



Piney Point Village

TEXAS

**City of Piney Point Village
Draft Application to the Texas General Land Office
CDBG-MIT Competitions
October 9th, 2020**

Background and Introduction

Following the federally declared disasters in 2015 and 2016 and Hurricane Harvey in 2017, the US Congress made available, through US Department of Housing and Urban Development (HUD), Community Development Block Grant Mitigation funding (CDBG-MIT) to disaster-affected communities to implement projects and plans that help the communities recover from these disasters and also reduce their risk from similar hazards in the future.

In turn, the State of Texas General Land Office (GLO) has made available, by competitive application, CDBG-MIT funds to local entities to implement risk mitigation and resilience projects. As a unit of local government in a disaster-affected community (Harris County), the City of Piney Point Village (Piney Point) is eligible to apply to these funding competitions. Piney Point will be applying to the competition to fund a drainage improvement and street infrastructure project to reduce flooding.

The following pages describe Piney Point's proposed project, its costs, its benefits, and the people and households that will benefit from it. This document serves as a draft application and to ensure transparency, public participation, and as a requirement of the program, the City of Piney Point Village is making this draft application available to the public to review and provide comments. The public comment period will run for 14 days, from October 9 through October 23, 2020. At the end of this comment period, the city will review and provide responses to all comments. The final application is to be submitted on or before October 28, 2020.

The draft grant application will be available for review at the following locations: City of Piney Point Village City Hall 7676 Woodway, Suite 300 Houston, TX 77063 and at www.cityofpineypoint.com.

Public comments may be submitted in writing by email to: citysec@pineypt.org or by mail to:

City of Piney Point Village
Attn: Karen Farris
7676 Woodway, Suite 300
Houston, TX 77063

Flood Risk in Piney Point

The City of Piney Point Village has made substantial investments to improve the drainage infrastructure throughout the city. However, several areas have not yet been improved and still face substantial risk from intense rainfall events. One of these areas, along Blalock Road, is the proposed project area for the city's application for CDBG-MIT funding.

The proposed project, the South Piney Point/Blalock Road Drainage Improvements Project – Phase II, seeks to reduce flood risk along Blalock Rd and adjacent areas. This area has been subject to inundation from federally declared disasters and other major rainstorms. Evidence of this flooding can be seen in the photographs in Appendix I.

The current storm sewer is not large enough to manage the volumes of stormwater that fall in significant rain events. This causes stormwater to flow overland, damaging public infrastructure and private property, and causing hazardous roadway conditions. Stormwater models showing the inundation levels in the Blalock drainage area from significant rain events are included in Appendix II.

Under the federal guidelines for CDBG-MIT funding, recipients of the funding must use grant money to fulfill a national objective. The City of Piney Point Village will use the funding to address flood risk, under the national objective called "Urgent Mitigation Need." This continuing threat of flooding to the area is Piney Point's "Urgent Mitigation Need." The analysis that demonstrates this need and calls for this type of project in this area is documented in the city's master drainage study. The pages specific to this area and project are excerpted and provided in this draft application in Attachment III.

Project Description and Scope of Work

The South Piney Point/Blalock Road Drainage Improvements Project – Phase II is located on the west side of the City of Piney Point Village along South Piney Point Road and Blalock Road. The City completed improvements in 2016 under Memorial Drive during Phase I of the City’s drainage improvements program in anticipation of Phase II that are to be included in this grant application. There are two drainage segments included in the proposed Phase II improvements. The Blalock Road segment (north of Memorial Drive) and the South Piney Point Road segment (south of Memorial Drive). The Blalock Segment begins at the intersection of Blalock Road and Quail Hollow Lane (Greenbay Street) continuing south along Blalock Road connecting to the Phase I improvements that were installed under Memorial Drive. The South Piney Point Road segment begins just south of Carlton Park tying into the Phase I improvements continuing south where it outfalls into Buffalo Bayou.

The proposed storm sewer in the Blalock Road segment ranges in size from 9’x9’ reinforced box culvert (RCB) to 24-inch reinforced concrete pipe (RCP) to replace dual 36-inch RCP along the east side of the road and an open ditch with driveway culverts on the west side of the road. Both of the existing systems are undersized and do not adequately convey runoff produced from a City of Houston 100-year storm event. Runoff repeatedly exceeds the drainage system resulting in sheet flow patterns causing flooding of multiple residences and accessory structures.

The proposed storm sewer in the South Piney Point Road segment ranges in size from 9’x9’ reinforced box culvert (RCB) to 24-inch reinforced concrete pipe (RCP) to replace a 96-inch corrugated metal pipe (CMP) east of South Piney Point Road. The existing 96-inch CMP is undersized and portions of the CMP show signs of structural fatigue (creasing and partial collapse of the pipe segment) as reported in previous inspections of the pipe. The City has previously completed repairs on the pipe including a full replacement of approximately 80-linear feet of the pipe after it collapsed following the Memorial Day 2015 flooding event.

A flow control device is proposed at the downstream end of the proposed 9’x9’ RCB near the outfall at Buffalo Bayou so that there is no adverse hydraulic impact to Buffalo Bayou. The flow control device cannot be removed until detention storage is obtained on Buffalo Bayou by the City in order to provide mitigation from the proposed improvements. Once mitigation is obtained, the flow control device could be removed, allowing the proposed drainage system to perform to its full capacity.

Due to limited right-of-way locations to install improvements of this size and potential roadway damage during construction, additional improvements included in the project are the removal and replacement of the asphalt pavement on Blalock Road from Quail Hollow Lane (Greenbay Street) to Memorial Drive, removal and replacement of the concrete sidewalk on the east side of Blalock Road from Quail Hollow Lane (Greenbay Street) to Memorial Drive, and installation of a sidewalk on the west side of Blalock Road from Quail Hollow Lane (Greenbay Street) to Memorial Drive.

The preliminary and final design stages will include traffic control and detour plans to maintain resident access to homes and Memorial Drive Presbyterian Church while meeting all Texas Manual on Uniform Traffic Control Devices (TxMUTCD) guidelines. The project will include removal of residential and side street driveways. Design and construction phasing plans will establish methods for the required removal and replacement of residential and adjacent street access throughout the construction of the project. Tree protection plans prepared by an urban forester will also be included in the project construction plans.

In summary, the proposed drainage improvements project will replace an undersized drainage system on both Blalock Road and South Piney Point Road and provide improvements on a drainage area that frequently experiences drainage issues in large rain events. The replacement of the existing deteriorated 96-inch CMP will improve the structural integrity of the compromised drainage system just east of South Piney Point Road. Additionally, the sidewalk improvements associated in this project will improve pedestrian mobility and safety.

The total Opinion of Probable Project Cost for the South Piney Point/Blalock Road Drainage Improvements Project – Phase II is \$12,075,375. Of this total, \$9,490,065.00 is budgeted to come from CDBG-MIT Funding and the balance will be matched by \$2,585,310 in city funds. A detailed project budget is included below on pages 12 and 13.

Project Area Maps

Maps detailing the project area and the project extent are enclosed on the following pages.

Map 1 – The city’s drainage areas (Page 6)

Map 2 – Blalock drainage area – the primary drainage area where the project will be implemented and the modeled inundation area in a 100-year storm (Page 7)

Map 3 – Overall Project Location Area (Page 8)

Map 4 – Project area map with project details labeled (Page 9)


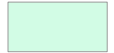



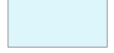
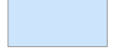
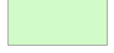

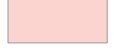

Map 5 – Census tracts and census block groups that will benefit from the project (Page 10)

