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*Final Report*

# **Brays Bayou Multi-Purpose Wetland Creation Project Conceptual Plan**



Prepared for  
**Harris County  
Flood Control District**

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# Introduction

Harris County Flood Control District (HCFCD) is working with a number of partners including the Texas Sea Grant to implement a pilot Multi-Purpose Wetland Project (MPWP) as part of the Brays Bayou Federal Project in Houston, Texas. This project consists of construction of a stormwater treatment wetland and a tidally influenced wetland shelf created adjacent to an existing Flood Control Channel.

This memorandum describes the preliminary design of the MPWP including a constructed treatment wetland and tidal marsh and includes the following:

- Existing site information
- Basis of design and expected performance and benefits
- Preliminary plan and section drawings of the proposed wetland with recommended dimensions
- Proposed planting plan for the wetland

## Existing Conditions

The Brays Bayou project site is located in southeast Houston, Texas (1.8 miles north of the I-610 and I-45 intersection). The project site is approximately 6.5 acres in size and is located within Mason Park. It is bordered by the Brays Bayou to the west and south, Mason Park to the north and west, and the New Orleans Railroad and high-density residential development to the northeast (Exhibit 1). The site is characterized by upland grasses, scattered cottonwood (*Populus sp.*), and a small slough dominated by cutgrass (*Zizaniopsis milacea*) and elephant ear (*Colocasia esculenta*). The slough conveys stormwater from the 30-acre watershed, dominated by residential development, to Brays Bayou. The National Wetland Inventory (NWI) does not identify any wetlands within the project site. A topographic 2-foot contour map of the project site with spot elevations is presented in Exhibit 2. The lowest elevations are present in the stormwater slough located at the northern section of the project site. Higher elevations (> 20 feet) on the project site are located along the eastern and southwest edge of the project site.

## Climatological Data

Monthly average air temperature from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center is presented in Exhibit 3. The average annual temperature for the Houston Texas area is 20.7 °C, ranging from 11.1 to 28.1 °C. Twenty-two years of historic annual rainfall and evapotranspiration data records from 1970 to 1991 are presented in Exhibit 4. Long-term average annual rainfall and evapotranspiration are 47.5 and 48.5 inches, respectively.

## Surface Water Quality

Limited water quality data are available in the vicinity of the project site. Exhibit 5 identifies the location for a number of STORET surface water quality stations,

