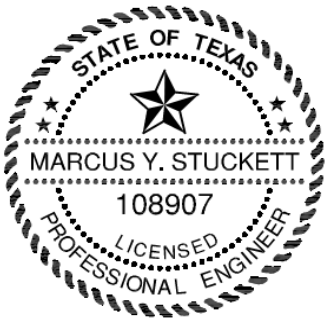
+\- 237-ACRE GULF BREEZE TRACT
Drainage Study

November 2023

PAPE-DAWSON ENGINEERS

Transportation | Water Resources | Land Development | Surveying | Environmental

+\- 237 ACRE GULF BREEZE TRACT
Drainage Study



November 2023

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EXECUTIVE SUMMARY

A Hydrologic and Hydraulic analysis was performed to establish and then mitigate the discharge and water surface elevation (WSEL) impacts that result from the proposed development. This report summarizes the drainage impact analysis for the +\- 237-acre (ac) Gulf Breeze tract. Approximately 142.5 ac will be designated as single-family residential, and 15.5 ac will be commercial. Of the remaining, 21 ac will be reserved for parkland and 58 ac for detention. The site is in the City of Hitchcock in Galveston County north of FM 2004, between Mecom Road and Avenue C as shown in **Exhibit 1, Location Map**.

The 2-, 25-, and 100-year Atlas 14 storm events were analyzed using the Galveston rainfall data (equivalent to Region 3 rainfall data from HCFCD). The site is proposed to be developed in two phases. Phase I will consist of approximately 58 acres of single-family residential development, 15.5 acres of commercial development, 25.5 acres of detention, and 25 acres of park space and open grass.

Under existing conditions, sheet flow enters the site at two (2) locations. **Exhibit 3, Existing Drainage Area Map** depicts these offsite sheet flow locations. One location is at the northwest corner of the site (Offsite NW). To handle this sheet flow, a 10-foot bottom width trapezoidal channel with 3:1 side-slopes is proposed to capture the sheet flow and route it north and then east to the North/South Ditch, which outfalls to the Jay Road Ditch north of the property. The second location at which sheet flow enters the site is along the southeastern boundary (Offsite SE). To handle this sheet flow, a trapezoidal channel with varying bottom widths from 10’ to 20’ and with 3:1 side-slopes will collect runoff from the existing industrial areas at the southeast corner of the development. Once collected, the channel carries the flow north and west to the North/South receiving channel. Additionally, some of the sheet flow being captured along the southeastern boundary will need to continue to flow west. It is recommended that a 20-foot bottom width, 3:1 side slope, trapezoidal channel allow the flow to pass the site and avoid adding additional volume to the basins. A conspan arch structure, which will approximately 16 feet wide, and 3.5 feet high will be required to allow flow to pass underneath the entrance. The ditch will then outfall into a ditch that will be 2-foot bottom width with 3:1 side-slopes and outfall to the roadside ditch along FM 2004.

To gain additional depth for the detention ponds, the channel that receives water from the development area and carries it north (North/South Ditch) to the Jay Road Ditch, as well as Jay Road Ditch, will require improvement. As part of Phase I, it is recommended to improve the North/South Ditch to a 5-foot bottom ditch, 3:1 side slope channel. This configuration will allow the channel to remain in the existing 60-foot right-of-way of the North/South Ditch. These improvements should extend up to the outfall of downstream most pond (Pond 2). For the Jay Road Ditch, a pilot channel is recommended. The pilot channel should begin approximately 1,500 feet upstream of Mecom Road where the flowline changes approximately 0.7 feet and extends to the confluence of the North/South Ditch. The pilot channel is modeled as a 20-foot bottom width section with 4:1 side-slopes. The section will daylight at the existing slopes as it intended to gain additional depth, without increasing the top width of Jay Road Ditch. These modifications will also require an improvement to the existing 3-30-inch reinforced concrete pipes (RCPs) at the crossing upstream of Mecom Road. The flowlines existing RCPs will need to be lowered and upsized to 4-42-inch RCPs.