LEGEND

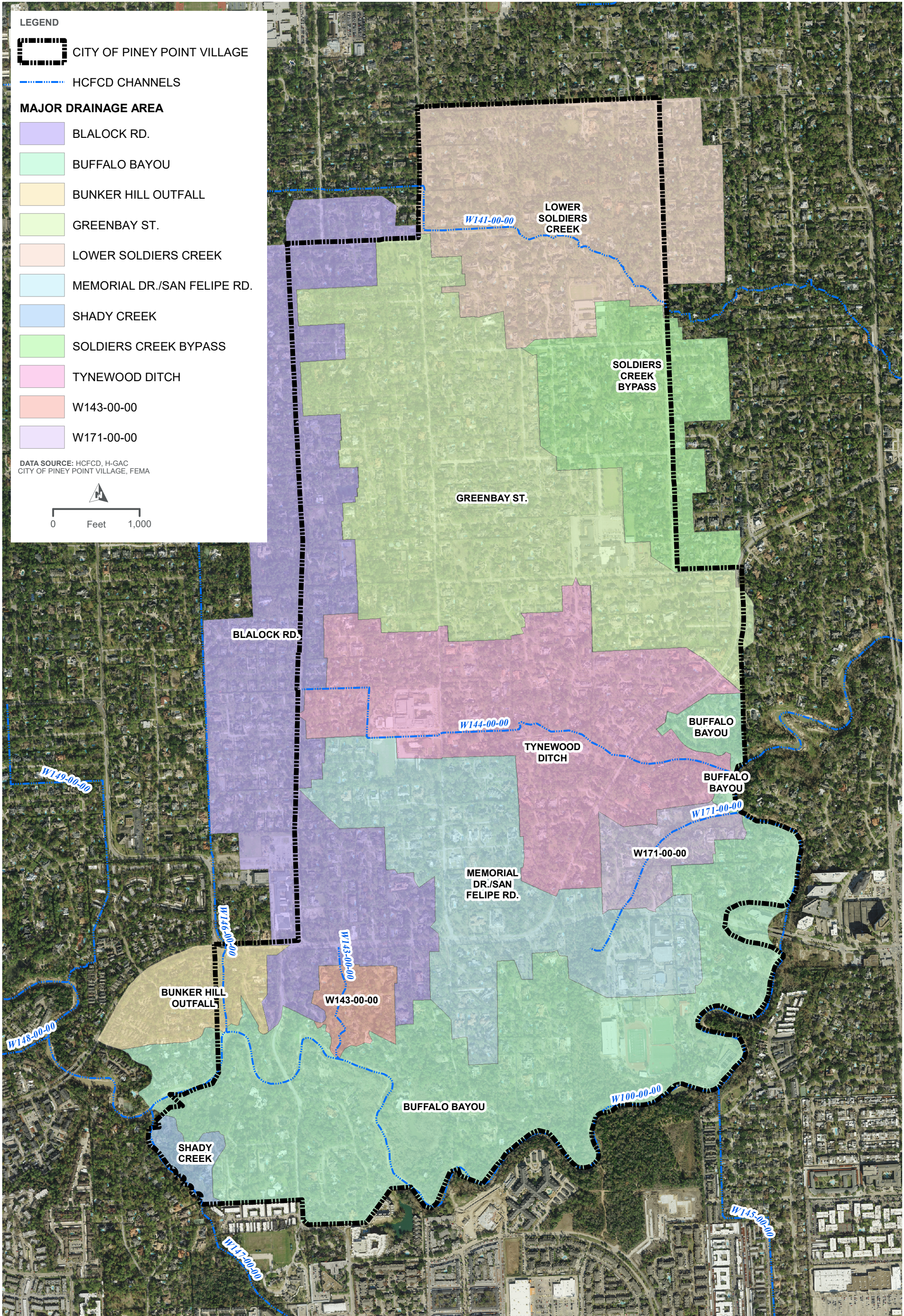
 CITY OF PINEY POINT VILLAGE

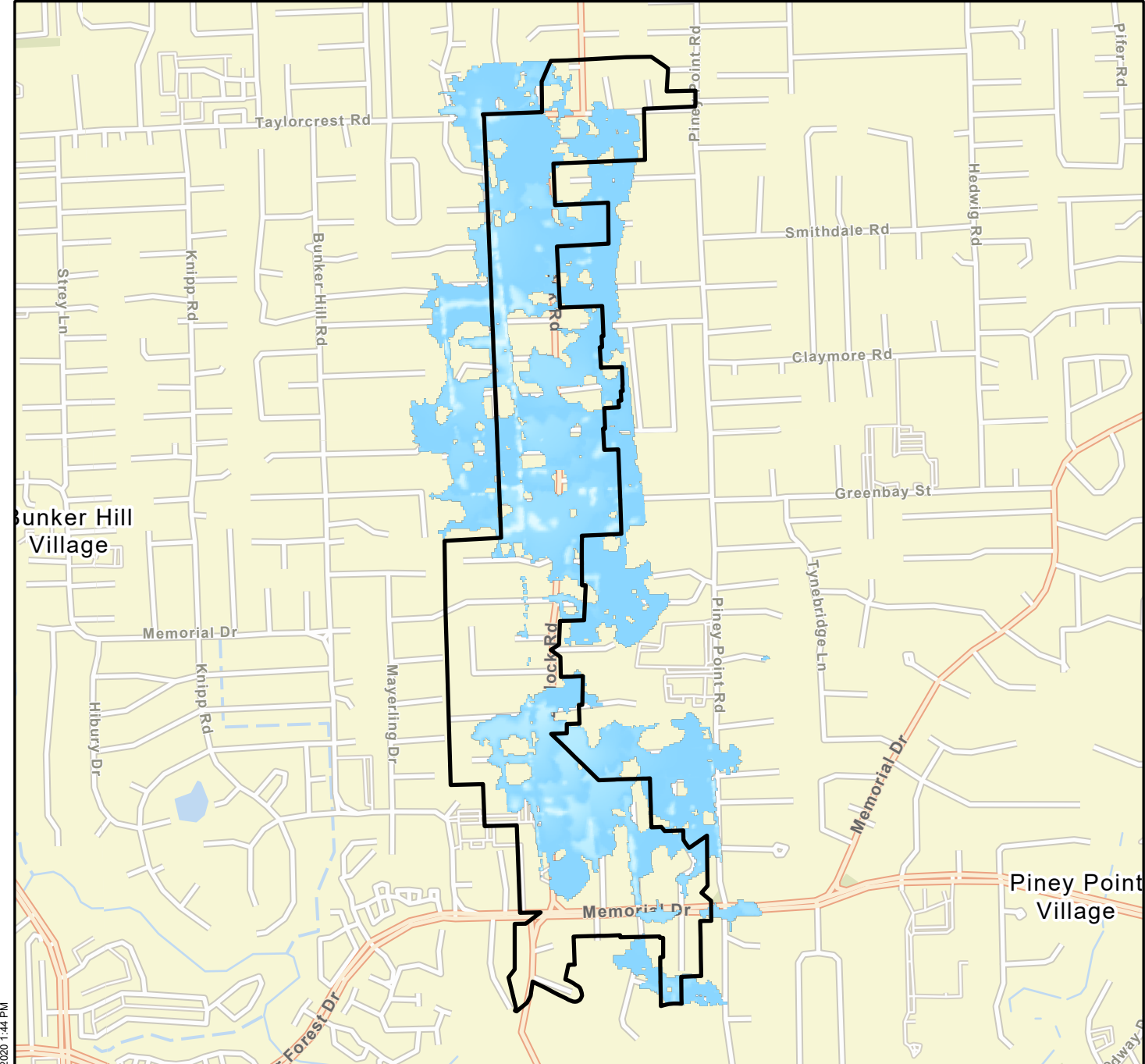
 HCFCD CHANNELS

MAJOR DRAINAGE AREA

-  BLALOCK RD.
-  BUFFALO BAYOU
-  BUNKER HILL OUTFALL
-  GREENBAY ST.
-  LOWER SOLDIERS CREEK
-  MEMORIAL DR./SAN FELIPE RD.
-  SHADY CREEK
-  SOLDIERS CREEK BYPASS
-  TYNEWOOD DITCH
-  W143-00-00
-  W171-00-00

DATA SOURCE: HCFCD, H-GAC
CITY OF PINEY POINT VILLAGE, FEMA






Legend

 Blalock Project Drainage Area

 100 Year Benefit Area

Value

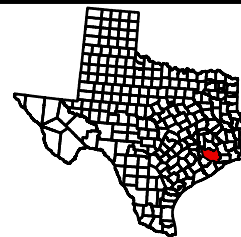
 0.776
 0



0 0.13 0.25 0.5 Miles

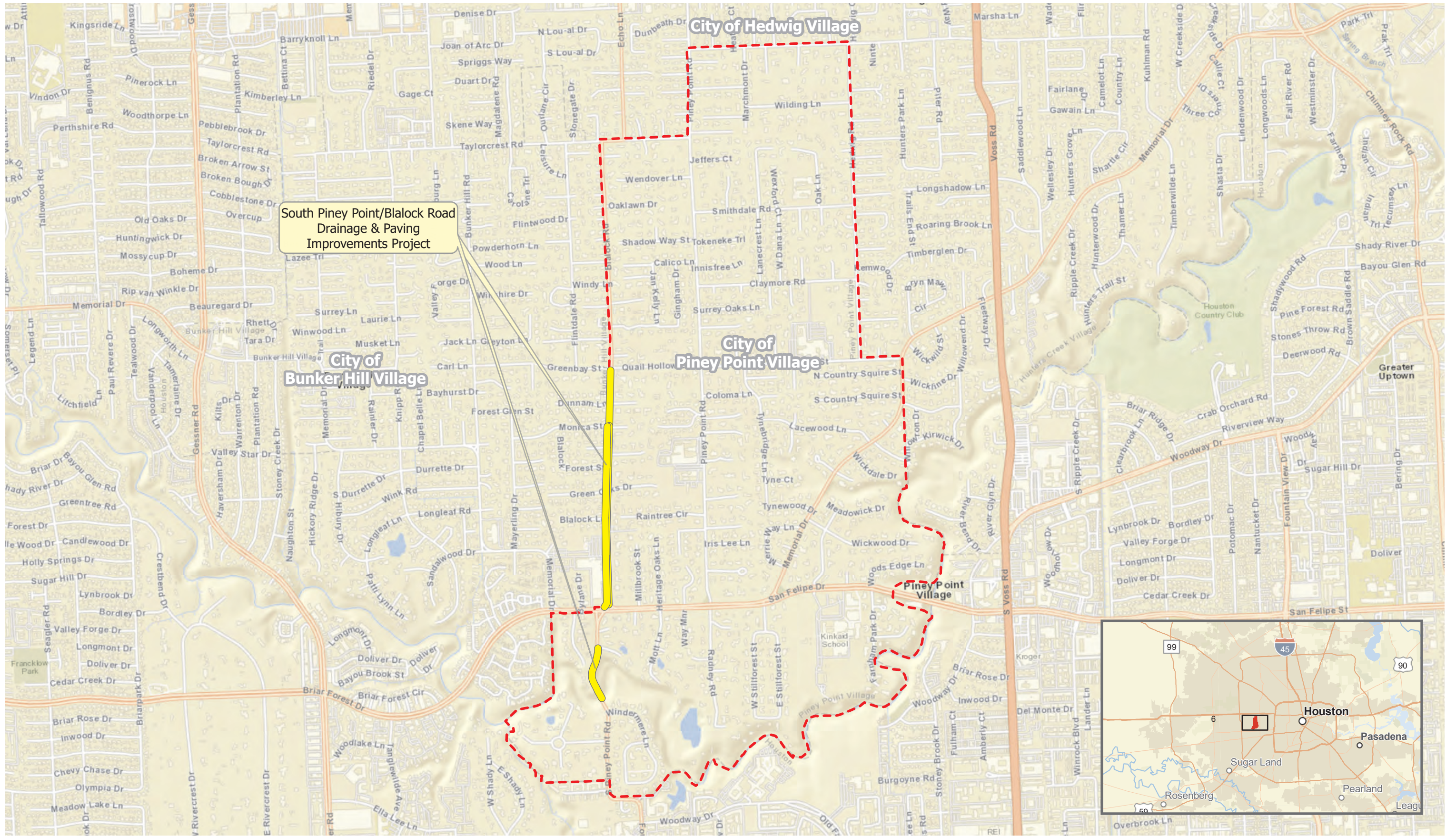
Blalock Drainage Area

Project Benefit Area



Harris County, TX





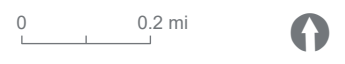
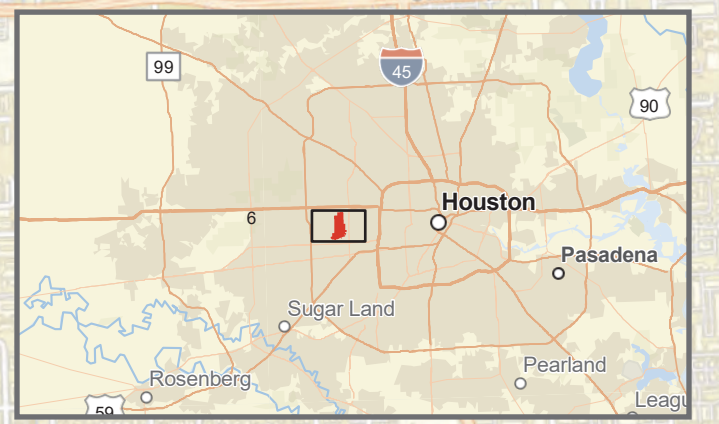
South Piney Point/Blalock Road
Drainage & Paving
Improvements Project

