity of learners to make informed decisions. CEE is a founding co-sponsor of Project WILD, Project Learning Tree, and Project WET, and administers Project WILD, Project WILD Aquatic, and WET in the City. (<http://www.c-e-e.org>)

East Harris County Manufacturers Association

East Harris County Manufacturers Association EHCMA is a non-profit professional association of approximately 125 chemical manufacturers, refiners, and supporting distribution/terminal facility managers in east Harris County that works to better understand and address community and industry issues/concerns, including risk reduction associated with the operation of associate plants, ensure effective emergency management related to industrial

incidents, and better promote the joint economic interests of our industry and local communities. (<http://www.ehcma.com/>)

Environmental Educators Exchange

The Environmental Educators Exchange (EEE) organizes environmental educators in the Houston area and provides a forum for meeting together and exchanging ideas and information. Several educators in the watershed, including the Texas Coastal Watershed Program and the Nature Center are members of this exchange.

Galveston Bay Foundation

Galveston Bay Foundation works to preserve, protect, and enhance Galveston Bay for multiple uses, through advocacy, education, conservation, and research. Its activities focus on the Galveston Bay watershed, particularly tidally influenced waters. (<http://www.galvbay.org>)

Houston Audubon Society

Houston Audubon Society is a nonprofit organization that promotes the conservation and appreciation of birds and wildlife habitat. Houston Audubon acquires and maintains critical habitat as bird sanctuaries. It conducts education programs and field trips for children and adults. It readily offers its expertise to efforts to promote conservation of birds and their habitats. (<http://www.houstonaudubon.org/>)

Joint Task Force

In a cooperative effort to address the EPA National Pollutant Discharge Elimination System (NPDES) Phase I Storm Water Permit requirements, four local entities chose to work together through a Joint Task Force (the "JTF") to prepare and submit a joint permit application. On October 1, 1998, EPA Region 6 issued a NPDES storm water permit to the City of Houston, Harris County, Harris County Flood Control District, and Texas Department of Transportation as co-permittees.

This joint approach has worked well, providing consistency and efficiency among agency programs and economizing permit implementation costs. At the same time, each entity of the JTF is responsible for implementing its own program. EPA has commended the JTF for the quality of its application as well as the consensus, cooperation and partnership building efforts of the four entities. (<http://www.cleanwaterclearchoice.org>)

Legacy Land Trust

Legacy Land Trust (LLT) is the principal land trust operating in the area. LLT will provide assistance in obtaining conservation easements, and can act as holder of an easement. In some cases, LLT may actually accept title to the land. (<http://www.legacylandtrust.org/>)

National Wildlife Federation

The National Wildlife Federation (NWF) is a national non-profit . It has partnered with the Texas Parks and Wildlife Department to offer a certification program for backyard wildlife

habitat through “Best of Backyard Habitats.” Its analysis of the National Flood Insurance program with respect to repetitive losses in floodplains is available on their website. Their Gulf States Natural Resources Center includes Texas as an area of interest. The Center is concerned with restoring rivers and estuaries and conserving wetlands. (<http://www.nwf.org/>)

The Trust for Public Land

The Trust for Public Land (TPL) works with local communities to develop and implement projects to meet parks and open space needs. TPL also provides assistance through their legal and real estate specialists to help locate and finance public green space. In the Houston-Galveston region, TPL is working specifically to increase public access to Galveston Bay and its tributaries and to save critical habitats in the watershed. (<http://www.tpl.org/>)

Wildlife Habitat Council

The Wildlife Habitat Council (WHC) helps large landowners, particularly corporations, manage their unused lands in an ecologically sensitive manner for the benefit of wildlife. WHC also works to broaden understanding of wildlife values. Over 120 companies are WHC members as are two dozen conservation organizations, plus many supporters and contributors. WHC opened an office in La Porte in 2001, and is working to develop projects in the Galveston Bay Area. (<http://www.wildlifehc.org/>)

Tools and Strategies

Habitat

Preservation Options

Although preservation can be an expensive endeavor, various tools are available to conserve natural areas. Several options are available to landowners interested in preserving their land, and several organizations are available to provide assistance.