A total of two basins (Pond 1 and Pond 2) will be provided for Phase I. These ponds supply a total 148.4 acre-feet (ac-ft) of detention below their maximum water surface elevations. See **Table 1** for individual pond details. The outflow from Pond 2 is calculated to be 122 cubic feet per second (cfs) through a single 5 ft x 5 ft (W:H) reinforced concrete box (RCB). Both the outfall structure to the channel, and the equalizer culverts connecting the two ponds will also be a single 5 ft x 5 ft RCB. The ponds will also require 3 weirs along the eastern side to allow some of the sheet flow from the east to enter basin. The weirs will be 2 feet deep with 50-ft bottom width set approximately at elevation 18 feet. The detention rate for the two complete ponds in Phase I is 1.2 ac-ft/ac.

Phase 2 of the project will be the ultimate buildout of the site and will consist of an additional 84.5 ac of single-family residential, an additional 32.5 ac for detention, and 4 ac less of parkland area taken up by an expanded Pond 2. These ponds supply a total of 281 acre-feet (ac-ft) of detention below their maximum water surface elevations. See **Table 2** for individual pond details. The outflow from Pond 2 is calculated to be 180 cfs through four (4) 42-in RCPs. The ultimate detention rate site is about 1.2 ac-ft/ac. The site does not lie in the FEMA 100-year floodplain as shown in **Exhibit 4, Floodplain Map**. Therefore, it is not anticipated that regulatory floodplain fill will be required.

Table 1. Phase I Detention Summary

	Project Name: 237-Acre Gulf Breeze Tract	Date: 10-20-2023		
	Phase I Condition– Pond 1			
	Detention Basin Service Area	68.5 ac		
	Storm Event	**1%**		
		(100-Yr)		
Flow (cfs)	Maximum Outflow Provided	N/A		
Elevation (GEOID 12B)	Design Water Surface Elevation	20.1 ft		
	Modeled Water Surface Elevation	19.4 ft		
Storage	Detention Storage Rate Required	0.75 ac-ft/ac		
	Detention Storage Required	51.4 ac-ft		
	Detention Storage Provided	69.4 ac-ft		

	Phase I – Pond 2			
	Detention Basin Service Area	56.2 ac		
	Storm Event	**50%**	**4%**	**1%**
		(2-Yr)	**(25-Yr)**	**(100-Yr)**
Flow (cfs)	Maximum Outflow Provided	12.5 cfs	102.9 cfs	121.7 cfs
Elevation (GEOID 12B)	Design Water Surface Elevation	20.1 ft		
	Modeled Water Surface Elevation	19.0 ft		
Storage	Detention Storage Rate Required	0.75 ac-ft/ac		
	Detention Storage Required	42.2 ac-ft		
	Detention Storage Provided	79.0 ac-ft		

Table 2. Ultimate Detention Summary

	Project Name: 237-Acre Gulf Breeze Tract	Date: 10-20-2023
	Ultimate Condition – Pond 1	
	Detention Basin Service Area	92 ac
	Storm Event	**1%**
		(100-Yr)
Flow (cfs)	Maximum Outflow Provided	N/A
Elevation (GEOID 12B)	Design Water Surface Elevation	20.1 ft
	Modeled Water Surface Elevation	19.1 ft
Storage	Detention Storage Rate Required	0.75 ac-ft/ac
	Detention Storage Required	69.0 ac-ft
	Detention Storage Provided	66.1 ac-ft

	Ultimate Condition – Pond 2	
	Detention Basin Service Area	85 ac
	Storm Event	**1%**
		(100-Yr)
Flow (cfs)	Maximum Outflow Provided	N/A
Elevation (GEOID 12B)	Design Water Surface Elevation	20.1 ft
	Modeled Water Surface Elevation	18.7 ft
Storage	Detention Storage Rate Required	0.75 ac-ft/ac
	Detention Storage Required	63.8 ac-ft
	Detention Storage Provided	153.2 ac-ft

Table 3. Ultimate Detention Summary (cont'd.)