City of Hedwig Village

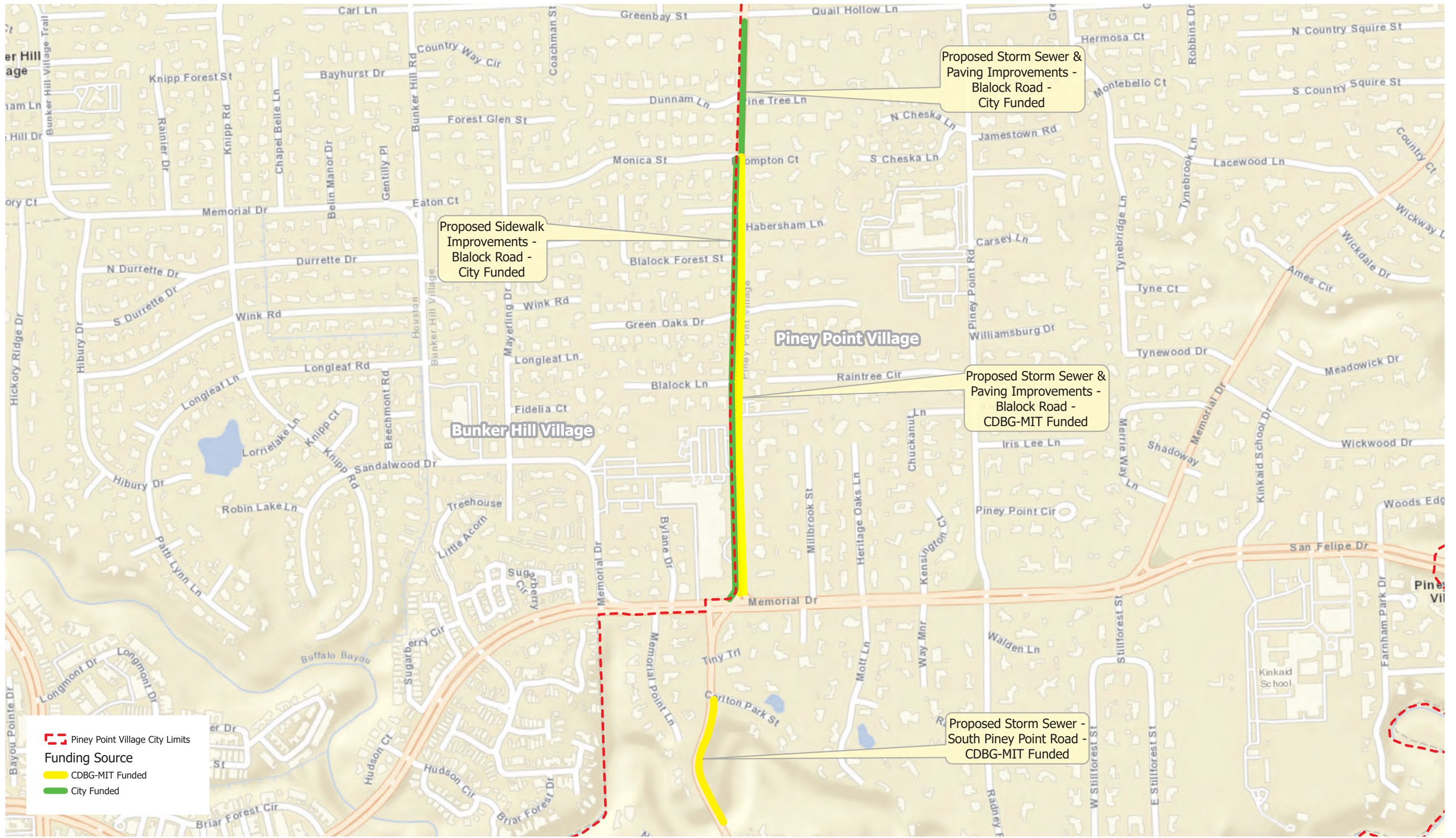
City of
Bunker Hill Village

City of
Piney Point Village

Piney Point
Village

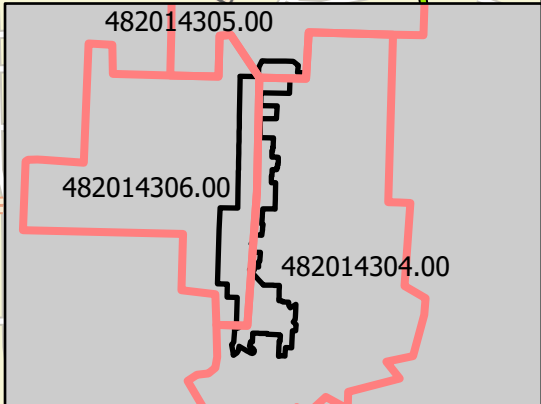
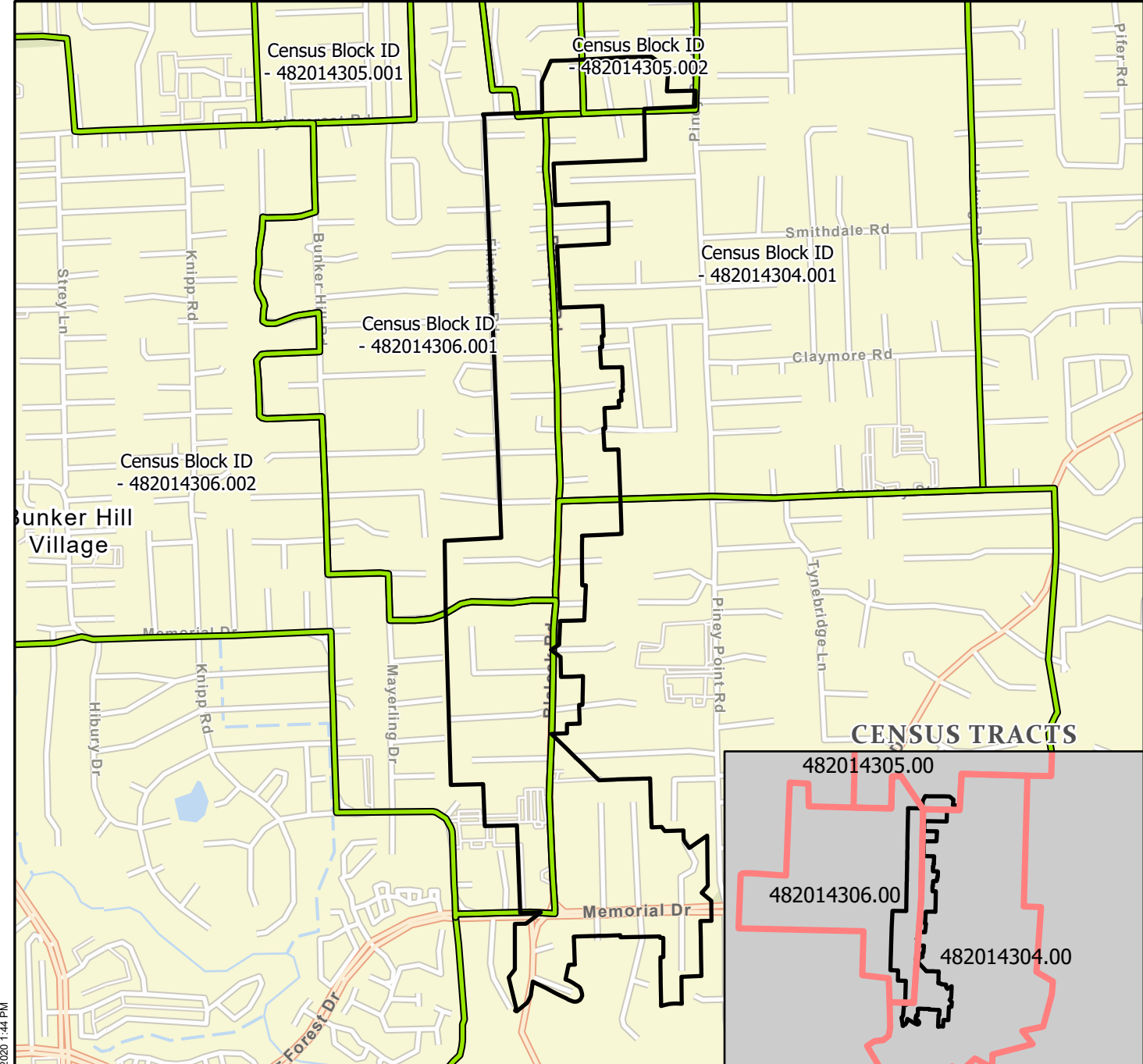


OVERALL PROJECT LOCATION MAP
Figure 1



0 0.1 mi

PROJECT LAYOUT MAP
Figure 2

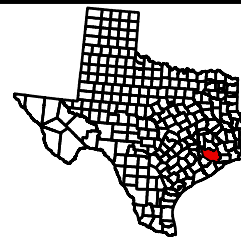


Legend

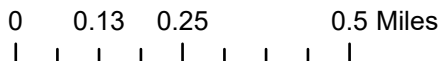
-  Blalock Project Drainage Area
-  Census Block

Blalock Drainage Area

Project Benefit Area



Harris County, TX



Project Budget

A detailed budget for the entire project including the sources of funds for each element of the project is included on the following pages (pages 12 and 13).