Purchase

In cases where the landowner wishes to dispose of a property entirely, outright purchase may be employed by conservation interests (government or nongovernmental organizations) to conserve the conservation value of natural areas by fee simple ownership. Purchase may be at fair market value or as a bargain sale (less than fair market value). Bargain sales can result in tax benefits to the seller. Fee simple ownership by a nongovernmental organization (NGO) may remove the property from tax rolls; however, some NGOs make in-lieu fee payments to taxing authorities.

Conservation Easements

A conservation easement is a legal restriction landowners voluntarily place on specified uses of their property to protect natural, productive or cultural features. With a conservation easement, the landowner retains legal title to the property and determines the types of land uses to continue and those to restrict. This agreement permanently restricts activities that would drastically alter conservation values of the land and is not revocable. The

entity receiving the easement—a government or NGO—agrees to monitor the land to ensure that the provisions of the agreement are honored. Conservation easements can result in tax savings to landowners.

Purchase of Development Rights

Purchase of Development Rights, or PDR, is a purchase of a conservation easement from a willing landowner. It separates development rights from ownership rights, while generating real income for the landowner based on the market value of the lands. Landowners can sell part or all of the development rights on their property and use the proceeds however they wish, often enabling them to keep their family on the land. Landowners may benefit from reduced taxes, and the opportunities to expand or modernize operations, invest for retirement, and/or settle estates with their PDR proceeds. As with other conservation easements, the government or NGO holding the easement must monitor for compliance.

Public access is not a required component of either conservation easements or PDRs.

Donation

Any of the above may be donated by the landowner, or “sold” at less than market value. This saves the receiving entity funds while providing various tax benefits to the landowner, as well as the benefit to society of open space.

Wildlife Property Tax Valuation

Landowners may request a wildlife management designation of their land if the land was previously appraised as 1-d-1 agricultural land. That is, the land is used for agriculture and has what is known as an agricultural exemption for lowered property taxes, based on the land’s productivity value instead of its full market value. To qualify for the wildlife management use appraisal, the land must be actively managed. At least three of seven management strategies must be employed: habitat control, erosion control, predator control, providing supplemental supplies of water, providing supplemental supplies of food, providing shelters, and/or making census counts to determine populations. Another alternative qualification is if the land is used “principally as an ecological laboratory by a public or private college or university.”



Mitigation

Many wetlands are protected under Section 404 of the Clean Water Act. Under USACE's policy of no net loss, wetlands within USACE jurisdiction may be filled only after receipt of a permit to do so. Applicants requesting a permit to



fill wetlands must mitigate, or replace the function of the wetlands to be filled based on a ratio determined by the USACE. This ratio depends on the quality of the wetlands to be filled, and the type of mitigation proposed by the applicant. Natural wetlands form over periods of many years, and thus, function and productivity are difficult to replace instantaneously. Consequently, mitigation usually requires creating or enhancing wetlands at a

ratio well above 1:1 (units created: units filled).

In some cases, USACE will allow the permanent protection of existing wetlands as mitigation. Although this mechanism arguably violates the no net loss policy since the function and value of filled wetlands are not replaced through preservation, protection of existing wetlands and natural areas may present a desirable alternative to the creation of new wetlands. Again, natural wetlands are almost always more productive than created

wetlands. If a mitigation plan includes the permanent protection of special wetlands, of large contiguous tracts of wetlands, and/or productive wetlands that would otherwise be lost in the future, USACE may consider this option.

Mitigation banks are large-scale restoration, enhancement, and/or preservation projects. The mitigation bank sponsor, which could be any type of organization, typically purchases land and restores or enhances wetlands on the site. Credits are then sold to Section 404 permit applicants to meet all or part of the mitigation requirements specified by USACE. Mitigation banking represents a potentially powerful preservation tool, as it presents the opportunity to set aside large, wetland rich tracts of land, which could ultimately pay for themselves as credits are sold to Section 404 permit applicants.

Other

A variety of permutations on the above themes are available, including zoning and park dedication requirements by local governments, trail easements, transfer of development rights, limited development options, and deed restrictions. More information on these options may be found in *Open Space*, a publication by the National Park Service.