	Ultimate Condition – Pond 3			
	Detention Basin Service Area	60 ac		
	Storm Event	**50%**	**4%**	**1%**
		(2-Yr)	**(25-Yr)**	**(100-Yr)**
Flow (cfs)	Maximum Outflow Provided	59.0 cfs	93.3 cfs	180.6 cfs
Elevation (GEOID 12B)	Design Water Surface Elevation	20.1 ft		
	Modeled Water Surface Elevation	18.0 ft		
Storage	Detention Storage Rate Required	0.75 ac-ft/ac		
	Detention Storage Required	45.0 ac-ft		
	Detention Storage Provided	61.8 ac-ft		

INTRODUCTION

Project Name and Purpose

The report below presents the drainage analysis and master drainage plan for the development of the Gulf Breeze tract consisting of approximately 237 ac. The planned proposed improvements are intended to provide detention for approximately 142.5 ac that will be classed single-family residential and 15.5 ac that will be commercial. Of the remaining, 25.5 ac will be reserved for parkland and 25 ac for drainage features including swales and detention ponds.

Project Location and Topography

The project is in the City of Hitchcock in Galveston County and is located north of FM 2004, between Mecom Rd and Avenue C. Under current conditions, the site is split into a south-westerly flow pattern (approximately 124.8 ac) and a north-easterly flow pattern (approximately 96.7 ac). The south-westerly flow sheet flows off the site towards Willow Bayou. The north-easterly flow is captured by a few ditches which carry the flow north towards Jay Road Ditch. **Exhibit 1, Location Map** illustrates the project location. **Exhibit 2, Topographic Map** illustrates the topography in the vicinity of the site and the primary drainage features.

Analysis Objective

The purpose of this analysis is to determine the existing drainage characteristic of the project site and propose a solution to mitigate impacts associated with the proposed residential development.

HYDROLOGY AND HYDRAULIC ANALYSIS

Methodology

The Galveston County Drainage District #1 Drainage Criteria Manual was used as a guide to develop some of the parameters used within the analysis. A 1D/2D approach was selected to analyze this development. This option was chosen due to the sheet flow within the vicinity and limited terrain variability. The 1D/2D approach makes it easier to identify these areas which are undetectable in a fully 1D model. HEC-HMS v4.9 was used to develop the hydrologic portions of the analysis. and HEC-RAS v6.3.1 was used to develop

the hydraulic modeling for the project. The direct runoff was developed in HEC-HMS and used as rain on grid into the 2D mesh as boundary conditions. The sections titled **Existing Conditions** and **Proposed Conditions** will detail the specific approach for the existing and proposed conditions.

Existing Conditions

The existing conditions model was modeled as purely 2D rain on grid. This allows us to determine existing conditions flow pattern and water surface elevations that we can compare to the proposed flow patterns once the site is developed and ensure locations where flow patterns are changed, do not cause and adverse impact to surrounding areas.

The existing topography on the project site, contains a high point which carries the northerly portion of the property to drain to the unnamed tributary which ultimately drains to Jay Road Ditch and the southerly portion of the property drains to Willow Bayou. **Exhibit 2, Topographic Map** illustrates the existing topography. There are also offsite flows that enter the property. These offsite flow patterns were determined using the 2D mesh and are accounted for in the proposed model. There are two locations at which offsite flows enter the property. One is located along the northwestern corner property boundary and consists of approximately 34.8 acres (Offsite NW). The other enters the property at the southeast corner and consists of approximately 29 acres (Offsite SE). **Exhibit 3, Existing Drainage Area Map** depicts the existing conditions drainage areas, offsite sheet flow locations, and land use values. There is no 100-year floodplain on the site. **Exhibit 4, Floodplain Map**.

Proposed Conditions

For proposed conditions, the modeled conditions outside of the project site remained the same as existing conditions. However, within the project site, modifications were made to the two phases (Phase I and Ultimate), to accurately capture offsite sheet flow and detention pond routing. The internal project site was converted to 1D unsteady, as opposed to 2D flow areas as they were in the existing conditions. The proposed condition hydrographs were then generated and inserted directly into the detention basin. Hydrographs were developed for the 2-year (50% annual chance event), 25-year (4% annual chance

event), and 100-year (1% annual chance event) storm events. **Appendix A** contains the proposed conditions hydrologic parameters and calculations used in this analysis.