S. Piney Point/Blalock Drainage & Paving Improvements

City of Piney Point Village
Opinion of Probable Construction Costs

S. Piney Point/Blalock Road Drainage Improvements - Single System

CDBG-MIT FUNDED

Drainage Improvements - South Piney Point Road (CDBG-MIT FUNDS)

Item	Item Description	Unit	Quantity	Unit Price	Cost
1	Remove Existing Storm Sewer	L.F.	675	\$100.00	\$ 67,500.00
2	Remove existing storm sewer inlets	EA.	4	\$550.00	\$ 2,200.00
3	9' x 9' Box Culvert	L.F.	675	\$950.00	\$ 641,250.00
4	24" HDPE Storm Sewer	L.F.	200	\$120.00	\$ 24,000.00
5	4' dia. Manway entry installed on storm sewer box	EA.	2	\$5,000.00	\$ 10,000.00
6	14' x 8' junction box manhole	EA.	3	\$30,000.00	\$ 90,000.00
7	Type E Inlet	EA.	4	\$4,000.00	\$ 16,000.00
8	Storm sewer outfall bank stabilization	LS	1	\$50,000.00	\$ 50,000.00
9	Restrictor	EA.	1	\$10,000.00	\$ 10,000.00
10	SWPP	LS	1	\$10,000.00	\$ 10,000.00
11	Trench Safety	LF	875	\$7.00	\$ 6,125.00
12	Traffic control	LS	1	\$5,000.00	\$ 5,000.00
11	Mobilization	LS	1	\$20,000.00	\$ 20,000.00
12	Tree Protection	LS	1	\$50,000.00	\$ 50,000.00

SUBTOTAL FOR SOUTH PINEY POINT RD DRAINAGE SYSTEM: \$ 1,002,075.00

CONSTRUCTION CONTINGENCY (30%): \$ 300,630.00

TOTAL FOR SOUTH PINEY POINT RD DRAINAGE SYSTEM: \$ 1,302,705.00

Drainage Improvements - Blalock Road from Memorial Drive to Brompton Ct. (CDBG-MIT FUNDS)

Item	Item Description	Unit	Quantity	Unit Price	Cost
1	Remove Existing Storm Sewer	L.F.	4,745	\$25.00	\$ 118,625.00
2	12" PVC Storm Sewer	L.F.	650	\$50.00	\$ 32,500.00
3	9'x8' RCB Storm Sewer	L.F.	2,000	\$870.00	\$ 1,740,000.00
4	8'x8' RCB Storm Sewer	L.F.	1,270	\$850.00	\$ 1,079,500.00
5	24" RCP	L.F.	900	\$115.00	\$ 103,500.00
6	Junction Boxes	EA.	12	\$10,000.00	\$ 120,000.00
7	Type A Inlets	EA.	39	\$5,000.00	\$ 195,000.00
8	Conflict Box	EA.	4	\$20,000.00	\$ 80,000.00
9	Water Line Adjustment	EA.	3	\$4,500.00	\$ 13,500.00
10	Traffic Control, Mobilication, and SWPPP	LS	1	\$300,000.00	\$ 300,000.00
11	4" reinforced concrete sidewalk, complete in place, the sum of:	S.F.	21,700	\$10.00	\$ 217,000.00
12	Curb ramps, complete in place, the sum of:	EA.	10	\$2,000.00	\$ 20,000.00
13	Remove & Replace 6" Concrete Driveway	S.Y.	465	\$100.00	\$ 46,500.00

SUBTOTAL FOR BLALOCK ROAD DRAINAGE SYSTEM: \$ 4,066,125.00

CONSTRUCTION CONTINGENCY (30%): \$ 1,219,840.00

TOTAL FOR BLALOCK ROAD DRAINAGE SYSTEM: \$ 5,285,965.00

Paving Improvements - Blalock Road Paving from Memorial to Brompton Ct. (CDBG-MIT FUNDS)

Item	Item Description	Unit	Quantity	Unit Price	Cost
1	6" lime and fly ash stabilized subgrade	S.Y.	10,030	\$7.00	\$ 70,210.00
2	Lime for treating pavement subgrade	TON	114	\$245.00	\$ 27,930.00
3	Fly ash for treating pavement subgrade	TON	221	\$140.00	\$ 30,940.00
4	3" Type D HMA	S.Y.	8,685	\$22.00	\$ 191,070.00
5	8" Type A HMA black base	S.Y.	9,315	\$50.00	\$ 465,750.00
6	Prime Coat	GAL	3,045	\$5.00	\$ 15,225.00

SUBTOTAL FOR BLALOCK PAVING: \$ 801,125.00

CONSTRUCTION CONTINGENCY (30%): \$ 240,340.00

TOTAL FOR BLALOCK PAVING: \$ 1,041,465.00

TOTAL CDBG-MIT FUNDED CONSTRUCTION ITEMS: \$ 7,630,135.00

ENGINEERING FEES (BASIC, 15%): \$ 1,144,520.00

SPECIAL ENGINEERING FEES - GEOTECHNICAL: \$ 30,000.00

SPECIAL ENGINEERING FEES - CONSTRUCTION MATERIALS TESTING: \$ 75,000.00

PROJECT ADMINISTRATION FEES (8%): \$ 610,410.00

TOTAL OPINION OF PROBABLE PROJECT COST (CDBG-MIT FUNDED) \$ 9,490,065.00

CITY FUNDED					
Drainage Improvements - Blalock Road from Brompton Ct. to Quail Hollow (CITY FUNDS)					
Item	Item Description	Unit	Quantity	Unit Price	Cost
1	Remove Existing Storm Sewer	L.F.	1,200	\$25.00	\$ 30,000.00
2	12" PVC Storm Sewer	L.F.	200	\$50.00	\$ 10,000.00
3	8'x8' RCB Storm Sewer	L.F.	820	\$850.00	\$ 697,000.00
4	24" RCP	L.F.	400	\$115.00	\$ 46,000.00
5	Junction Boxes	EA.	3	\$10,000.00	\$ 30,000.00
6	Type A Inlets	EA.	10	\$5,000.00	\$ 50,000.00
7	Conflict Box	EA.	2	\$20,000.00	\$ 40,000.00
8	Water Line Adjustment	EA.	1	\$4,500.00	\$ 4,500.00
9	Traffic Control, Mobilication, and SWPPP	LS	1	\$300,000.00	\$ 300,000.00
10	Remove & Replace 6" Concrete Driveway	S.Y.	120	\$100.00	\$ 12,000.00
SUBTOTAL FOR BLALOCK ROAD DRAINAGE SYSTEM:					\$ 1,219,500.00
CONSTRUCTION CONTINGENCY (30%):					\$ 365,850.00
TOTAL FOR BLALOCK ROAD DRAINAGE SYSTEM:					\$ 1,585,350.00
Paving Improvements - Blalock Road from Brompton Ct. to Quail Hollow (CITY FUNDS)					
Item	Item Description	Unit	Quantity	Unit Price	Cost
1	6" lime and fly ash stabilized subgrade	S.Y.	2,500	\$7.00	\$ 17,500.00
2	Lime for treating pavement subgrade	TON	30	\$245.00	\$ 7,350.00
3	Fly ash for treating pavement subgrade	TON	60	\$140.00	\$ 8,400.00
4	3" Type D HMAc	S.Y.	2,175	\$22.00	\$ 47,850.00
5	8" Type A HMAc black base	S.Y.	2,330	\$50.00	\$ 116,500.00
6	Prime Coat	GAL	770	\$5.00	\$ 3,850.00
SUBTOTAL FOR BLALOCK PAVING:					\$ 201,450.00
CONSTRUCTION CONTINGENCY (30%):					\$ 60,440.00
TOTAL FOR BLALOCK PAVING:					\$ 261,890.00
Sidewalk Improvements - Blalock Road Westside from Memorial to Quail Hollow (CITY FUNDS)					
1	4" reinforced concrete sidewalk, complete in place, the sum of:	S.F.	27,300	\$10.00	\$ 273,000.00
2	Curb ramps, complete in place, the sum of:	EA.	15	\$2,000.00	\$ 30,000.00
SUBTOTAL FOR SIDEWALK:					\$ 303,000.00
MISCELLANEOUS ITEMS (30%):					\$ 90,900.00
TOTAL FOR BLALOCK SIDEWALK:					\$ 393,900.00
TOTAL CITY FUNDED CONSTRUCTION ITEMS:					\$ 2,241,140.00
ENGINEERING FEES (BASIC, 15%):					\$ 336,170.00
SPECIAL ENGINEERING FEES - GEOTECHNICAL:					\$ 7,000.00
SPECIAL ENGINEERING FEES - CONSTRUCTION MATERIALS TESTING:					\$ 1,000.00
TOTAL OPINION OF PROBABLE PROJECT COST (CITY FUNDED)					\$ 2,585,310.00
SUMMARY					
TOTAL OPINION OF PROBABLE PROJECT COST (CDBG-MIT FUNDED)					\$ 9,490,065.00
TOTAL OPINION OF PROBABLE PROJECT COST (CITY FUNDED)					\$ 2,585,310.00
TOTAL OPINION OF PROBABLE PROJECT COST (ENTIRE PROJECT):					\$ 12,075,375.00
CDBG-MIT FUNDED PORTION OF ENTIRE PROJECT:					78.59%
CITY FUNDED PORTION OF ENTIRE PROJECT:					21.41%

These estimates are presented for planning purposes only and are subject to change as the project progresses.

Paving Quantities are included for the full replacement of Blalock Road paving from Brompton to Memorial Drive based on the assumption that the proposed storm sewer system would be placed under the pavement.

Project Benefits and Beneficiaries

The South Piney Point / Blalock Rd Drainage Improvement Project has demonstrable benefits for reducing flood risk. By increasing the capacity of the subsurface drainage infrastructure, the improvements will reduce the amount of overland flood that sheet flows across the surfaces of streets and damages infrastructure and property. Since Blalock road also serves as a boundary between Piney Point and the City of Bunker Hill Village, the flood risk reduction benefits of the project also extend to the City of Bunker Hill Village immediately to the west of Piney Point Village, making this a multi-jurisdictional project. In addition to the flood risk reduction benefits, the project will also replace the road surface along Blalock Rd and replace a drainage ditch with a sidewalk, adding a pedestrian amenity and eliminating a driving hazard.

The people and neighborhoods that will benefit directly from this project are those immediately surrounding the project area. The demographics from the 6 Census block groups shown on Map 5 that intersect with the project are included below.

Total Population	10,216	
Total Number of Households	3,535	
Demographics	Total	Percentage
Hispanic Populaiton	858	8.4%
White/Non-Hispanic	7,478	73.2%
Black African American Non-Hispanic	119	1.2%
American Indian/Alaska Native Non-Hispanic	11	0.1%
Asian Non-Hispanic Non-Hispanic	1,551	15.2%
Pacific Islander Non-Hispanic	8	0.1%
Other Non-Hispanic	27	0.3%
Male Population	5,063	49.6%
Female Population	5,233	51.2%
Unemployment Rate		3.2%
Average povery rate		5.1%
Median Age	49	
Median Income	\$ 200,001	

Appendix I – Evidence of Recent Flooding



Recent flooding documented along
Blalock and Pinetree Roads



Recent flooding documented along
Blalock and Pinetree Roads

Appendix II – Stormwater models

The following maps show projected inundation levels in the Blalock drainage area during the 100-year, 10-year, and 2-year design storms.