Multiple-Use Open Space

Acquiring land for multiple uses may be an effective means of preserving lands within urban areas. For example, land acquired for detention basins may function as habitat if maintained as wet-bottom detention and jointly used for passive recreation, such as nature observation areas, nature trails, etc. Sensitive areas can still be protected from intensive use, while controlled access provides numerous nature viewing and educational opportunities. The Harris County Flood Control District, in particular, is introducing new concepts for multi-use facilities along creeks and drainage corridors.

Employing multiple-use parks as a means for conserving lands opens a wide range of potential partners and funding sources. Local governments are often willing to participate, as these facilities help to meet recreational needs for nearby communities. Including strong conservation and educational components in this type of project also opens up a range of funding possibilities such as federal conservation programs, as well as state programs such as Texas Parks and Wildlife Department's Outdoor Recreation and Regional Parks grant programs.

FEMA Buy-outs

Lands that are bought through the Federal Emergency Management Agency (FEMA) as buy-outs for flood mitigation may not be developed with permanent structures. These lands are another example of potential for multiple use projects.

Restoration/Management

Prior to settlement, fire was an important part of the local ecology. Fires were the result of lightning strikes and, more frequently, were set by the Native Americans. In addition, low

frequency, high intensity grazing by buffalo was also an important component of prairie ecology.

Because of human changes in the natural ecosystem, much of the habitat in southeast Texas quickly becomes infested with brush, unless some kind of habitat restoration and management is employed. Native prairies are overtaken by Chinese tallow thicket, and exotic brush species invade coastal flatwoods.

Restoration management today seeks to mimic pre-settlement ecology. Prescribed burns and grazing and/or mowing are the most important tools for maintaining the prairies. For densely infested areas, removal of pest species may be required – by mechanical or chemical means, and frequently by both.

The Armand Bayou Nature Center (Nature Center) has the most developed restoration and management plan in the watershed. Within the past 5-6 years, they have restored several hundred acres of Chinese tallow thicketized prairies into diverse tall-grass prairies.

One of the most profound habitat losses in the watershed was the disappearance of more than 250 acres of tidal marshes, the result of subsidence-induced drowning, particularly along the main stem of Armand Bayou. An extensive restoration effort, led in large part by ABNC, has to date restored 12 acres of this important habitat.

Assistance

Many sources of assistance in putting together acquisition projects to preserve, restore, and/or manage ecologically valuable lands can be found, including land trusts and natural resource agencies.

Nongovernmental Organizations

Several land conservation organizations are currently active in the Galveston Bay area, such as the Trust for Public Land (TPL), Legacy Land Trust (LLT), and The Nature Conservancy (TNC). Each offers unique sets of expertise and services. TPL, for example, provides assistance in project development, fund-raising, and completing real estate transactions on lands, focusing on lands that provide enjoyment opportunities for people. LLT works with private landowners to place conservation easements on ecologically valuable lands and actually holds the easements, monitoring sites to ensure terms of the easements are upheld.

Additionally organizations such as the National Wildlife Federation (NWF), Environmental Institute of Houston at University of Houston - Clear Lake (EIH), Texas Parks and Wildlife Department, and others provide information about backyard habitats – providing food, water, and shelter for birds and smaller wildlife within neighborhood areas. See Appendix L for organizations active in the Armand Bayou area.

Government

Several government agencies are available to provide assistance in developing conservation projects in the Galveston Bay watershed. Natural resource agencies such as the U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, NOAA Fisheries, the USDA Natural Resource Conservation Service, and

the Galveston Bay Estuary Program offer a variety of resource and project development expertise. Assistance for proper management of private lands is available through the Natural Resources Conservation Service and the Harris County Soil and Water Conservation District. Texas Sea Grant and Texas Cooperative Extension also have programs and information to assist good land management.

Departments within local governments, particularly parks and recreation departments and flood control districts, often share interests with groups seeking to conserve lands. Local governments have the authority to levy in-lieu fees for parkland acquisition, dedicate portions of sales tax revenues, and establish zoning ordinances dedicating areas for parks, etc. And, local governments have the ability to raise funds for park acquisitions through issuing bonds. This mechanism has been used frequently in central Texas for parkland acquisition and protection of lands directly impacting recharge zones for important aquifers.