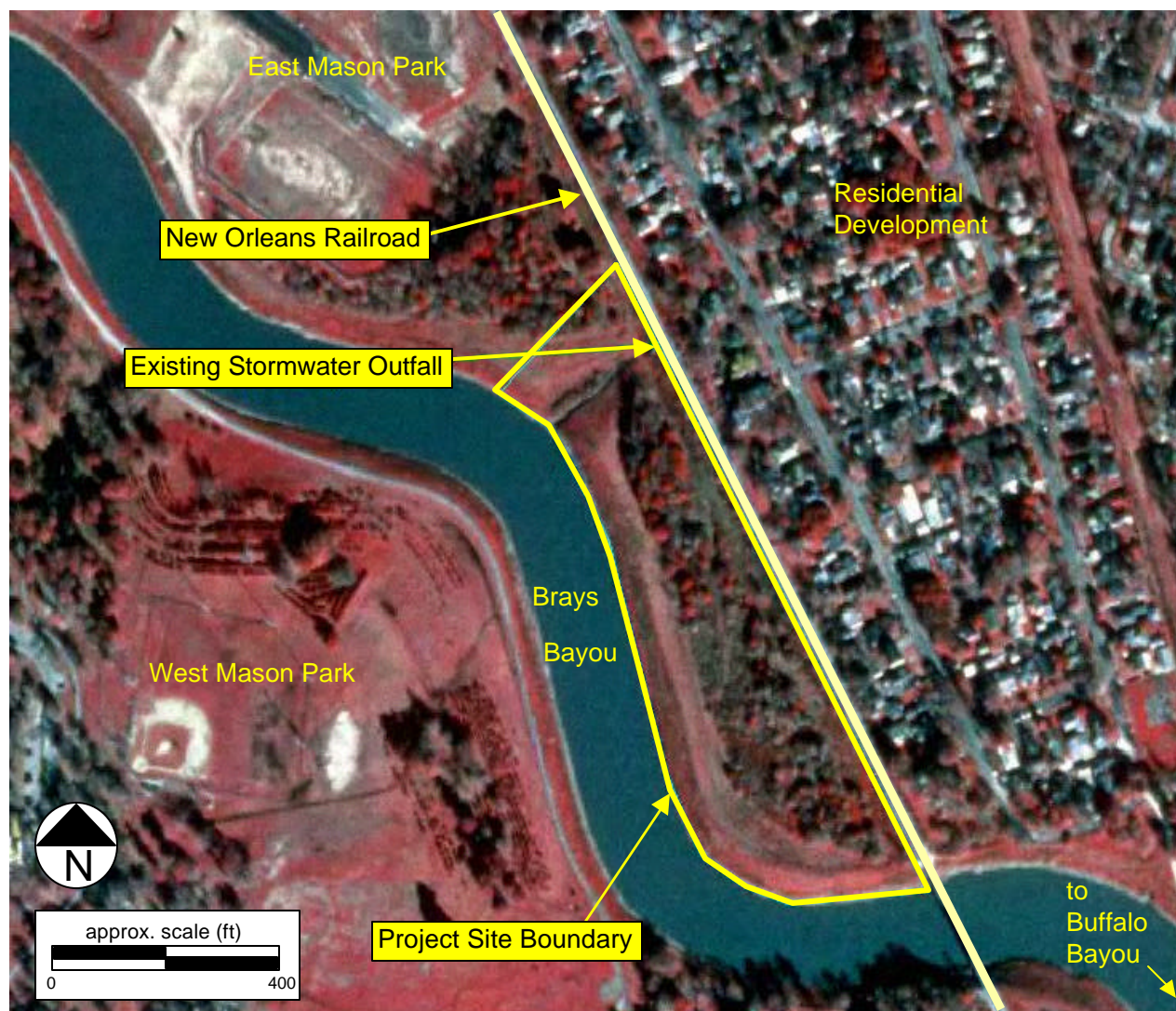


EXHIBIT 1  
Brays Bayou Multi-Purpose Wetland Project Site

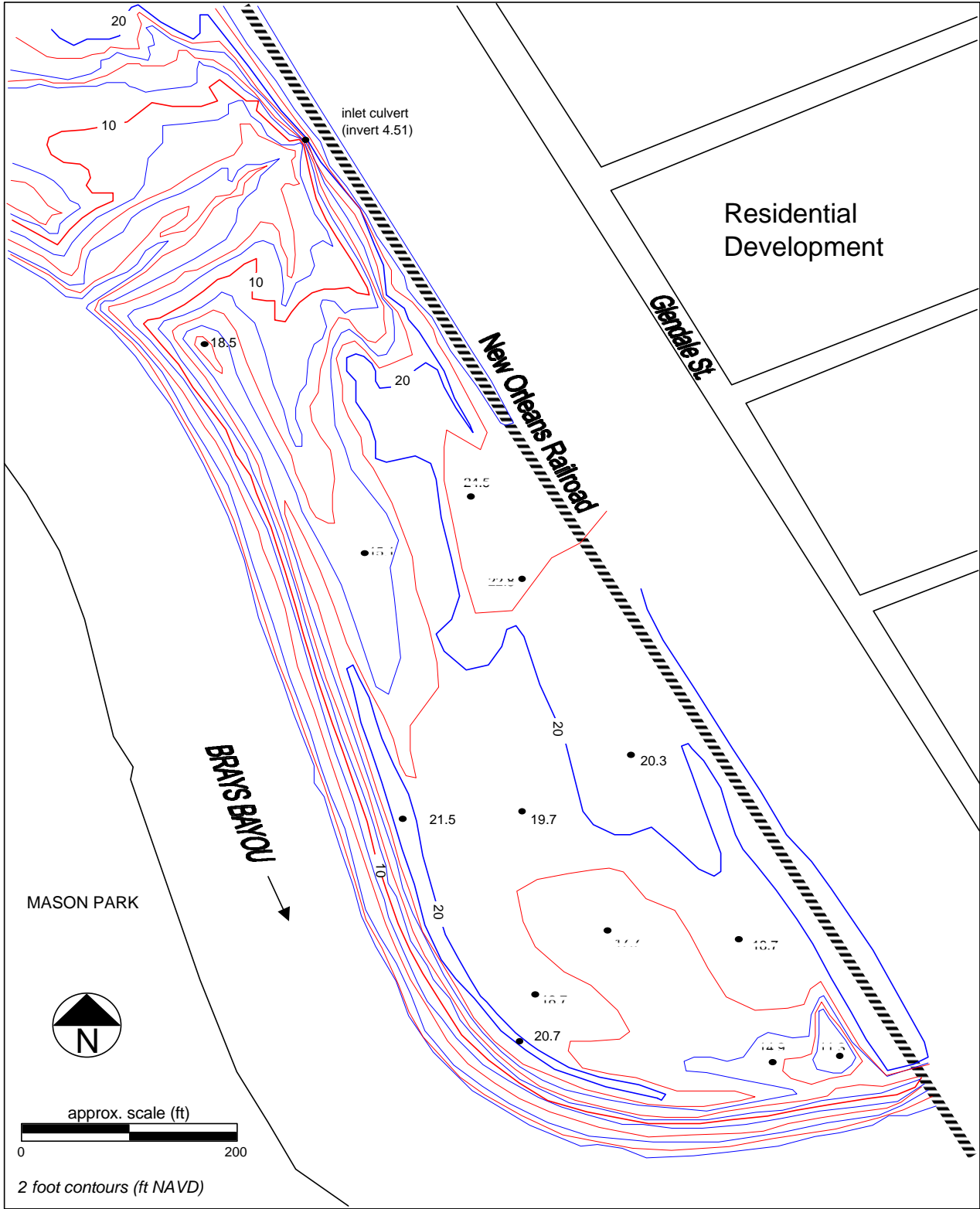


EXHIBIT 2  
Brays Bayou Multi-Purpose Wetland Project Site Topographic Map

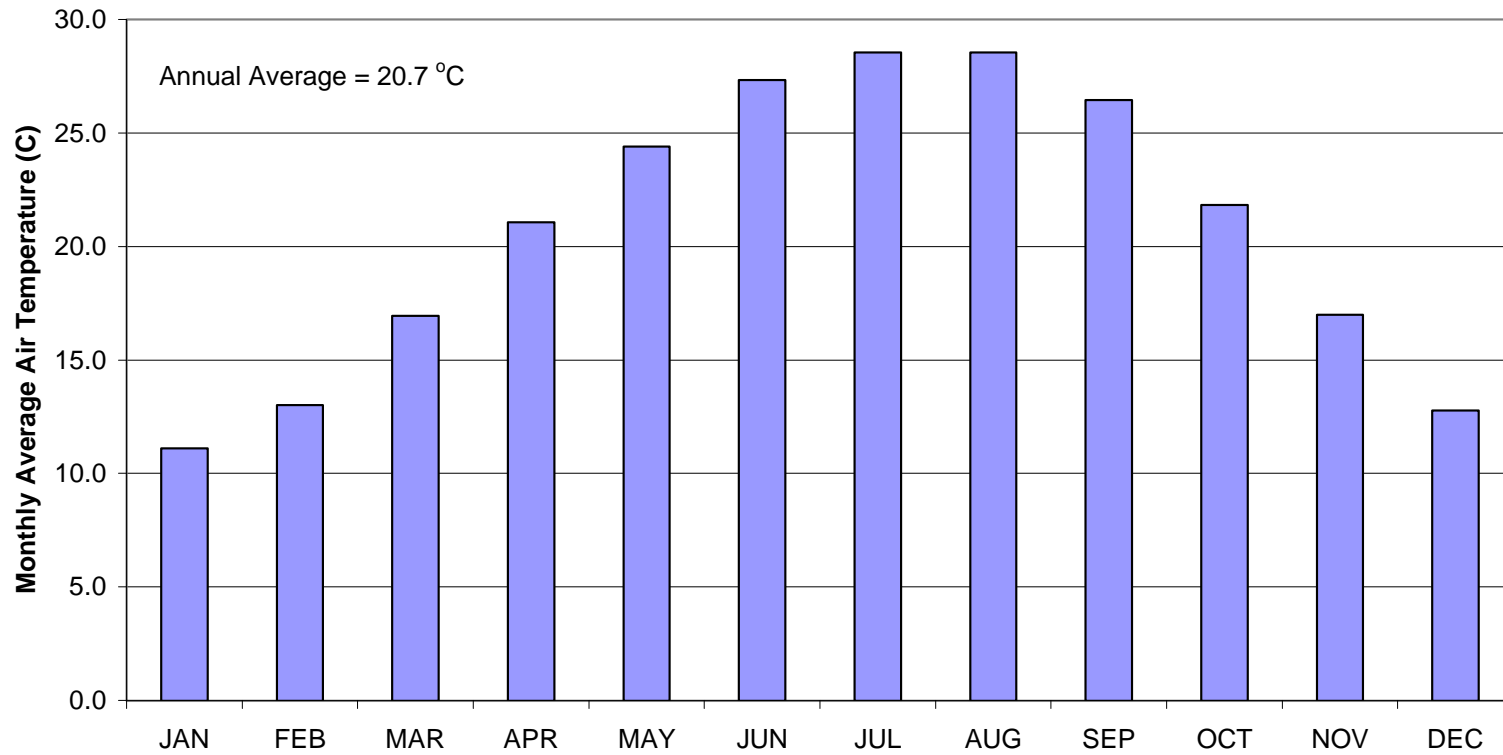


EXHIBIT 3  
Monthly Average Air Temperature for Houston Texas

Source: National Weather Service (NOAA Climate Data)