LEGEND

CITY OF PINEY POINT VILLAGE

EXISTING - 100 YEAR

DEPTH (FT)

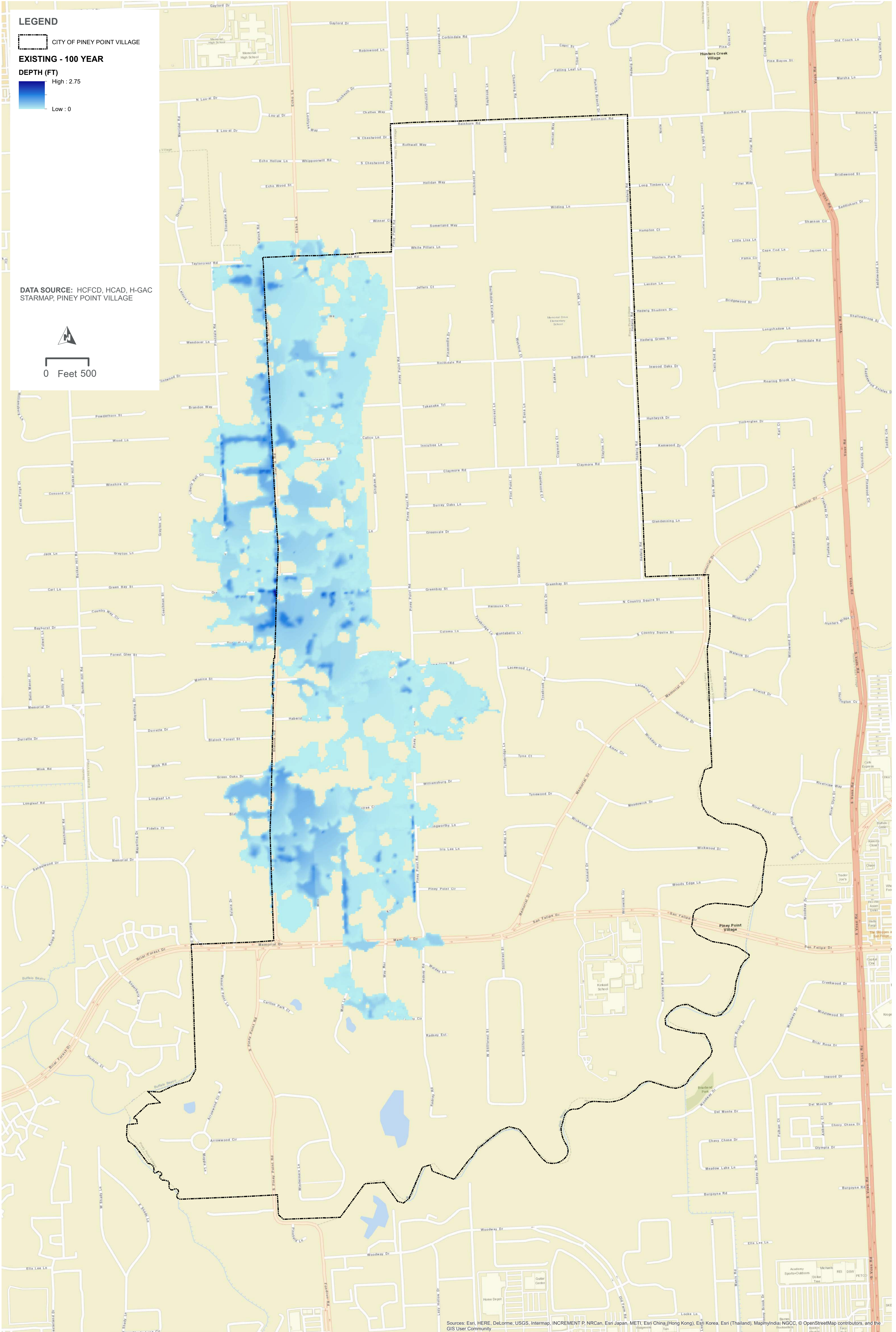
High : 2.75

Low : 0

DATA SOURCE: HCFCD, HCAD, H-GAC
STARMAP, PINEY POINT VILLAGE



0 Feet 500



Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community



CITY OF PINEY POINT VILLAGE, TEXAS
EXISTING CONDITIONS - 100-YEAR INUNDATION DEPTH GRID

EXHIBIT 13

LEGEND

CITY OF PINEY POINT VILLAGE

EXISTING - 10 YEAR

DEPTH (FT)