Phase I Impact Analysis

The project will be developed in 2 phases. Phase I will consist of approximately 58 acres of single-family residential development, 15.5 acres of commercial development, 25.5 acres of detention, and 25 acres of park space and open grass. Phase I primarily mitigated by way of two (2) detention ponds. In addition to detention, a combination of channel improvements and sheet flow swales were necessary to mitigate the impacts produced by the proposed development. **Exhibit 5, Phase I Proposed Conditions Drainage Map** depicts phase one conditions drainage areas, offsite sheet flow locations, and land use values.

For Phase I, swales will be required to capture and redirect offsite flows that enter the property under existing conditions. The offsite areas along the eastern boundary are diverted around the development via swales located inside the property. The offsite flow to the northwest (Offsite NW) is captured within a swale that has a bottom width of 10 ft and 3:1 side-slopes and drains north then east to the receiving channel. The offsite flow southeast (Offsite SE) is captured within a swale which will need to extend approximately 6,900 ft upstream, beginning at the receiving channel at the northern boundary of the site. The furthest upstream 500’ will require a 20’ bottom width, the next 700’ will require a 15’ bottom width, and the rest will only require a 10’ bottom width. The locations of each of these sections are called out on **Exhibits 6** and **11**. Both swales are sufficiently sized to convey the offsite flows around the development without impacting adjacent properties. The final on-site mitigation strategy is a channel directing runoff under the commercial tracts and the entrance roadway. To handle sheet flow attempting to flow west at the southern portion of the site, it is recommended that a 20-foot bottom width, trapezoidal channel with 3:1 side-slopes be used to allow the flow to pass the site and avoid adding additional volume to the basins. The channel will then outfall into a ditch that will be 2-foot bottom width with 3:1 side-slopes and outfall to the roadside ditch along FM 2004.

To gain additional depth for the detention ponds, the channel that receives water from the development area and carries it north (North/South Ditch) to the Jay Road Ditch, as well as Jay Road Ditch, will require improvement. As part of Phase I, it is recommended to improve the North/South Ditch to a 5-foot bottom

ditch, 3:1 side slope channel. These improvements should extend up to the outfall of downstream most pond (Pond 2). For the Jay Road Ditch, a pilot channel is recommended. The pilot channel should begin approximately 1,500 feet upstream of Mecom Road where the flowline changes approximately 0.7 feet and extends to the confluence of the North/South Ditch. The pilot channel is modeled as a 20-foot bottom width section with 4:1 side-slopes. The section will daylight at the existing slopes as it intended to gain additional depth, without increasing the top width of Jay Road Ditch. These modifications will also require an improvement to the existing 3-30-inch reinforced concrete pipes (RCPs) at the crossing upstream of Mecom Road. The flowlines existing RCPs will need to be lowered and upsized to 4-42-inch RCPs. Note that the channel improvements outside the development boundary are proposed within the City of Hitchcock right of way, however additional ROW will not be required for the improvements.

The proposed basins are all 3:1 side slope, wet-bottom basins. Ponds 1 will be fully excavated and 2 will be partially excavated to mitigate impacts generated by Phase I of the development. Pond 1 will contain approximately 69.4 ac-ft of volume at an elevation 19.4 ft and Pond 2 will provide approximately 79.0 ac-ft of volume at an elevation of 19.0 ft, for a total of 148.5 ac-ft. Due to sheet flows attempting to cross the site from the east, Phase I will require temporary 50 ft wide, 2 ft deep spillways on the east side of each pond. Pond 1 will require one spillway and Pond 2 will require two. The spillway flowlines will be set at an elevation of approximately 18.0 ft. The top of bank of the basin will be set at an elevation of 20.1 ft. As shown on **Exhibit 6, Phase I Proposed Improvements** illustrates the location of the drainage features required for Phase I. The outfalls for Ponds 1 and 2 will each consist of a single 5 ft x 5 ft RCB. Water surface elevation impacts from the Phase I activities can be seen in **Exhibits 7 through 9**.

Ultimate Conditions Impact Analysis

The ultimate development will consist of an additional 113 ac of development, for a total of developed acreage of 237 ac. **Exhibit 10, Ultimate Conditions Drainage Map** depicts ultimate conditions drainage areas, offsite sheet flow locations, and land use values.