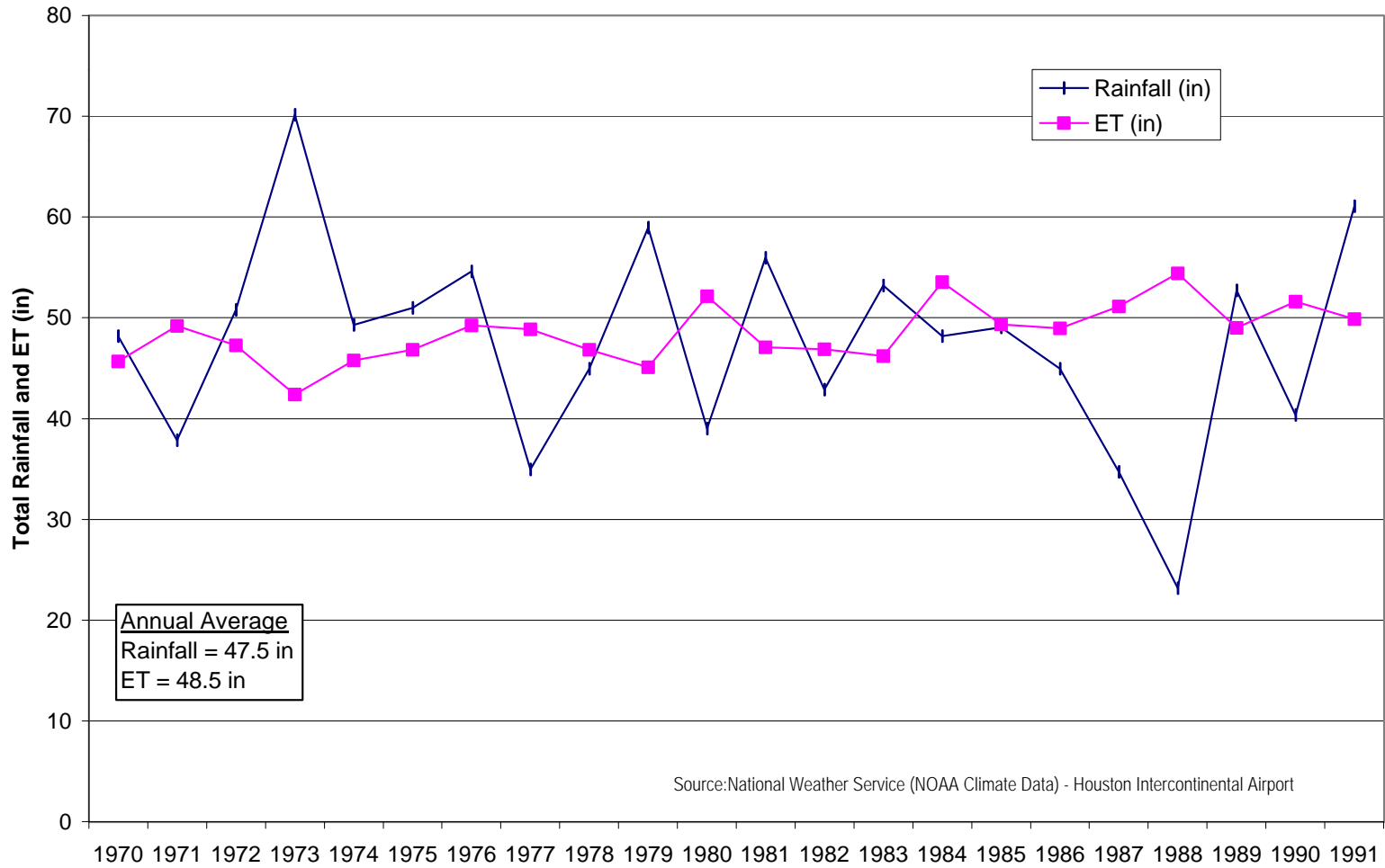


EXHIBIT 4  
Annual Rainfall and Evapotranspiration for the Harris County Texas Area, 1970-91



maintained by the Texas Water Commission. Three STORET water quality stations were found in Brays Bayou and three in Buffalo Bayou (Houston Ship Channel). The closest upstream station to the project site is station 11306 located on Brays Bayou at 75<sup>th</sup> Street.

Exhibit 6 summarizes period of record water quality for the STORET stations illustrated in Exhibit 5. Water quality in Brays and Buffalo Bayous is poor and clearly impacted by wastewater and stormwater discharges. Timeseries plots of select parameters are provided in Appendix A. These trend charts indicate that ambient concentrations of total phosphorus and ammonium nitrogen have been declining over the 30 year period-of-record. Nitrate nitrogen concentrations have increased over this same period. These trends are likely indicative of increasing levels of advanced treatment and nitrification of municipal and industrial effluents discharged to the bayous.

Upstream stations in the Brays Bayou exhibited lower average specific conductance concentrations than stations in Buffalo Bayou. Average specific conductance ranged from 1,838 and 5,334  $\mu\text{mhos}/\text{cm}$  in the upstream Brays Bayou stations and values averaged 10,108 and 9,863  $\mu\text{mhos}/\text{cm}$  at the confluence of Brays and Buffalo Bayou and the downstream station. These high concentrations indicate the influence of brackish water at some of the stations. These stations may also be influenced by any upstream industrial or municipal discharges. Waters that receive industrial and/or municipal discharges tend to have elevated inorganic ion concentrations that will result in higher conductivity measurements.

The upstream Brays Bayou station (11307) exhibited slightly higher average ammonia nitrogen levels (3.0 mg/L) than station 11306 (2.5 mg/L). Total phosphorus concentrations averaged 2.7 mg/L for each of the Brays Bayou stations (11306 and 11307). Both stations exhibited elevated fecal coliform concentrations. Fecal coliforms averaged approximately 16,000 and 320,000 col/100 ml for stations 11306 and 11307, respectively. Other parameters and statistics are summarized in Exhibit 6.