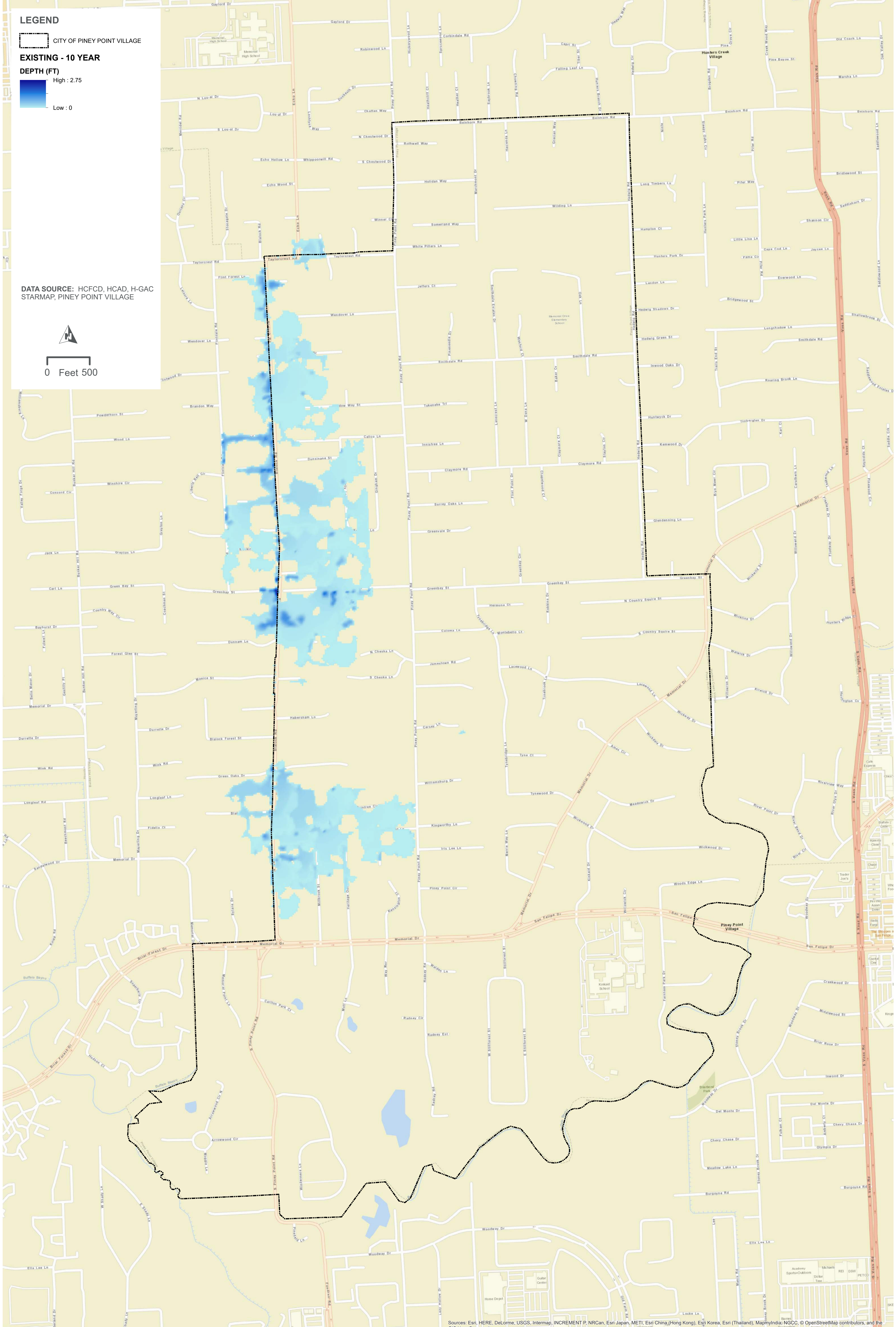
High : 2.75

Low : 0

DATA SOURCE: HCFCD, HCAD, H-GAC
STARMAP, PINEY POINT VILLAGE



0 Feet 500



Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community



CITY OF PINEY POINT VILLAGE, TEXAS
EXISTING CONDITIONS - 10-YEAR INUNDATION DEPTH GRID

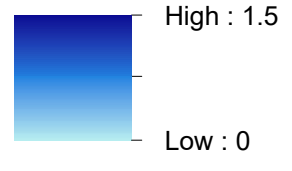
EXHIBIT 14

LEGEND

CITY OF PINEY POINT VILLAGE

EXISTING - 2 YEAR

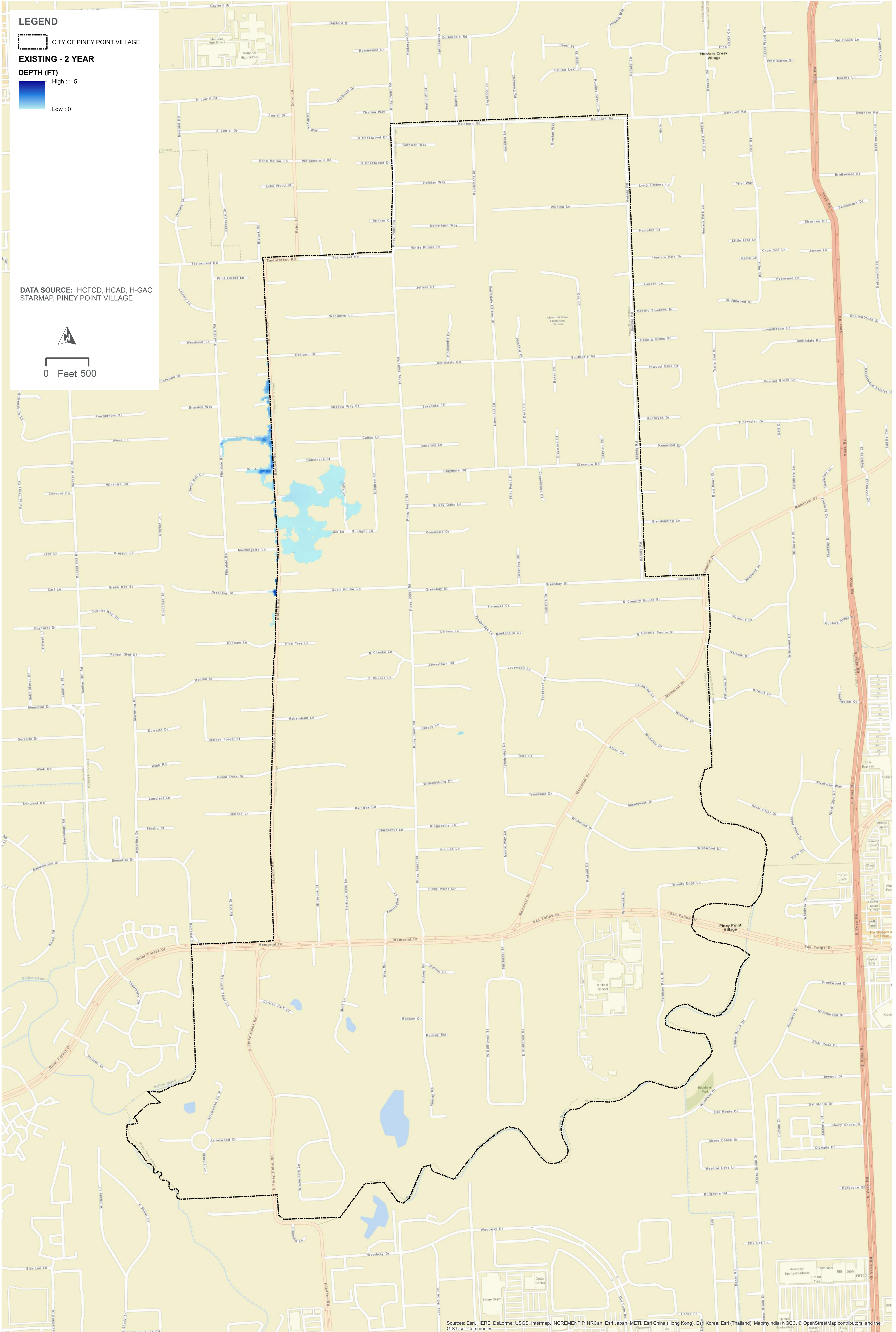
DEPTH (FT)



DATA SOURCE: HCFCD, HCAD, H-GAC STARMAP, PINEY POINT VILLAGE



0 Feet 500



Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community



CITY OF PINEY POINT VILLAGE, TEXAS
EXISTING CONDITIONS - 2-YEAR INUNDATION DEPTH GRID

EXHIBIT 15

Appendix III – Master Drainage Study – excerpted pages for Blalock Drainage Area

The following pages are excerpted from the City of Piney Point Village’s Master Drainage Study and demonstrate the need for drainage improvements in the Blalock Road Drainage area.

Table 4 - Required Mitigation for Category II Areas

System	Drainage Area (acres)	Existing BDF	BDF x A	Proposed BDF	BDF x A	Storage Rate	Localized Required Detention (ac-ft)
Beinhorn	22.196	4.5	99.882	10.5	233.058	0.26	5.8
Chuckanut	7.701	1.5	11.5515	10.5	80.8605	0.39	3.0
Country Squire	30.68	9	276.12	12	368.16	0.12	3.7
Memorial Drive (W144-00-00)	10.426	9	93.834	12	125.112	0.12	1.3
Memorial Drive (Smithdale)	3.737	9	33.633	12	44.844	0.12	0.4
Robbins, Tynebrook, Lacewood	29.62	5	148.1	10.5	311.01	0.19	5.6
Shadow	18.26	9	164.34	10.5	191.73	0.12	2.2
Tokeneke	6.67	4.5	30.015	10.5	70.035	0.26	1.7
Total Required Detention	129					0.18	23.7

As shown in Table 4, approximately 24 acre-feet of detention storage is necessary to offset impacts associated with the proposed improvements to the storm sewer systems within the Category II areas.

9 Analysis of Category III Areas

Category III identifies streets and areas within the City where drainage patterns and conditions are relatively complex and where detailed modeling analyses are necessary. The following paragraphs provide a summary of the detailed modeling for areas identified as Category III areas.

9.1 HCFCD Unit W146-00-00

The City of Bunker Hill Village provided a model of W146-00-000 in 2017 upon the request of the City of Piney Point Village. Unit W146-00-000 outfalls through a 7'x7' box culvert in the City of Piney Point Village at Memorial Drive just west of Memorial Point. Results from the model output at that 7'x7' RCB culvert are shown below in **Table 5**.

Table 5 - HCFCD Unit W146-00-00 Model Results

Storm Event	Flow (cfs)	WSEL (feet)
10-Yr	392	62.21
100-Yr	582	62.91
250-Yr	653	63.16

Reports of water rapidly moving through the creek portion of W146-00-000 in the City limits appear to be confirmed by model results as velocities from the flows above range from 8 to 13 feet per second.

9.2 Blalock Rd.

Drainage areas draining to Blalock Road were identified based on the topography and existing drainage infrastructure within the subject area. A portion of the area draining to Blalock Road is diverted via an existing 60-inch RCP just a short distance south of Habersham Road. That 60-inch RCP drains eastward to Piney Point Road and thence to HCFCD Unit W144-00-00 (Tynewood Ditch). During a storm event greater than a 2-year event, stormwater runoff exceeds the capacity of the storm sewer along Blalock Road and diverts eastward through an existing 36" RCP, thence through dual 30" RCPs, thence through an open channel, thence through a single 48" RCP, thence through the 6'x4' RCB system on N. Piney Point Road, then into the 7'x6' RCB system on Carsey

Lane and ultimately to HCFCD Unit W144-00-00. The following paragraphs describe the methodology used to analyze the Blalock Road system. In the 2010 Master Drainage Study, the Blalock Road/South Piney Point system was identified as a system that needed significant improvements in order to convey the design discharge to Buffalo Bayou.

9.2.1 Hydrologic Calculations

This section documents the hydrologic calculations of the study area which have resulted in 100-year, 10-year and 2-year runoff time series. The study area was sub-divided into multiple sub-drainage areas, then the 100-year peak runoff was calculated for each catchment using the rational method. The drainage areas were delineated based on the topography of areas draining toward Blalock Road. The drainage areas were compared with previous drainage area delineations completed by HDR, and no major changes were made. The catchments were then modeled in HEC-HMS to obtain runoff hydrographs, using the Clark Unit Hydrograph Method. The HEC-HMS hydrograph model was calibrated to reach the peak 100-year runoff from the rational method, by iterating the storage coefficient. Once the HEC-HMS model was calibrated, runoff hydrographs were computed for 100-year, 10-year and 2-year rainfall events.

9.2.2 Detailed Hydraulic Modeling

The Environmental Protection Agency (EPA) has released the Storm Water Management System (SWMM) which is the 1-D analytical model for links and nodes. XP Solutions Inc. (XP) has released XPSWMM which is created by coupling the EPA SWMM with a 2-D engine that solves for overland flows.

XPSWMM Version 2016.1 was used to model the City's storm drainage system within the study area. All major storm sewers, ditches, channels, etc. were included in the model. Light Detection and Ranging (LIDAR) data from Harris County was used to model the topography of the study area. The hydrographs calculated by HEC-HMS were inserted in XPSWMM as user-inflow.

9.2.3 Existing Conditions

The existing conditions model was created by merging models previously created by HDR. Those models were completed as part of an analysis of Millbrook Rd., South Piney Point Road, and Blalock Road north. This existing conditions model includes Blalock Road from Taylorcrest southward to Buffalo Bayou, and then the storm sewer diversion to Unit W144-00-00 east of Piney Point Road. The model also includes the existing roadside ditch on the west side of Blalock Road and cross-drainage culverts which convey eastward across Blalock Road from that roadside ditch to the Blalock Road storm sewer system based on construction drawings provided by the City of Bunker Hill Village. Those cross-drainage culverts include a 36-inch RCP just north of Memorial Drive, a 30-inch RCP at Dunham Lane, and an 8'x3' box culvert between Dunham Lane and Mockingbird Street.

Based on the results of that model, several areas were identified as areas in need of improvement. **Exhibits 13-15** provide an inundation depth grid from the existing conditions XP-SWMM model of the Blalock Road system.

9.2.4 Proposed Improvements to Blalock Rd. System

The following paragraphs provide a description of the proposed modifications to the Blalock Road system on the east side of the road. **Exhibit 16** provides a preliminary layout of the proposed improvements within the subject area. The proposed storm sewers convey the 2-year storm event, without significant ponding within the street right-of-way.

Outfall to Carlton Park Ct.

From the model outfall to the southern edge of the intersection of South Piney Point Rd and Carlton Park Court, the outfall currently consists of a single 96" RCP which appears inadequate and is failing. The proposed modifications includes adding an additional 96" RCP parallel to the existing pipe or combining the dual 96" pipe outfall into a single 12'x10' RCB culvert outfall or installing dual 8'x7' RCB culverts.

Memorial Dr. to Taylorcrest St.

On the eastern side of Blalock Rd., the existing system has a series of storm sewers (including parallel reaches) that carry flow to the south. The proposed modifications include upsizing and re-grading the existing system to a 6' x 4' RCB from the northern edge of the intersection of Blalock Road and Memorial Drive to the northern edge of the intersection of Blalock Road and Blalock Circle. For the remaining reach of Blalock Road, from the northern edge of the intersection with Blalock Circle to the southern edge of the intersection with Taylorcrest Road, the proposed modifications include upsizing and re-grading the existing system with 42-inch to 48-inch RCPs. Drainage infrastructure on the west side of Blalock Road is proposed to remain in place.

Laterals from Private Streets

Several private streets on the eastern side of Blalock Rd. have lateral storm sewers that convey flow to the Blalock Road mainline. Because the proposed modifications on the Blalock Road mainline include re-grading, these private storm sewer laterals will also require re-gradation. In particular, there is an 8" PVC pipe on Shady Grove Ln. that appears inadequate for the 2-year runoff and is recommended for upsizing and re-gradation. Other lateral systems are recommended for re-grading to maintain positive slope since the pipe sizes does not appear to be problematic. Cost-sharing and/or reimbursement agreements with private owners may be needed as the City is not responsible for the maintenance of private streets.

9.2.5 Blalock Rd. Proposed Conditions Results

An inundation depth grid was developed for the existing and proposed conditions to determine the reduction of flooding for various storm events within the Blalock Road corridor and adjacent areas. It is important to note that the 2D model domain follows a north-south boundary generally along Gingham Road a short distance west of Piney Point Road. Because of this, the flooding extents will likely extend past this boundary, but the model does not capture this phenomenon due to the extents of the 2D model boundary.