Pond 2 will be completed in this stage and Pond 3 will be developed. This detention basin will capture runoff and discharge into the proposed improved North/South channel, located north of the site. At ultimate build out, Pond 2 will contain 153 ac-ft of volume under an elevation of 18.7 ft and Pond 3 will

provide approximately 61.8 ac-ft of volume under an elevation of 18 ft. The proposed outfall structure for Pond 3 is 4-42-inch RCPs. **Exhibit 11, Ultimate Proposed Improvements** depicts the ultimate improvements for the full buildout of the site.

Verification of no impacts along Willow Bayou, the unnamed tributary, Jay Road Ditch, or to adjacent properties was achieved by comparing the existing versus proposed conditions WSEL's in the overbanks on the 2D mesh within RAS Mapper by subtracting the Existing WSEL from the Proposed WSEL. **Exhibits 12** through **14, WSEL Impacts Map** show these. Note that the hydraulic analysis of the completed development shows post-development improvements of up to half of a foot to the west of the site and up to four (4) inches to the east during the 100-year event. The maximum water surface elevations along Jay Road Ditch are expected to be lowered by up to approximately two (2) inches.

CONCLUSION

Approximately, 281 ac-ft of volume from the 237 acres of development is captured within the three basins at a detention rate of 1.2 ac-ft/ac. The proposed development significantly reduces water surface elevations within the area surrounding the site. The mitigation plan limits the proposed outflows from the site to Willow Bayou, the unnamed tributary, and Jay Road Ditch, such that the development causes no adverse impacts to neighboring properties for the 2-, 25-, and 100-year storm on the 2D mesh areas as shown in WSEL Impacts in **Exhibits 12** through **14**.

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Legend

- Stream Centerlines
- Project Area

Unnamed Tributary to Highland Bayou
N Morningview St
S Morningview St
Avenue B
Jay Rd
Jay Road Ditch
Avenue B 1/2
Greenbriar St E
Commander Roland Dr
Delesandro
Sunrise Creek
Pigeon Dr
Blimp Base Blvd
E Cleary
32nd 1/2 St
Sandy Ln
E Gulfway
Willow Bayou
Unnamed Tributary to Willow Bayou
200 4
6
35
288
610
Houston
Baytown
Pasadena
Missouri City
Pearland
League City
Texas City
Galveston
Angleton
Lake Jackson

N

0 1,000
Feet

JOB NO.	41304-00
DATE	Nov 2023
DESIGNER	IWH
CHECKED	MYS
DRAWN	IWH
SHEET	1.0

Location Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

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Legend

- Stream Centerlines
- Project Area

LiDAR (ft)

- High : 25.616
- Low : -10.03

Jay Road Ditch
Sunrise Creek
Willow Bayou
Unnamed Tributary to Willow Bayou
N Morningview St
S Morningview St
Schanzer Rd
Jay Rd
Devries Rd
Tacquard Dr
Creekside D
Delesandro
Pigeon Dr
Commander Roland Dr
Blimp Base Blvd
Avenue B
Avenue B 1/2
Avenue C
Avenue E
Gretchen St E
32nd 1/2 St
Sandy Ln
2004

N

0 1,000
Feet

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Topographic Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

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Legend

- Stream Centerlines
- Drainage Areas - Onsite
- Drainage Areas - Offsite

Land Use - Existing

- Single Family Residential
- Unimproved Area
- Open Water

Jay Road Ditch
Offsite NW
Offsite SE
Commander Roland Dr
Pigeon Dr
Sunrise
Willow Bayou
Avenue G
200 A
N
0 600
Feet

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Existing Drainage Area Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

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Legend

- Stream Centerlines
- Project Area

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee
- Area with Risk Due to Levee

Zone AE (EL 15)
Zone AE (EL 14)
Zone AE (EL 13)
Zone AE (EL 13)
Zone AE (EL 13)
Zone AE (EL 13)
Jay Road Ditch
Sunrise Creek
Willow Bayou
Unnamed Tributary to Willow Bayou
N Morningview St
S Morningview St
Schanzer Rd
Jay Rd
Devnes Rd
Blimp Base Blvd
Commander Roland Dr
Pigeon Dr
Delesandro
Creekside D
Avenue E
Avenue G
Greenbriar St E
32nd 1/2 St
Sandy Ln
200 4
N
0 1,000 Feet