## Tide Gauge

Existing tide gauge data (May 1996 to September 2001) from the Manchester Gauge – Station 513 and published tidal data are presented in Exhibits 7 and 8. This gauge is approximately 1 mile downstream from the project site (Exhibit 9) and located in the Houston Ship Channel on the west side of the I-620 bridge. Both Exhibits 7 and 8 are reporting water levels relative to the North American Vertical Datum (NAVD). The mean tide level (MTL) for this gauge is reported as 0.91 feet NAVD with a mean high water (MHW) and mean low water (MLW) elevation of 1.53 and 0.29 feet NAVD, respectively. This gauge is owned by the Port of Houston Port Authority and the data are available from the Conrad Blucher Institute - Division of Nearshore Research website (<http://dnr.cbi.tamucc.edu>).

An Infinities ultrasonic water level recorder was temporarily installed at the Brays Bayou MPWP site for approximately one month (October 10, 2001 – November 16, 2001). The recorder was installed on a railroad bridge piling located downstream from the project site. A temporary benchmark was created on both the piling and at the project site relative to a reference point (ultrasonic sensor) on the recorder. Water level records were used to relate the observed MTL to historical data collected at the Manchester

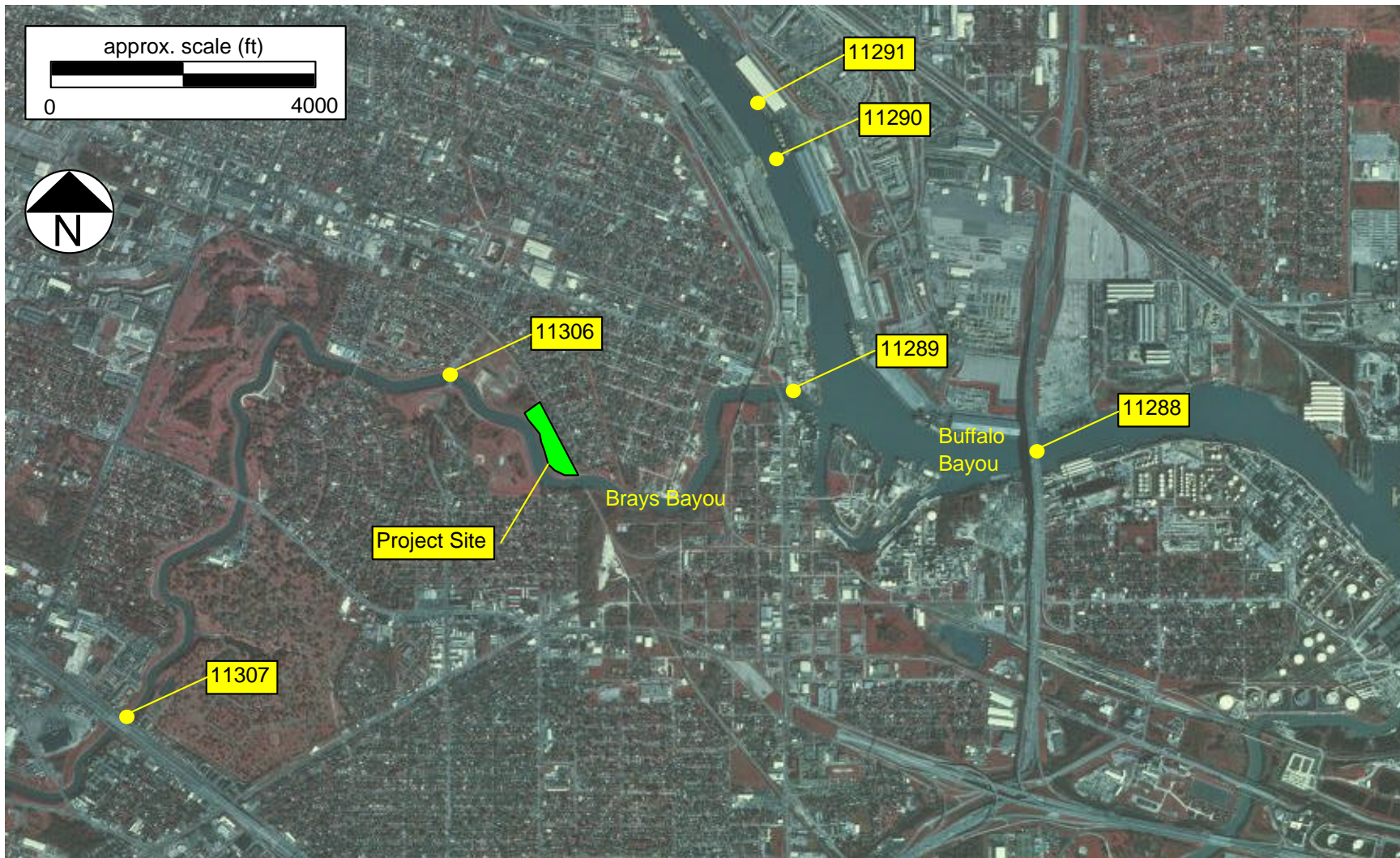


EXHIBIT 5  
Surface Water Quality Stations in the Brays Bayou Multi-Purpose Wetland Project Site Area

## EXHIBIT 6

Summary of Surface Water Quality Data from Stations in the Brays Bayou Multi-Purpose Wetland Project Site Area