Figure 10 below provides a comparison of the 100-year inundation depth grids for the existing and proposed conditions. As shown, the inundation depths are reduced throughout the project area; however, significant ponding throughout the corridor and significant overland flow to the east of Blalock Road is expected. **Exhibits 17-19** provide an inundation depth grid from the proposed conditions XP-SWMM model of the Blalock Road system.

Figure 10 - Blalock Road 100-Year Inundation Depth Grid

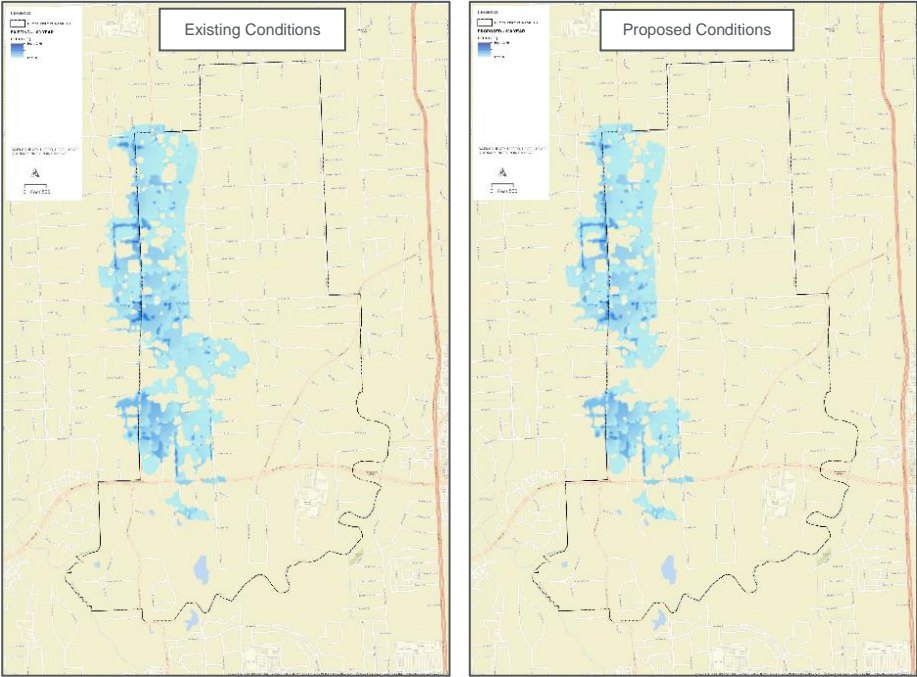


Figure 11 below provides the inundation depth grid for the 10-year storm event for the existing and proposed conditions. As shown, significant ponding along the corridor is expected, and overland flow to the east of Blalock Road is also expected. As shown, the proposed improvements cause significant reductions in flooding depths along the roadway corridor and adjacent areas.

Figure 11 - Blalock Road 10-Year Inundation Depth Grid

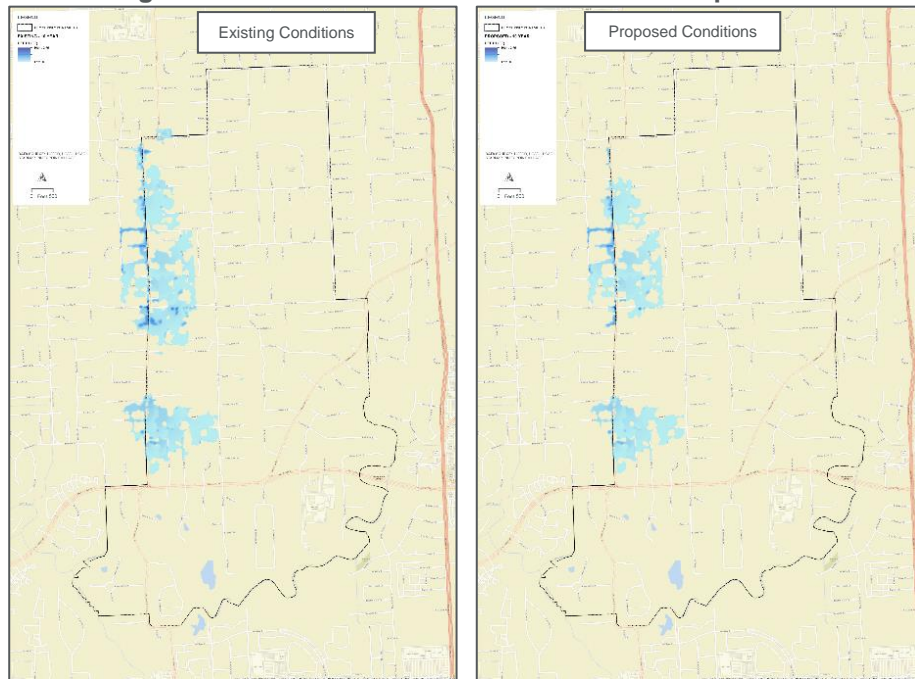
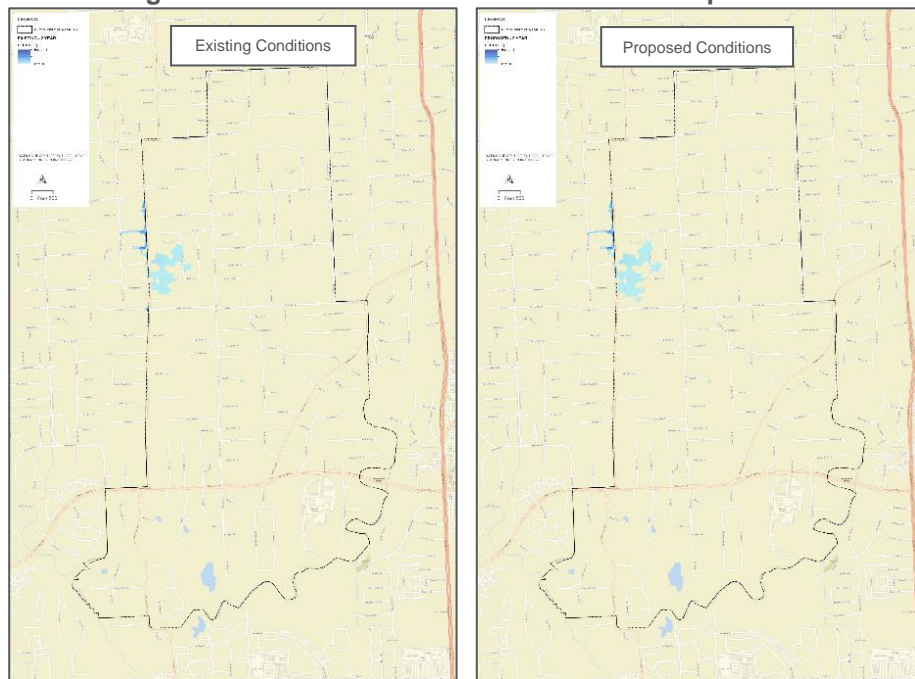


Figure 12 below provides a comparison of the existing and proposed inundation depth grids for the 2-year storm event. As shown, minimal street ponding and overland flow is expected during a 2-year storm event in the existing conditions, and the storm sewer is designed to convey the 25-year and 100-year storm events. The results of the proposed conditions model indicate that street ponding is reduced slightly during a 2-year storm event along the Blalock Road corridor.

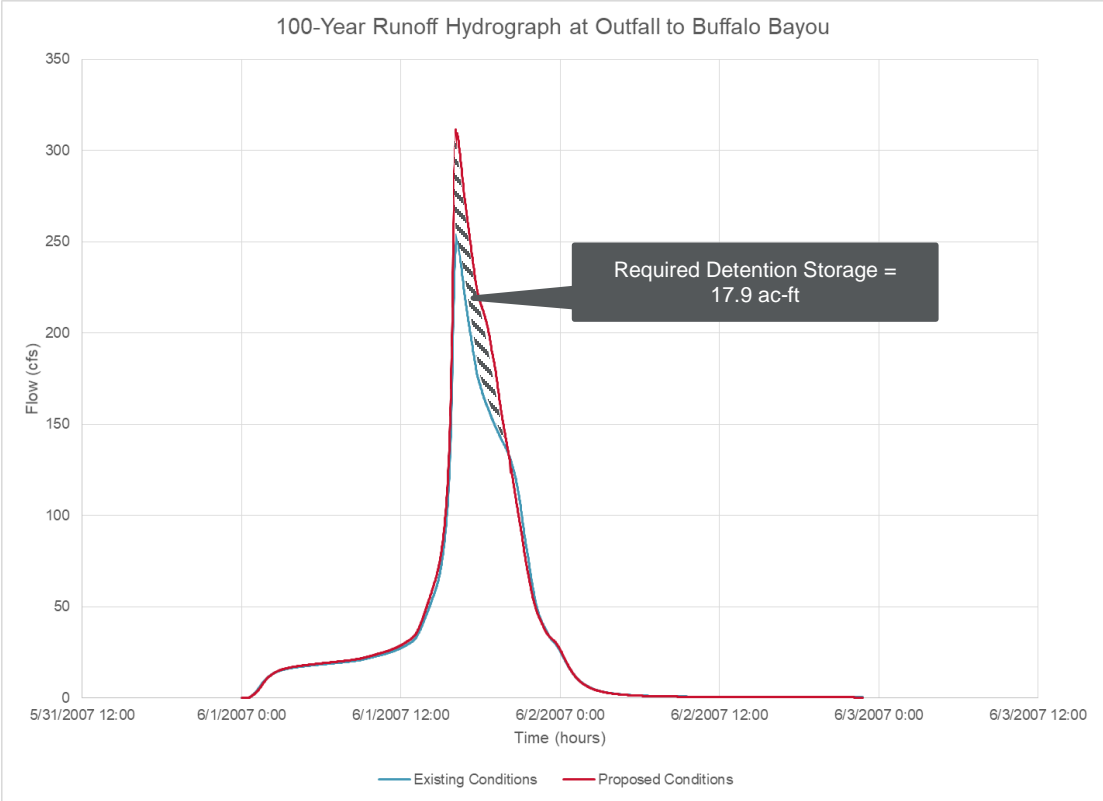
Figure 12 - Blalock Road 2-Year Inundation Depth Grid