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Floodplain Map

GULF BREEZE DEVELOPMENT
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Legend

- Stream Centerlines
- Drainage Areas - Onsite
- Drainage Areas - Offsite

Land Use - Phase I

- Commercial Area
- Park/Roadway Grass
- Single Family Residential
- Unimproved Area
- Open Water

Jay Road Ditch
Willow Bayou
Offsite NW
DA-3
DA-2
DA-1
Offsite SE
Commander Roland Dr
Pigeon Dr
Sunrise
Ln
Avenue C
200 A

N

0 600
Feet

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Phase I Conditions Drainage Area Map

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Legend

- Stream Centerlines
- Phase I Improvements
- Drainage Areas - Offsite
- Drainage Areas - Onsite

Jay Road Ditch Upstream Culvert
4 - 42" RCP

Jay Road Ditch Improvements
Bottom Width: 20'
Side-slope: 4:1

Receiving Channel Improvements
Bottom Width: 5'
Side-slope: 3:1

Offsite NW Swale
Bottom Width: 5'
Side-slope: 4:1

Receiving Channel Improvements Extension
Bottom Width: 5'
Side-slope: 3:1

Offsite SE Swale Part 3
Bottom Width: 10'
Side-slope: 3:1

Pond 2 Outfall
5' x 5' RCB

Pond 2
Equalizer Weir #1

Pond 2
Equalizer Weir #2

Pond 2
Volume: 79.0 ac-ft @ 19.0'

Pond 1 Outfall
5' x 5' RCB

Pond 1
Equalizer Weir

Pond 1
Volume: 69.4 ac-ft @ 19.4'

Entrance Road Crossing
Conspan Arch
Width: 16'
Height: 3.5'

Entrance Road Crossing
Bottom Width: 20'
Side-slope: 3:1

Offsite SE Swale Part 2
Bottom Width: 15'
Side-slope: 3:1

SW Swale
Bottom Width: 2'
Side-slope: 4:1

Offsite SE Swale Part 1
Bottom Width: 20'
Side-slope: 3:1

Offsite NW
DA-3
DA-2
DA-1
Offsite SE

Jay Road Ditch
Willow Bayou
Commander Roland Dr
Pigeon Dr
Sunrise
Avenue C
200 A

N

0 600
Feet

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Phase 1 Proposed Improvements Map

GULF BREEZE DEVELOPMENT
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N

S Morningview St
Schanzer Rd
Jay Rd
Avenue B
Avenue C 1/2
Jay Road Ditch
Jay Road Ditch
Jay Road Ditch
Greenbriar St
Commander Roland Dr
Blimp Base Blvd
Sunrise Creek
Pigeon Dr
Willow Bayou
32nd 1/2 St
Sandy Ln
Avenue G
290 4

Legend

- Stream Centerlines
- Project Site

2-Year WSEL Impacts (ft)

- < -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - -0.07
- -0.07 - -0.06
- -0.06 - -0.04
- -0.04 - 0.04
- 0.04 - 0.06
- 0.06 - 0.07
- 0.07 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- > 0.5

0 800
Feet

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CHECKED	MYS
DRAWN	IWH
SHEET	7.0

2-Year Phase I WSEL Impacts Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

PAPE-DAWSON ENGINEERS
HOUSTON | SAN ANTONIO | AUSTIN | DALLAS | FORT WORTH
10350 RICHMOND AVE, STE 200 | HOUSTON, TX 77042 | 713.428.2400
TEXAS ENGINEERING FIRM #470 | TEXAS SURVEYING FIRM #10193974

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N

S Morningview St
Schanzer Rd
Jay Rd
Avenue B
Avenue C 1/2
Greenbriar Stc
Jay Road Ditch
Jay Road Ditch
Jay Road Ditch
Blimp Base Blvd
Commander Roland Dr
Sunrise Creek
Pigeon Dr
Willow Bayou
32nd 1/2 St
Sandy Ln
Avenue C
200 4

Legend

- Stream Centerlines
- Project Site

25-Year WSEL Impacts (ft)

- < -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - -0.07
- -0.07 - -0.06
- -0.06 - -0.04
- -0.04 - 0.04
- 0.04 - 0.06
- 0.06 - 0.07
- 0.07 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- > 0.5