Parameter	Data	Brays Bayou			Buffalo Bayou		
		11306	11307	11289	11288	11290	11291
Water Temperature (C)	Average	26.95	23.83	30.50	26.66	25.30	30.42
	Max	32.30	32.30	31.00	30.50	30.30	30.50
	Min	17.00	8.90	30.20	16.20	16.28	30.00
	StdDev	4.92	5.25	0.23	5.91	6.71	0.20
	Count	42	73	8	13	9	6
Turbidity (JCU)	Average	---	46.34	---	---	---	---
	Max	---	350.00	---	---	---	---
	Min	---	1.00	---	---	---	---
	StdDev	---	55.54	---	---	---	---
	Count	---	41	---	---	---	---
Secchi Disc (in)	Average	12.0	26.7	---	11.0	8.0	---
	Max	18.0	39.4	---	11.0	8.0	---
	Min	4.0	9.8	---	11.0	8.0	---
	StdDev	7.2	9.0	---	---	---	---
	Count	3	12	---	1	1	---
Specific Conductance ( $\mu$ mhos/cm)	Average	5334	1838	10108	9863	8427	9269
	Max	15000	15600	11000	16200	12700	10000
	Min	411	290	9700	2000	1600	8000
	StdDev	5203	3160	368	4160	4887	807
	Count	19	44	12	16	9	8
Dissolved Oxygen (mg/L)	Average	4.37	3.13	---	4.40	4.70	0.50
	Max	11.60	11.19	---	4.40	4.70	0.50
	Min	0.10	0.00	---	4.40	4.70	0.50
	StdDev	2.94	3.10	---	---	---	---
	Count	31	76	---	1	1	1
pH (SU)	Average	7.84	7.69	7.40	7.48	6.98	7.33
	Max	8.70	8.70	7.60	7.60	7.00	7.40
	Min	6.40	7.00	7.30	7.40	6.90	7.30
	StdDev	0.73	0.46	0.12	0.11	0.05	0.05
	Count	14	35	5	5	4	4
BOD5 (mg/L)	Average	---	10.84	---	---	---	---
	Max	---	35.00	---	---	---	---
	Min	---	1.40	---	---	---	---
	StdDev	---	7.18	---	---	---	---
	Count	---	28	---	---	---	---
Alkalinity (mg/L as CaCO <sub>3</sub> )	Average	166.6	184.9	---	---	---	---
	Max	208.0	254.0	---	---	---	---
	Min	71.0	144.0	---	---	---	---
	StdDev	52.1	35.9	---	---	---	---
	Count	7	13	---	---	---	---
Salinity (ppt)	Average	---	2.26	---	---	---	---
	Max	---	9.50	---	---	---	---
	Min	---	0.40	---	---	---	---
	StdDev	---	2.81	---	---	---	---
	Count	---	14	---	---	---	---
Total Suspended Solids (mg/L)	Average	36.3	46.6	---	10.0	---	---
	Max	196	460	---	10.0	---	---
	Min	4.0	2.0	---	10.0	---	---
	StdDev	70.5	85.1	---	---	---	---
	Count	7	33	---	1	---	---
Total Dissolved Solids (mg/L)	Average	---	619	---	5303	---	---
	Max	---	1310	---	9020	---	---
	Min	---	204	---	1586	---	---
	StdDev	---	398	---	5257	---	---
	Count	---	10	---	2	---	---
Non-filterable Residue, volatile (mg/L)	Average	5.3	12.9	---	9.0	---	---
	Max	21.0	113	---	10.0	---	---
	Min	2.0	1.0	---	8.0	---	---
	StdDev	7.0	26.3	---	1.4	---	---
	Count	7	35	---	2	---	---

## EXHIBIT 6

Summary of Surface Water Quality Data from Stations in the Brays Bayou Multi-Purpose Wetland Project Site Area

Parameter	Data	Brays Bayou			Buffalo Bayou		
		11306	11307	11289	11288	11290	11291
Total Organic Nitrogen (mg/L)	Average	---	2.84	---	---	---	---
	Max	---	7.64	---	---	---	---
	Min	---	0.38	---	---	---	---
	StdDev	---	2.72	---	---	---	---
	Count	---	8	---	---	---	---
Ammonia Nitrogen (mg/L)	Average	2.46	2.95	---	0.79	---	---
	Max	4.65	17.3	---	0.79	---	---
	Min	0.57	0.14	---	0.79	---	---
	StdDev	1.53	3.67	---	---	---	---
	Count	7	36	---	1	---	---
Unionized Ammonia (mg/L)	Average	0.10	0.07	---	---	---	---
	Max	0.23	0.30	---	---	---	---
	Min	0.01	0.00	---	---	---	---
	StdDev	0.08	0.07	---	---	---	---
	Count	7	29	---	---	---	---
Nitrite-N (mg/L)	Average	0.64	0.14	---	0.34	---	---
	Max	0.85	0.19	---	0.34	---	---
	Min	0.13	0.09	---	0.34	---	---
	StdDev	0.34	0.04	---	---	---	---
	Count	4	8	---	1	---	---
Nitrate-N (mg/L)	Average	1.24	1.54	---	---	---	---
	Max	2.19	7.80	---	---	---	---
	Min	0.48	0.00	---	---	---	---
	StdDev	0.66	2.17	---	---	---	---
	Count	5	29	---	---	---	---
Period of Record	Min	Aug-82	Sep-70	Aug-82	Aug-82	Jul-84	Aug-82
	Max	Sep-87	Aug-96	Aug-82	Feb-85	Feb-85	Aug-82

## EXHIBIT 6

Summary of Surface Water Quality Data from Stations in the Brays Bayou Multi-Purpose Wetland Project Site Area

Parameter	Data	Brays Bayou			Buffalo Bayou		
		11306	11307	11289	11288	11290	11291
Total Kjeldahl Nitrogen (mg/L)	Average	---	1.66	---	2.50	---	---
	Max	---	3.49	---	2.50	---	---
	Min	---	0.90	---	2.50	---	---
	StdDev	---	0.75	---	0.00	---	---
	Count	---	12	---	2	---	---
Nitrite+Nitrate-N (mg/L)	Average	1.93	4.73	---	---	---	---
	Max	2.38	6.19	---	---	---	---
	Min	1.47	1.70	---	---	---	---
	StdDev	0.64	1.63	---	---	---	---
	Count	2	6	---	---	---	---
Total Phosphate (mg/L as PO <sub>4</sub> )	Average	---	9.35	---	---	---	---
	Max	---	20.6	---	---	---	---
	Min	---	0.00	---	---	---	---
	StdDev	---	7.06	---	---	---	---
	Count	---	21	---	---	---	---
Ortho Phosphate (mg/L as PO <sub>4</sub> )	Average	---	10.8	---	---	---	---
	Max	---	17.2	---	---	---	---
	Min	---	2.48	---	---	---	---
	StdDev	---	4.16	---	---	---	---
	Count	---	14	---	---	---	---
Total Phosphorus (mg/L)	Average	2.70	2.66	---	---	---	---
	Max	6.30	6.74	---	---	---	---
	Min	0.44	0.35	---	---	---	---
	StdDev	2.06	2.02	---	---	---	---
	Count	7	35	---	---	---	---
Ortho-Phosphorus, Dissolved (mg/L)	Average	1.86	2.12	---	---	---	---
	Max	3.56	5.62	---	---	---	---
	Min	0.39	0.30	---	---	---	---
	StdDev	1.22	1.75	---	---	---	---
	Count	5	28	---	---	---	---
Total Organic Carbon (mg/L)	Average	10.00	9.93	---	---	---	---
	Max	10.00	26.00	---	---	---	---
	Min	10.00	5.00	---	---	---	---
	StdDev	0.00	5.72	---	---	---	---
	Count	6	28	---	---	---	---
Total Chloride (mg/L)	Average	251	381	---	2655	---	---
	Max	644	2790	---	4533	---	---
	Min	10	22	---	776	---	---
	StdDev	240	482	---	2657	---	---
	Count	7	53	---	2	---	---
Dissolved Chloride (mg/L)	Average	---	247	---	---	---	---
	Max	---	745	---	---	---	---
	Min	---	91	---	---	---	---
	StdDev	---	198	---	---	---	---
	Count	---	11	---	---	---	---
Sulfate (mg/L as SO <sub>4</sub> )	Average	27.5	54.5	---	404	---	---
	Max	37.0	139	---	677	---	---
	Min	18.0	14.0	---	131	---	---
	StdDev	13.4	28.4	---	386	---	---
	Count	2	53	---	2	---	---
Total Coliform Membrane Filter (#/100 ml)	Average	---	3817692	---	---	---	---
	Max	---	17000000	---	---	---	---
	Min	---	80000	---	---	---	---
	StdDev	---	5911286	---	---	---	---
	Count	---	13	---	---	---	---
Total Coliform MPN Method (#/100 ml)	Average	---	1061600	---	---	---	---
	Max	---	2400000	---	---	---	---
	Min	---	24000	---	---	---	---
	StdDev	---	1234684	---	---	---	---
	Count	---	5	---	---	---	---