Local governments often create master plans and ordinance policies for provision of open space to enhance the overall quality of life. In an attempt to balance the built environment with the natural environment, these plans address how housing, transportation, open space, commerce, and environmental systems interrelate and project those relationships into the future. Local governments that conserve portions of these lands as development proposals in such areas are reviewed. The use of new technologies, such as Geographic Information Systems (GIS), helps decision makers analyze multiple layers of information simultaneously to make more informed decisions.

Financing Acquisition, Easements, Restoration, and Management of Open Space

A variety of options are available to help fund the preservation of open space. The Trust for Public Land has a Matrix of Local Finance tools on their web site, (<http://www.tpl.org>), which has an excellent listing of tools available for local governments. A variety





of grants are also available for the purchase of public lands.

Several federal and state programs exist for which acquisition for conservation purposes is an eligible activity. The U.S. Fish and Wildlife Service administers the North American Waterfowl Conservation Act and the Coastal Wetlands Planning, Protection, and Response Act programs – two programs for which large amounts of funding are available for wetlands preservation and acquisition. Texas Parks and Wildlife’s Outdoor Grants and Regional Park Grants programs also offer large grants for acquisition is an eligible activity. The Texas General Land Office administers the Coastal Management Program and other programs for conservation activities. This agency also maintains a coastal funding website:

(<http://www.glo.state.tx.us/coastal/funding/index.html>). Funding and assistance is often available through local flood control and drainage districts from flood control mitigation, preemptive voluntary buyout, and disaster mitigation programs. Also, several Houston-area foundations maintain endowments that may be used for preservation.

Water Quality

Preservation of Open Space

The preservation of open space is an integral component of preserving and restoring water quality. The slow sheet flow of water allows excess nutrients to be metabolized by vegetation and absorbed. Vegetated open space also retards sediment runoff into water bodies. Generally, open space with healthy ground cover retards rapid runoff into drainage systems and streams. Benefits of open space extend to enhanced wildlife habitat, possible recreation uses, and aesthetic advantages.

²⁴WaterSmart, a program of the Texas Coastal Watershed Program, provides outreach and education on issues of water quality, specifically runoff pollution, and water conservation as they relate to residential and commercial landscapes.

Low Impact Development / Natural Processes

Low Impact Development (LID) is a design principle that seeks to decrease the “ecological footprint” of development. LID can cover a wide variety of practices, ranging from environmentally friendly landscaping to natural swales and constructed wetlands. The governing principle behind LID is to provide as many opportunities as possible for water to percolate into the ground, and to provide that opportunity as close to the source as possible. A “thousand drops of water” – many small containments of water – do much more and cost less than large “industrial-sized” detention basins.

Because a large part of the nutrient load in Armand Bayou originates in commercial and residential landscapes, WaterSmart²⁴ landscapes can contribute greatly to water quality improvement in the bayou. WaterSmart landscapes use native and adapted plants that require fewer fertilizers and pesticides than conventional landscapes do.

Hydrologically functional landscapes can improve water quality even more by mimicking the natural processes that occur in this watershed. Rain gardens, for example, detain water temporarily much as prairie potholes do. Water quality is improved as it passes through a rain garden. Any practice that encourages detention and particularly infiltration of water into the soil could be labeled a “low impact development” practice. Pervious pavement or concrete, for example, allows water to infiltrate into the underlying soil while still providing support for vehicles or other uses. Rain barrels or cisterns catch rainwater that can later be used to irrigate landscapes. Other low impact features include swales and compost beds and filters. For other practices, see (http://www.urban-nature.org/landuse/low_impact_development.htm)

Wastewater Treatment

According to the 2000 Texas Commission on Environmental Quality (TCEQ) water quality inventory, three domestic, one agricultural, and six industrial dischargers are permitted in the Armand Bayou Watershed. Only the domestic wastewater facilities are reported to actually discharge to the watershed, totaling a permitted 11.85 million gallons per day of effluent. The three permitted domestic wastewater dischargers in the Armand Bayou Watershed are:

- City of Houston Metro Central Wastewater Treatment Plant (TCEQ Permit No. 10495-136) located approximately 1.6 miles east-northeast of the intersection of FM 1959 and I-45, adjacent to the southeast corner of Ellington Field, in Houston. The treated effluent is discharged to a HCFCD ditch, thence to Horsepen Bayou, thence to Armand Bayou. The plant’s maximum allowable (two-hour peak) discharge rate is 10,417 gallons per minute (23.2 cubic feet per second) and annual average discharge rate is 5 million gallons per day (7.7 cubic feet per second).
- Clear Lake City Water Authority Wastewater Treatment Plant (TCEQ Permit No. 10539-001) located 14210 Middlebrook Drive, approximately 1 mile northeast of the intersection of Bay

Area Boulevard, in Houston. The treated effluent is discharged to Horsepen Bayou, thence to Armand Bayou. The plant's maximum allowable (two-hour peak) discharge rate is 21,528 gallons per minute (47.9 cubic feet per second) and annual average discharge rate is 10 million gallons per day (15.5 cubic feet per second).