0 800
Feet

JOB NO.	41304-00
DATE	Nov 2023
DESIGNER	IWH
CHECKED	MYS
DRAWN	IWH
SHEET	8.0

25-Year Phase I WSEL Impacts Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

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N

S Morningview St
Schanzer Rd
Jay Rd
Avenue B
Avenue C 1/2
Jay Road Ditch
Jay Road Ditch
Jay Road Ditch
Greenbriar Blvd
Blimp Base Blvd
Commander Roland Dr
Sunrise Creek
Pigeon Dr
Willow Bayou
Willow Bayou
32nd 1/2 St
Sandy Ln
Avenue C
200 4

Legend

- Stream Centerlines
- Project Site

100-Year WSEL Impacts (ft)

- < -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - -0.07
- -0.07 - -0.06
- -0.06 - -0.04
- -0.04 - 0.04
- 0.04 - 0.06
- 0.06 - 0.07
- 0.07 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- > 0.5

0 800
Feet

JOB NO.	41304-00
DATE	Nov 2023
DESIGNER	IWH
CHECKED	MYS
DRAWN	IWH
SHEET	9.0

100-Year Phase I WSEL Impacts Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

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Legend

- Stream Centerlines
- Drainage Areas - Onsite
- Drainage Areas - Offsite

Land Use - Ultimate

- Commercial Area
- Park/Roadway Grass
- Single Family Residential
- Unimproved Area
- Open Water

Jay Road Ditch
Offsite NW
DA-3
DA-2
DA-1
Offsite SE
Willow Bayou
Willow Bayou
Commander Roland Dr
Pigeon Dr
Sunrise
Avenue G
2 St
Ln
200 4
N
0 600
Feet

JOB NO.	41304-00
DATE	Nov 2023
DESIGNER	IWH
CHECKED	MYS
DRAWN	IWH
SHEET	10.0

Ultimate Conditions Drainage Area Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

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Legend

- Stream Centerlines
- Ultimate Improvements
- Phase I Improvements
- Drainage Areas - Offsite
- Drainage Areas - Onsite

Jay Road Ditch Upstream Culvert
4 - 42" RCP

Jay Road Ditch

Jay Road Ditch Improvements
Bottom Width: 20'
Side-slope: 4:1

Receiving Channel Improvements
Bottom Width: 5'
Side-slope: 3:1

Commander Roland Dr

Pond 3 Outfall
4 - 42" RCP

Offsite NW

Willow Bayou

Offsite NW Swale
Bottom Width: 5'
Side-slope: 4:1

Pond 3
Volume: 61.8 ac-ft @ 18.0'

Phase I Receiving Channel

Pigeon Dr

DA-3

Offsite SE Swale Part 3
Bottom Width: 10'
Side-slope: 3:1

Sunrise

Pond 2 Outfall
5' x 5' RCB

Phase I Pond 2

DA-2

Pond 2
Volume: 153.2 ac-ft @ 18.7'

Pond 1 Outfall
5' x 5' RCB

Pond 1
Volume: 66.1 ac-ft @ 19.1'

Offsite SE

DA-1

Entrance Road Crossing
Conspan Arch
Width: 16'
Height: 3.5'

200 4

Entrance Road Crossing
Bottom Width: 20'
Side-slope: 4:1

Offsite SE Swale Part 2
Bottom Width: 15'
Side-slope: 3:1

SW Swale
Bottom Width: 2'
Side-slopes: 4:1

Offsite SE Swale Part 1
Bottom Width: 20'
Side-slope: 3:1

Avenue G

N

0 600
Feet

JOB NO.	41304-00
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CHECKED	MYS
DRAWN	IWH
SHEET	11.0

Ultimate Proposed Improvements Map

GULF BREEZE DEVELOPMENT
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N

S Morningview St
Schanzer Rd
Jay Rd
Avenue B
Avenue C 1/2
Greenbriar St
Jay Road Ditch
Jay Road Ditch
Jay Road Ditch
Blimp Base Blvd
Sunrise Creek
Willow Bayou
Willow Bayou
32nd 1/2 St
Sandy Ln
Avenue C
260
Project Site