9.2.6 Required Mitigation for Blalock Road Improvements – East Side Only

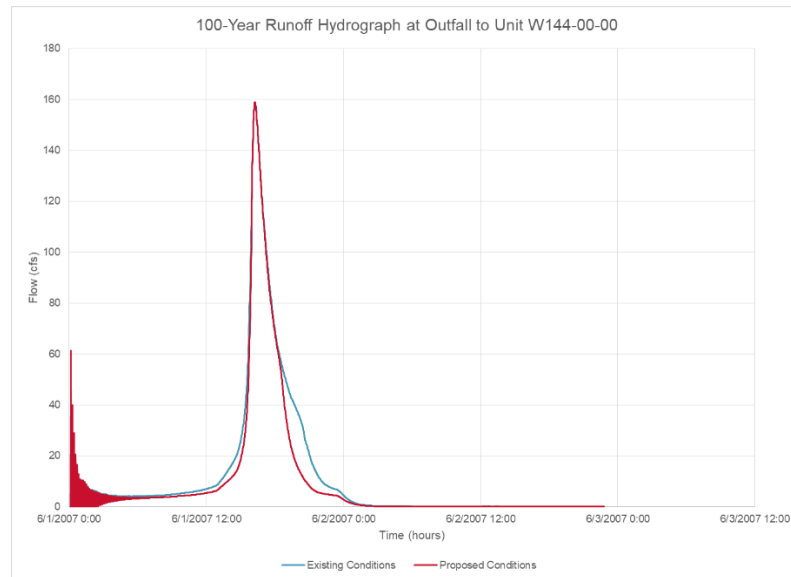
A comparison of runoff hydrographs from the existing and proposed conditions model at the outfalls to Buffalo Bayou and HCFCD Unit W144-00-00 indicate that the proposed east side improvements cause an increase in peak discharge rates at Buffalo Bayou. In order to offset those potential adverse impacts, stormwater detention must be provided. The proposed conditions runoff hydrographs at the outfalls have been compared versus the pre-project conditions runoff hydrographs in order to estimate the volume of detention required to offset the increases in peak flow rate on downstream properties. **Figure 13** shows the required detention volume is estimated to be 17.9 acre-feet that accounts for the east side improvements, which serves approximately 275 acres of drainage area.

Figure 13 - Comparison of Existing & Proposed Runoff Hydrographs at Buffalo Bayou Outfall



A comparison of the outfall to HCFCD Unit W144-00-00 indicates that the peak discharge rate at that outfall from the Blalock Road system does not increase. Therefore, no adverse impacts are expected along HCFCD Unit W144-00-00. **Figure 14** below provides a comparison of the existing and proposed runoff hydrographs.

Figure 14 - Comparison of Existing & Proposed 100-Year Runoff Hydrographs at Outfall to Unit W144-00-00



9.2.7 Supplemental Analysis of Blalock Rd. System – West & East Side Improvements

As shown in **Figures 2, 3, and 4**, the results of the analysis indicate that significant street ponding and overland sheet flow occurs even though the storm sewer is sized for the 25-year storm event for locations where the cumulative drainage area ranges from 100 acres to 200 acres and the 100-year storm event for locations where the cumulative drainage area is greater than 200 acres. This can be attributed to the overtopping of the roadside ditch on the west side of Blalock Road during significant storm events and tributary systems which do not have capacity to convey the 25-year or 100-year storm events.

In order to determine the magnitude of improvements necessary to provide a level of service for a 25-year storm event for locations where the cumulative drainage area ranges from 100 acres to 200 acres and a level of service for a 100-year storm event for locations where the cumulative drainage area is greater than 200 acres, a supplemental analysis was completed by replacing the roadside ditch along the west side of the road with a storm sewer parallel to the proposed storm sewer on the east side of Blalock Road. The results of that analysis indicate that a storm sewer ranging in size from 24" RCP to 7'x7' RCB is necessary to provide that level of service. **Exhibit 20** provides an exhibit which displays those improvements.

Supplemental Analysis Results

An inundation depth grid exhibit was prepared for the 100-year storm event with both sets of improvements on the east and west sides of Blalock Road. It is important to note that the 2D model domain follows a north-south boundary generally along Gingham Road a short distance west of Piney Point Road. Because of this, the flooding extents will likely extend past this boundary, but the model does not capture this phenomenon due to the extents of the 2D model boundary.

Figures 15 and 16 below provide a comparison of the 100-year and 10-year inundation depth grids for the existing and proposed conditions, respectively. As shown, the inundation depths are reduced throughout the project area; however, significant ponding throughout the corridor and significant overland flow to the east of Blalock Road is expected due to tributary systems which do not have capacity to convey the 100-year storm event.

Required Mitigation for Improvements to the West & East Sides of Blalock Rd.

A comparison of runoff hydrographs from the existing and proposed conditions model at the outfalls to Buffalo Bayou indicate that the proposed improvements cause an increase in peak discharge rates at Buffalo Bayou. In order to offset those potential adverse impacts, stormwater detention must be provided. The proposed conditions runoff hydrographs at the outfalls have been compared versus the pre-project conditions runoff hydrographs in order to estimate the volume of detention required to offset the increases in peak flow rate on downstream properties. The required detention volume is estimated to be 44.4 acre-feet (17.9 ac-ft. from the East side + 26.5 ac-ft. from the West side).

Figure 15 - Blalock Road Supplemental Analysis 100-Year Inundation Depth Grid

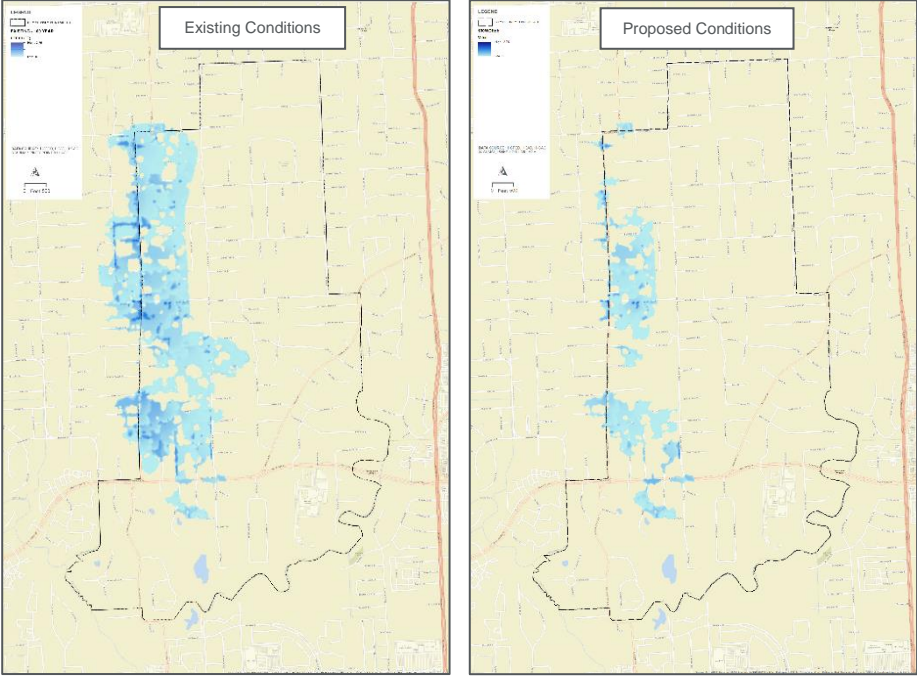
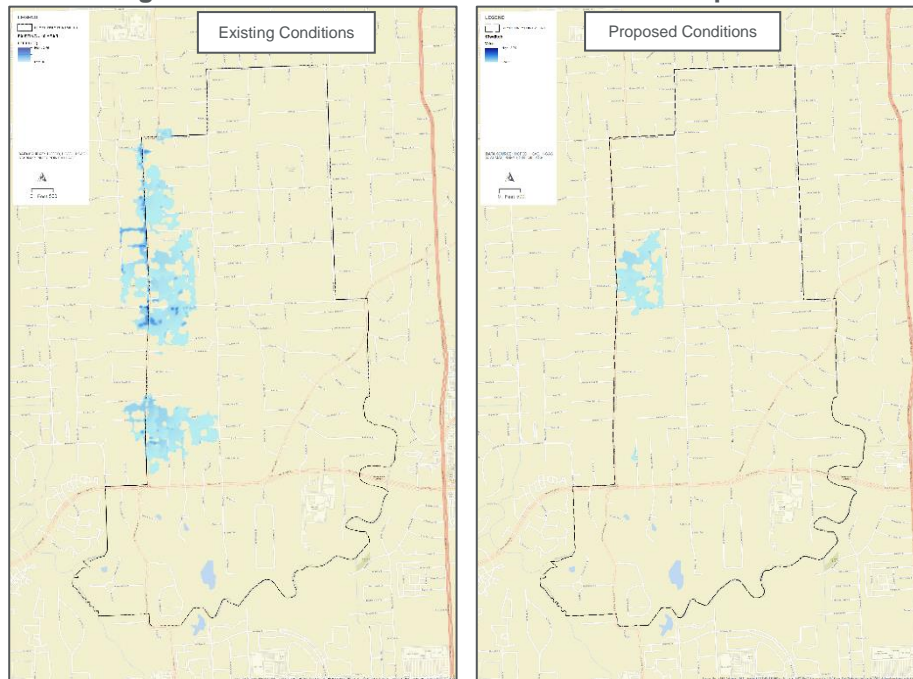


Figure 16 - Blalock Road 10-Year Inundation Depth Grid



9.3 Bothwell Way, Holidan Way, Marchmont Dr. & Wilding Ln.

The City of Piney Point Village provided information which indicated that portions of Bothwell Way and Holidan Way do not drain properly due to limited depth in Soldiers Creek. In order to provide positive drainage along Bothwell Way and Holidan Way, the City has requested that an analysis be completed to determine if a storm sewer could be constructed along Bothwell Way, thence southward along Piney Point Road, thence eastward along Holidan Way, thence southward along Marchmont Drive, and then eastward along Wilding Way to tie into storm sewer along Hedwig Road. However, redirecting flow may cause adverse impacts on downstream flow rates along Hedwig Road and Soldiers Creek. It is important to note that these improvements would require revisions to agreements between the City of Hunter's Creek Village and the City of Piney Point Village regarding the Solders Creek Impact Study. The following paragraphs provide a description of the methodology to assess the potential for adverse impacts on downstream peak flow rates along Hedwig Road and Soldiers Creek.

9.3.1 Discussion of 2013 Soldier's Creek Drainage Impact Study

The XP-SWMM models developed as a part of the 2013 Soldier's Creek Drainage Impact Study were developed using XP-SWMM version 2011. Since that time, XP-SWMM has released subsequent versions of software, and the same models were re-run with no changes in XP-SWMM version 2016.1. **Table 6** below provides a summary of the Soldier's Creek Impact Study results with the Soldier's Creek bypass improvements in place.