- Pecan Plantation Mobile Home Park c/o Heritage Financial Group Inc. (TCEQ Permit No. 12677-001) located approximately 0.25 miles south of the intersection of Spencer Highway and Canada Street in Pasadena. The treated effluent is discharged via pipe to Spring Gully, thence to Armand Bayou. The plant's maximum allowable (two-hour peak) discharge rate is 278 gallons per minute (0.619 cubic feet per second) and annual average discharge rate is 0.100 million gallons per day (0.155 cubic feet per second).

Totals: annual average = 15.100 mgd (23.3 cfs); two-hour peak = 32,223 gpm (71.7 cfs)

Modern technology and permit requirements have greatly improved the water quality of the discharges from domestic and industrial wastewater treatment plants. Small wastewater treatment plants (typically less than 1 million gallons per day discharge) are more likely to experience operations and maintenance problems that may reduce discharge quality.

Permitted dischargers are required to monitor their discharge quality, report violations to the TCEQ, and correct the deficiencies. The TCEQ and the Harris County Pollution Control Division also inspect Armand Bayou watershed wastewater treatment plants. The Gulf Coast Waste Disposal Authority currently offers a technical assistance program for small wastewater treatment plant (less than 1 million gallons per day discharge) operators and managers.

Another source of pollutants to area water bodies originates from aging sanitary sewer collection systems. As this infrastructure degrades, stormwater enters the sanitary sewer system thereby causing a hydraulic overload, which can lead to untreated sewage bypasses and overflows to Armand Bayou and its tributaries. The Harris County Pollution Control Division monitors these excursions and works with the responsible parties to correct the problems.

The three industrial stormwater discharge permits are:

- Sunoco R&M Bayport Plant (TCEQ Permit No. 0002600-000)
- Syngenta Crop Protection (TCEQ Permit No. 0002654-000)
- Equistar Chemicals Pasadena Plant (TCEQ Permit No. 0003029-000)

Storm Water Permitting

Currently, four Armand Bayou Watershed local governments, the City of Houston, the City of Pasadena, Harris County, and the Harris County Flood Control District are required to have a storm water discharge permit as a requirement of the Phase I National Pollutant Discharge Elimination System Storm Water Program for medium (municipal separate storm sewer systems with



population between 100,000 and 249,999) and large (municipal separate storm sewer systems with population equal or greater than 250,000) communities.

Proposed Phase II rules will require all the small communities (municipal separate storm sewer systems with population located in an urbanized area, as defined by the Bureau of the Census, or located outside of an Urbanized Area and brought into the program, on a case-by-case basis) in the Armand Bayou Watershed, including La Porte, Deer Park, and Taylor Lake Village, to obtain a permit to discharge their storm water runoff



to area water bodies. It is anticipated that these communities will be required to enter into a general Texas Pollution Discharge Elimination System Phase II storm water permit or obtain an individual permit. Phase II will require the permittees to develop storm water management programs to address six areas as defined by the United States Environmental Protection Agency:

- Public Education and Outreach – a program to distribute educational materials to the community or conduct outreach activities about the impacts of storm water discharges on water bodies and the steps that the public

can take to reduce pollutants in storm water runoff

- Public Participation/Involvement – including the public in developing, implementing, and reviewing the storm water management program
- Illicit Discharge Detection and Elimination - a program to detect and eliminate illicit discharges, which are illegal and/or improper connections to storm drainage systems and receiving waters
- Construction Site Runoff Control – a program to reduce pollutants in any storm water runoff from construction activities that result in a land disturbance of greater than or equal to one acre

- **Post-Construction Runoff Management in New Development and Redevelopment** – a program to address storm water runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale
- **Pollution Prevention/Good Housekeeping for Municipal Operations** – a program to prevent and reduce storm water pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance

As communities implement their storm water management programs, they will determine which control measures are working effectively and which must be fine-tuned to improve water quality. This is an opportunity for local communities to implement important public education and outreach activities that may reduce pollution at the source and incorporate effective best management practices to improve the quality of storm water runoff. Local ordinances that address each of the storm water management programs areas may also be enacted.