## EXHIBIT 6

Summary of Surface Water Quality Data from Stations in the Brays Bayou Multi-Purpose Wetland Project Site Area

Parameter	Data	Brays Bayou			Buffalo Bayou		
		11306	11307	11289	11288	11290	11291
Fecal Coliform	Average	16162	319949	---	---	---	---
Membrane Filter	Max	180000	3390000	---	---	---	---
M-FC Broth	Min	10	1600	---	---	---	---
(#/100 ml)	StdDev	41375	799546	---	---	---	---
	Count	19	21	---	---	---	---
Fecal Coliform	Average	---	1370500	---	---	---	---
MPN Method	Max	---	3300000	---	---	---	---
(#/100 ml)	Min	---	24000	---	---	---	---
	StdDev	---	1493128	---	---	---	---
	Count	---	6	---	---	---	---
Chlorophyll-a	Average	---	6.25	---	3.00	---	---
(µg/L)	Max	---	41.00	---	3.00	---	---
	Min	---	0.20	---	3.00	---	---
	StdDev	---	10.50	---	---	---	---
	Count	---	29	---	1	---	---
Pheophytin-a	Average	---	7.69	---	2.00	---	---
(µg/L)	Max	---	28.60	---	2.00	---	---
	Min	---	0.00	---	2.00	---	---
	StdDev	---	9.08	---	---	---	---
	Count	---	15	---	1	---	---
Period of Record	Min	Aug-82	Sep-70	Aug-82	Aug-82	Jul-84	Aug-82
	Max	Sep-87	Aug-96	Aug-82	Feb-85	Feb-85	Aug-82

Source: STORET

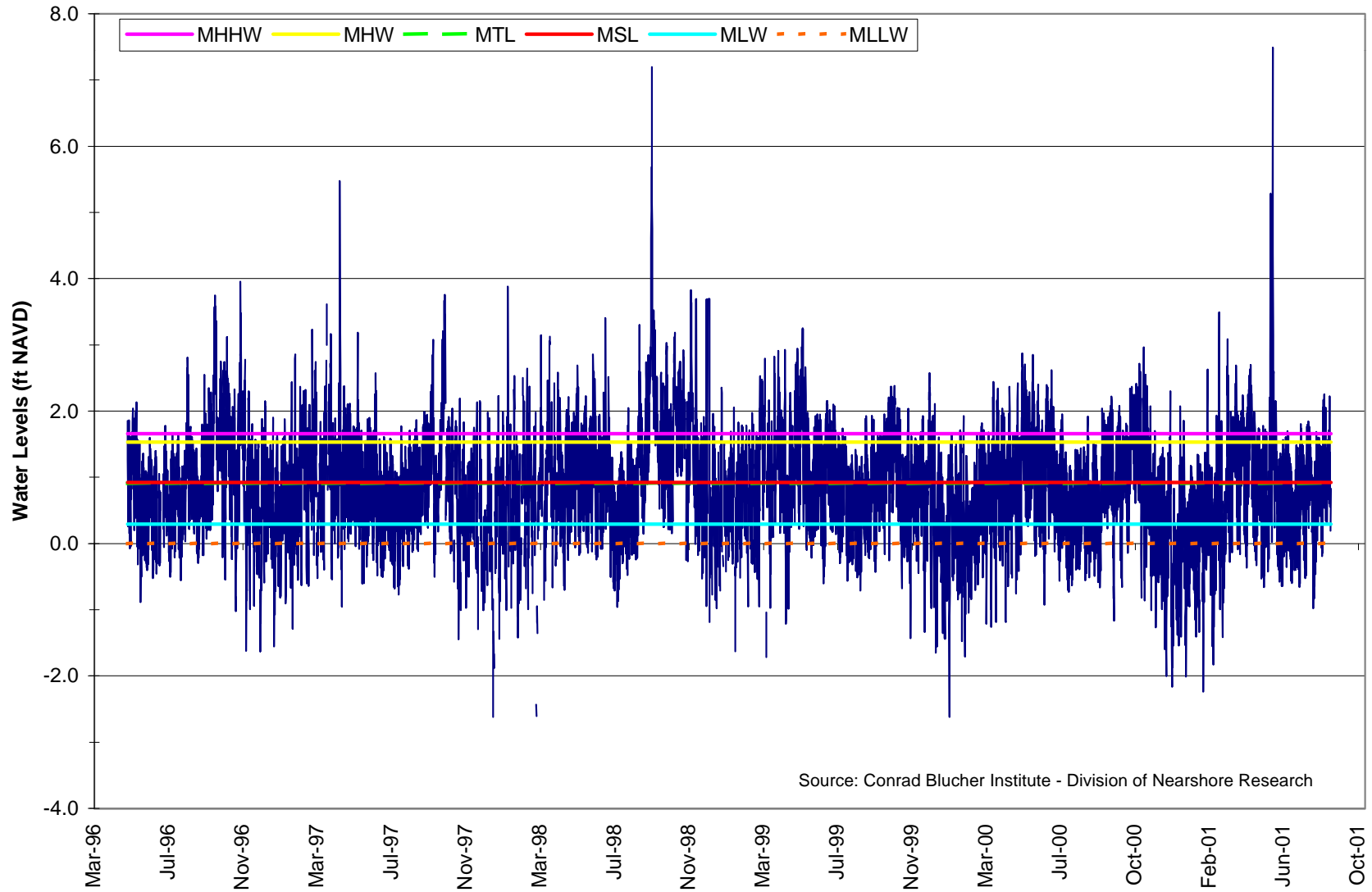


EXHIBIT 7  
Manchester Gauge (Stn 513) Primary Water Levels and Tidal Data

gauge. The Manchester gauge was temporarily out of service during the initial placement of the Infinities recorder, resulting in ‘overlapping’ data only from November 6 to November 16, 2001. Exhibit 10 presents a timeseries plot of the Manchester gauge tidal data and data collected from the Infinities water level recorder. Water levels ranged from approximately -0.01 to 3.12 ft NAVD from the Brays Bayou site and from -0.09 to 2.93 ft NAVD from the Manchester Gauge for this ‘overlap’ period. The short-term MTL for this period was 1.37 and 1.20 ft NAVD for the Brays Bayou Site and Manchester gauge, respectively. The MTL difference (0.17 ft) was used to estimate long term tidal data for the Brays Bayou site based on the long-term record from the Manchester gauge (Exhibit 8).