Legend

- Stream Centerlines
- Project Site

2-Year WSEL Impacts (ft)

- < -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - -0.07
- -0.07 - -0.06
- -0.06 - -0.04
- -0.04 - 0.04
- 0.04 - 0.06
- 0.06 - 0.07
- 0.07 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- > 0.5

0 800
Feet

JOB NO.	41304-00
DATE	Nov 2023
DESIGNER	IWH
CHECKED	MYS
DRAWN	IWH
SHEET	12.0

2-Year Ultimate WSEL Impacts Map

GULF BREEZE DEVELOPMENT
CITY OF HITCHCOCK, GALVESTON COUNTY, TX

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N

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Jay Road Ditch
Jay Road Ditch
Jay Road Ditch
Blimp Base Blvd
Sunrise Creek
Willow Bayou
Willow Bayou
32nd 1/2 St
Sandy Ln
Avenue C
200 4

Legend

- Stream Centerlines
- Project Site

25-Year WSEL Impacts (ft)

- < -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - -0.07
- -0.07 - -0.06
- -0.06 - -0.04
- -0.04 - 0.04
- 0.04 - 0.06
- 0.06 - 0.07
- 0.07 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- > 0.5

0 800
Feet

JOB NO.	41304-00
DATE	Nov 2023
DESIGNER	IWH
CHECKED	MYS
DRAWN	IWH
SHEET	13.0

25-Year Ultimate WSEL Impacts Map

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S Morningview St
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Greenbriar Ste
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Jay Road Ditch
Jay Road Ditch
Blimp Base Blvd
Sunrise Creek
Willow Bayou
Willow Bayou
32nd 1/2 St
Sandy Ln
Avenue G
200 4

Legend

- Stream Centerlines
- Project Site

100-Year WSEL Impacts (ft)

- < -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - -0.07
- -0.07 - -0.06
- -0.06 - -0.04
- -0.04 - 0.04
- 0.04 - 0.06
- 0.06 - 0.07
- 0.07 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- > 0.5

0 800
Feet

JOB NO.	41304-00
DATE	Nov 2023
DESIGNER	IWH
CHECKED	MYS
DRAWN	IWH
SHEET	14.0

100-Year Ultimate WSEL Impacts Map

GULF BREEZE DEVELOPMENT
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TEXAS ENGINEERING FIRM #470 | TEXAS SURVEYING FIRM #10193974

APPENDIX A

Offsite Drainage Areas										
Drainage Area	Area	Runoff Coefficient	Impervious Cover	Time of Concentration	Storage Coefficient			Peak Flow Rates		
					2-year	10-year	100-year	2-year	10-year	100-year
	(ac)		(%)	(hr)	(hr)			(cfs)		
Offsite NW	34.8	0.32	18.83	0.85	2.758	3.163	2.658	27.88	41.64	82.87
Offsite SE	29.0	0.37	17.62	0.27	0.950	1.030	1.178	49.87	73.02	112.26
Development Drainage Areas										
Phase I Condition Drainage Areas										
Drainage Area	Area	Runoff Coefficient	Impervious Cover	Time of Concentration	Storage Coefficient			Peak Flow Rates		
					2-year	10-year	100-year	2-year	10-year	100-year
	(ac)	(-)	(%)	(hr)	(hr)			(cfs)		
DA-1	68.5	0.68	67.16	0.17	0.216	0.211	0.110	265.58	389.83	749.73
DA-2	56.2	0.60	55.32	0.17	0.284	0.281	0.162	192.88	283.12	544.50
Ultimate Condition Drainage Areas										
Drainage Area	Area	Runoff Coefficient	Impervious Cover	Time of Concentration	Storage Coefficient			Peak Flow Rates		
					2-year	10-year	100-year	2-year	10-year	100-year
	(ac)		(%)	(hr)	(hr)			(cfs)		
DA-1	92.3	0.67	66.14	0.24	0.300	0.299	0.164	303.84	444.93	854.46
DA-2	85.0	0.70	68.26	0.17	0.201	0.197	0.098	338.67	497.10	956.04
DA-3	59.9	0.70	68.58	0.20	0.238	0.235	0.122	220.09	322.51	619.37