Reduced Use of Toxic Products at Homes and Businesses

An effective way to lessen pollutant impacts to area water bodies is to reduce the use of potentially toxic household products. Common products such as cleansers, fertilizers, pesticides, and herbicides may be harmful to the environment if improperly applied, stored, or disposed. These products are termed household hazardous wastes.

Presently, household hazardous waste collection days are held each spring around Earth Day by the Association of Bayport Companies, the City of Deer Park, and UH/Clear Lake. The City of Pasadena intends to implement a continuous collection program instead of a single collection event. The Texas Commission on Environmental Quality’s Household Hazardous Waste webpage contains information and resources for proper use and disposal of these potentially damaging materials.

Flooding and Stormwater Management

Tools

A number of options are available to reduce flood damages. Some are termed “structural” tools, while others are termed “non-structural” tools. Examples of each type include:

“Structural” Tools

- **Channelization** consists of widening, deepening, lining, and/or clearing stretches of a channel.
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- **Detention Basins.** The concept of stormwater detention as an urban stormwater management tool is widely used throughout the Texas Gulf Coast. It is designed to alleviate expedited and increased runoff by collecting the rain that falls on a given site, directing it into a basin, and detaining it from discharging into

the stream or storm sewer system until the peak flow of the stream or system has subsided. It then releases the stormwater through a small outflow pipe that is placed at an elevation below peak flow.

- **Bypass Channels**
- **Bridge Evaluations** consist of assessing, removing, replacing and/or modifying bridges.
- **Construction of Levees and/or Flood Walls**
- **Building New Outlets and/or Transition Structures**

“Non-Structural” Tools

- **Buyout of Structures**, including both residential and commercial buildings, removes these structures from harm’s way.
- **Flood-Proofing Structures** may include raising homes above flood elevations.
- **Flood Alerts** include warnings and temporary evacuations. The City of Pasadena implemented an automated telephone notification system, capable of notifying residents of an emergency. Residents in specified areas receive a phone call from the system, which plays a recorded message identifying recommended actions in response to the emergency. The system has simultaneous call capability.
- **Floodplain Management and Regulation** includes prohibiting building in the floodplain and/or applying more stringent elevation criteria for new structures.
- **On-Site Measures** can assist by keeping as much water as possible on individual sites, significantly contributing to a reduction in the need for large-scale detention and retention facilities. On-site measures include such things as rain or bog gardens, cisterns, and natural swales. While the individual contributions may be small, the sum of contributions over a neighborhood or subdivision could equal the volume of a standard stormwater detention basin.

Strategies

Cities within the Armand Bayou watershed address flooding of their jurisdictions in a variety of ways. Some of these include: implementing and enforcing stormwater management ordinances which regulate development characteristics, creating design manuals for construction projects, participating in federal, state and regional programs designed to reduce flooding impacts, creating plans to address multi-partner and collaborative opportunities with other local jurisdictions, regional government, educational institutions, non-profits and special purpose districts. See the Policy and Criteria Matrix in Appendix L for area jurisdiction regulations.

FEMA plays a major role in setting national policy to reduce and abate natural and man-made disasters and provides funding for projects. In the context of flood abatement, FEMA ensures that local cities implement appropriate regulations/processes through the Community Rating System. The Community Rating System is a point based system that allows a reduction in flood insurance



premiums for all policyholders of the community if the community adopts and successfully implements certain regulatory standards and adopts processes intended to publicize related information. FEMA provides funding for disaster relief and mitigation, which is distributed through the Texas Division of Emergency Management in accordance with state mitigation priorities.

The waterways of the region form an integral and distinguishing part of the local landscape, offering distinctive vistas, whether in their original natural condition, or sculpted by modernization. Entities working in the Armand Bayou watershed utilize several strategies for reducing the risk of flooding from these waterways, with appropriate regard for community and natural values.