**EXHIBIT 8**

Tidal Data for the Manchester Gauge located in the Houston Ship Channel and Estimates for the Brays Bayou MPWP

<b>Datum</b>	<b>Manchester Gauge<sup>1</sup> (ft NAVD)</b>	<b>Brays Bayou MPWP<sup>2</sup> (ft NAVD)</b>
Mean Higher High Water (MHHW)	1.66	1.83
Mean High Water (MHW)	1.53	1.70
Mean Tide Level (MTL)	0.91	1.08
Mean Low Water (MLW)	0.29	0.46
Mean Lower Low Water (MLLW)	0.00	0.17

<sup>1</sup> Computed January 29, 2001 for Period of Record (5/96-5/99; 7/99-4/00)

<sup>2</sup> Estimated from correlation analysis between the Manchester and water level recorder installed at the Brays Bayou NPWP (Nov 6 – 16, 2001)

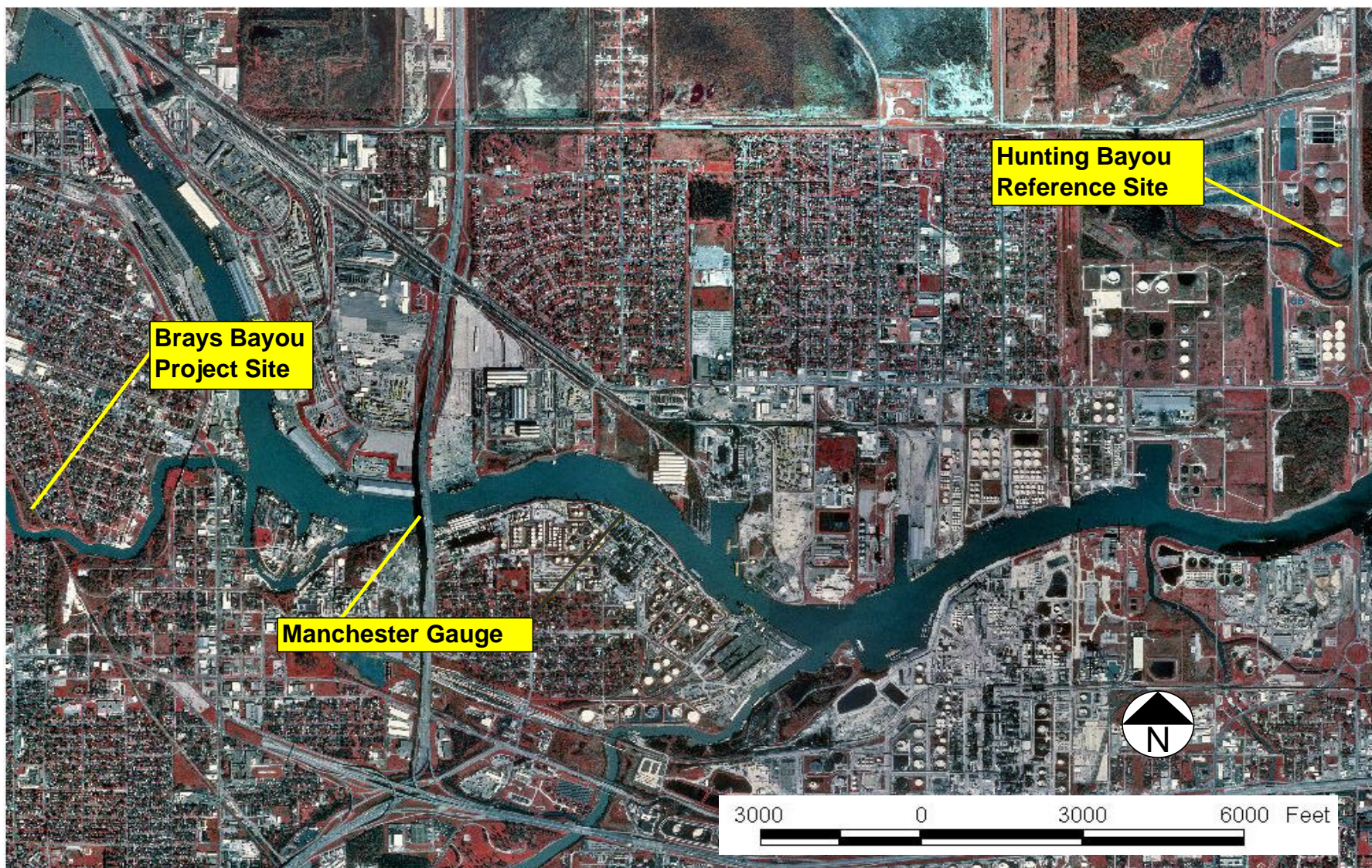
**Reference Site**

The Brays Bayou wetland project will create a tidally influenced wetland shelf adjacent to the Brays Bayou. Tidal wetlands generally have several distinct hydrological zones:

- Open water
- Low marsh
- High marsh
- High marsh/upland transition
- Upland

To help identify dominant plant species within each zone and their elevation relative to the mean tide level, a reference site was located in the vicinity of the project site. The Hunting Bayou reference tidal marsh is located approximately 6 miles east of the project site at the confluence of Hunting Bayou and Buffalo Bayou (Exhibit 9).





**EXHIBIT 9**  
Location of the Brays Bayou Multi-Purpose Wetland Project Site, Manchester Gauge, and Reference Site

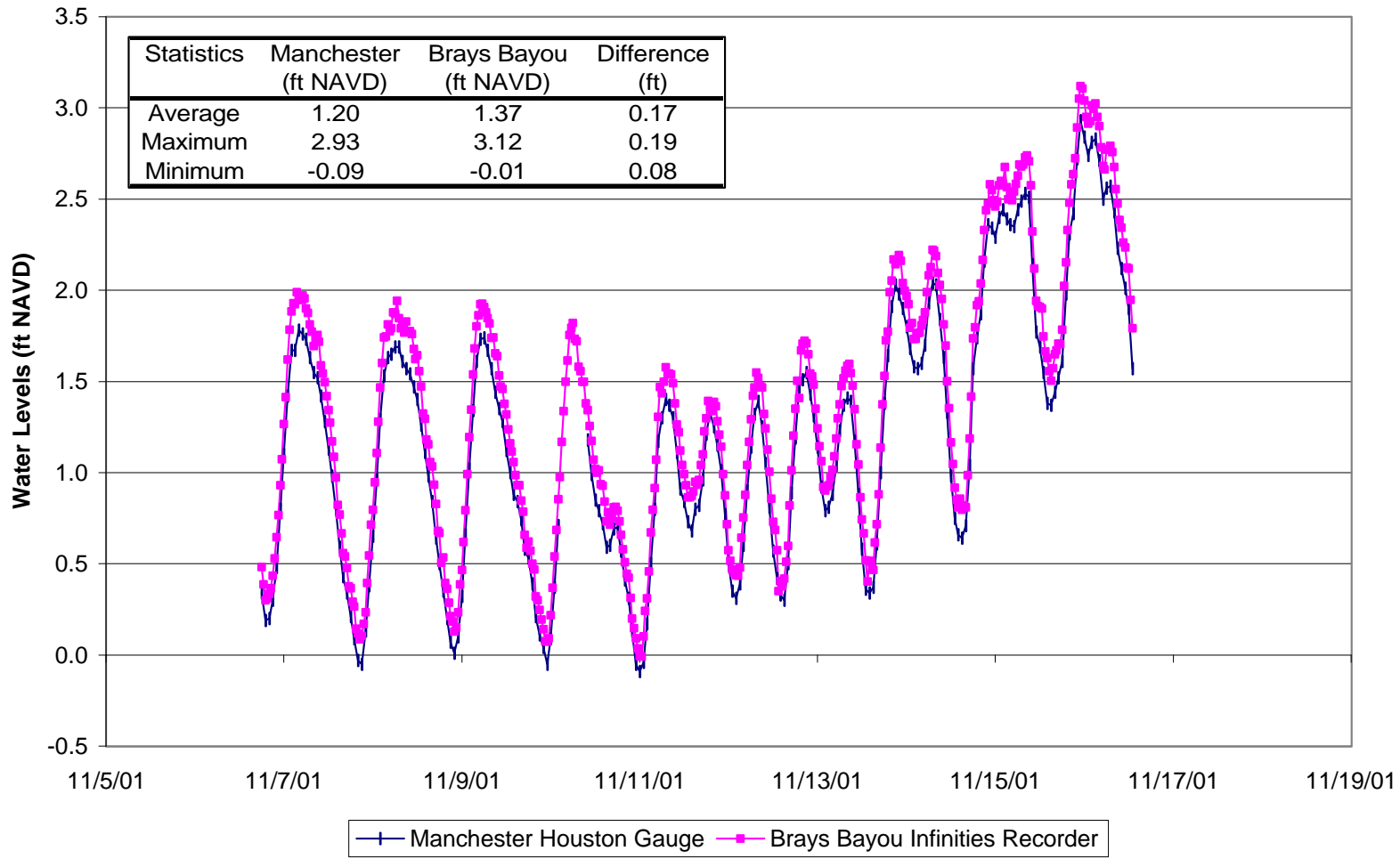


EXHIBIT 10

Correlation of Manchester Gauge Tidal Data to Infinities Water Level Recorder Located at the Brays Bayou Multi-Purpose Wetland Project

## EXHIBIT 11

Tidal Wetland Vegetation Species observed at Hunting Bayou Reference Site

Scientific Name	Common Name
<b>Low Marsh</b>	
<i>Alternanthera philoxeroides</i>	alligator weed
<i>Crinum americanum</i>	swamp lily
<i>Eleocharis parvula</i>	dwarf spikerush
<i>Scirpus robustus</i>	saltmarsh bulrush
<i>Typha angustifolia</i>	narrow-leaved cattail
<b>High Marsh</b>	
<i>Baccharis halimifolia</i>	eastern baccharis
<i>Ipomea sagittata</i>	saltmarsh morning glory
<i>Panicum hians</i>	gaping panicum
<i>Scirpus robustus</i>	saltmarsh bulrush
<i>Typha angustifolia</i>	narrow-leaved cattail
<i>Vigna luteola</i>	deer pea
<b>High Marsh/Upland Transition</b>	
<i>Ambrosia trifida</i>	giant ragweed
<i>Panicum hians</i>	gaping panicum
<i>Vigna luteola</i>	deer pea
<b>Upland</b>	
<i>Celtis laevigata</i>	sugarberry
<i>Salix nigra</i>	black willow

Source: Sipocz 2001

Texas Parks and Wildlife surveyed the Hunting Bayou reference marsh on July 21, 2001 (Sipocz, 2001). Exhibit 11 summarizes the dominant tidal wetland vegetation species observed at the Hunting Bayou reference marsh site during this survey. A total of 12 species were identified. Exhibit 12 presents the hydrological zone elevations relative to the mean tide level (MTL) observed at the reference site and estimated elevations for the Brays Bayou MPWP site. Since the MTL will vary from location to location, a comparison was done between the Manchester and Lynchburg Ferry gauges (Sipocz, 2001). The Lynchburg gauge is located at the confluence of Buffalo Bayou and the San Jacinto River. The comparison during the study resulted in a less than 30-minute difference between tidal floods and ebbs. The magnitude of the high and low tides were also almost identical.

**EXHIBIT 12**

Hydrological Zones Identified at the Hunting Bayou Reference Site and Estimates for the Brays Bayou MPWP

<b>Hydrological Zone</b>	<b>Hunting Bayou<sup>1</sup> Upper Elevation (ft) relative to MTL</b>	<b>Brays Bayou MPWP<sup>2</sup> Upper Elevation (ft NAVD)</b>
Open Water	-0.25	0.83
Low Marsh	0.59	1.67
High Marsh	1.35	2.43
High Marsh/Upland Transition	1.98	3.06
Upland	>1.98	> 3.06

<sup>1</sup> Source: Sipocz, 2001

<sup>2</sup> Estimated using a MTL of 1.08 ft NAVD

## Basis of Design

The MPWP consists of a stormwater management system, a created tidal wetland, and various public use facilities. The stormwater management system will consist of wetlands that are designed and constructed to capture and detain a significant amount of runoff within a given watershed. Exhibit 13 presents a conceptual plan view of the Brays Bayou constructed wetland stormwater treatment system. This MPWP will produce a ‘treatment train’ composed of three major compartments:

- Wet pond
- Shallow treatment marsh
- Tidal marsh

In addition to these pond and wetland components, the MPWP also includes a number of public use features. Each of these will be discussed in further detail below. Exhibits 14 and 15 present cross sectional profiles of the constructed wetland treatment system. Cross sectional profiles were prepared along the project site from the NW to SE (A-A’) and from the SW to NE (B-B’).