The most comprehensive effort of the Harris County Flood Control District (HCFCD) to actually reduce flood levels and flood damages comes from implementing projects, which HCFCD carries out on its own and through partnerships with others. Foremost among several key components of HCFCD's Capital Improvement Program is District's partnership with the U.S. Army Corps of Engineers. This association has helped bring about federal funding assistance for flood damage reduction projects. HCFCD also funds its own Regional Program of projects.

Prevention

Many of the low impact development measures discussed previously serve to detain stormwater on the site. Using compost to increase soil permeability, cisterns, pervious pavement, etc. all serve to increase infiltration into the soil, which not only improves water quality, it also decreases the speed and amount of runoff coming off of a site. No institutional structure or program exists for promoting prevention through on-site measures.

Within city boundaries, local floodplain administrators conduct hydrological engineering analysis to ensure that new development does not exacerbate existing flooding problems by adding an additional burden to the primary drainage system. HCFCD assumes this role outside of local jurisdictions and within some jurisdictions that defer to HCFCD for that purpose. Strict adherence to the FEMA guidelines is recommended for existing and new developments in the storm surge areas.

One initiative, HCFCD's Frontier Program, aims for acquisitions that reserve land in developing areas. This program prevents dramatic increases in impervious surface cover and thus reduces flooding. Another initiative of HCFCD, known as the Tropical Storm Allison Recovery Project (TSARP), will help increase understanding of the areas at risk of flooding from the primary bayou systems. Jointly funded by FEMA and HCFCD, TSARP will result in fully updated computer models and floodplain maps for all of Harris County. TSARP will generate a new set of Flood Insurance Rate Maps. The upshot of TSARP will be a more disaster resistant community that is better prepared for the next major flooding event.

Detention

Within city boundaries, local floodplain administrators regulate construction of detention facilities to mitigate increases in downstream discharge. HCFCD again assumes this role outside of local

jurisdictions and within some jurisdictions that defer to HCFCD for that purpose. Detention is used to varying degrees by different jurisdictions. Communities in the watershed require detention for large residential developments, and most require detention in some form for even small commercial development. Several onsite and subregional detention facilities are located in the watershed. Some of these are on upper Horsepen Bayou, the Ellington Air Force Base, and near the actively developing Beltway 8 Fairmont Parkway area.

In a private analysis for Friendswood Development Company, potential benefits of detention along the lower reaches of Horsepen Bayou were investigated, but no benefits in lowering peak flows were found.

In 1996, HCFCD partnered with the City of Pasadena to produce an analysis of potential measures that would help contain the 100-year flood frequency event. The report, done by Klotz and Associates Inc., quantified the amount of existing right of way along the main stem of Armand Bayou, and quantified the amount of remaining undeveloped sites in the watershed that would be suitable for detention pond construction. The report also recommended actions to increase the flow capacity of the main stem of the bayou coupled with acquisition of the identified tracts to provide additional detention. Specifically, the report recommended a total of 1,373 acre-feet of detention volume be constructed on 6 sites. No analysis of potential measures was conducted outside of Pasadena in this report.

Drainage

HCFCD and local jurisdictions have worked to create a network of channelized streams throughout the county, including the upper reaches of Armand Bayou and its tributaries. Channelization accelerates the movement of water out of the neighborhoods, reducing the threat of flooding in the vicinity, but may increase flooding risk downstream. Extensive maintenance is performed by the jurisdictions and by HCFCD of their respective channel systems to ensure that the intended flood carrying capacity is available when the rains come. Downstream of Bay Area Boulevard, flood reduction and management options are limited in addition to being prohibitively expensive.

Public Outreach

Almost every organization involved in water, watershed, or water quality work in the Armand Bayou area deals at least tangentially with public education and outreach. Locally existing outreach programs are listed in Appendix I, Appendix J, and Appendix M. However, as previously stated, while a substantial amount of outreach activity occurs in the watershed and surrounding areas, the efforts lack a unified approach. The efforts are somewhat of a "shotgun" approach, scattered and unorganized.

Nationally, however, several examples of well-organized outreach programs may be found, as well as organizations dedicated to supporting such efforts. Some of the more effective, well-known ones are listed in Appendix M.

