

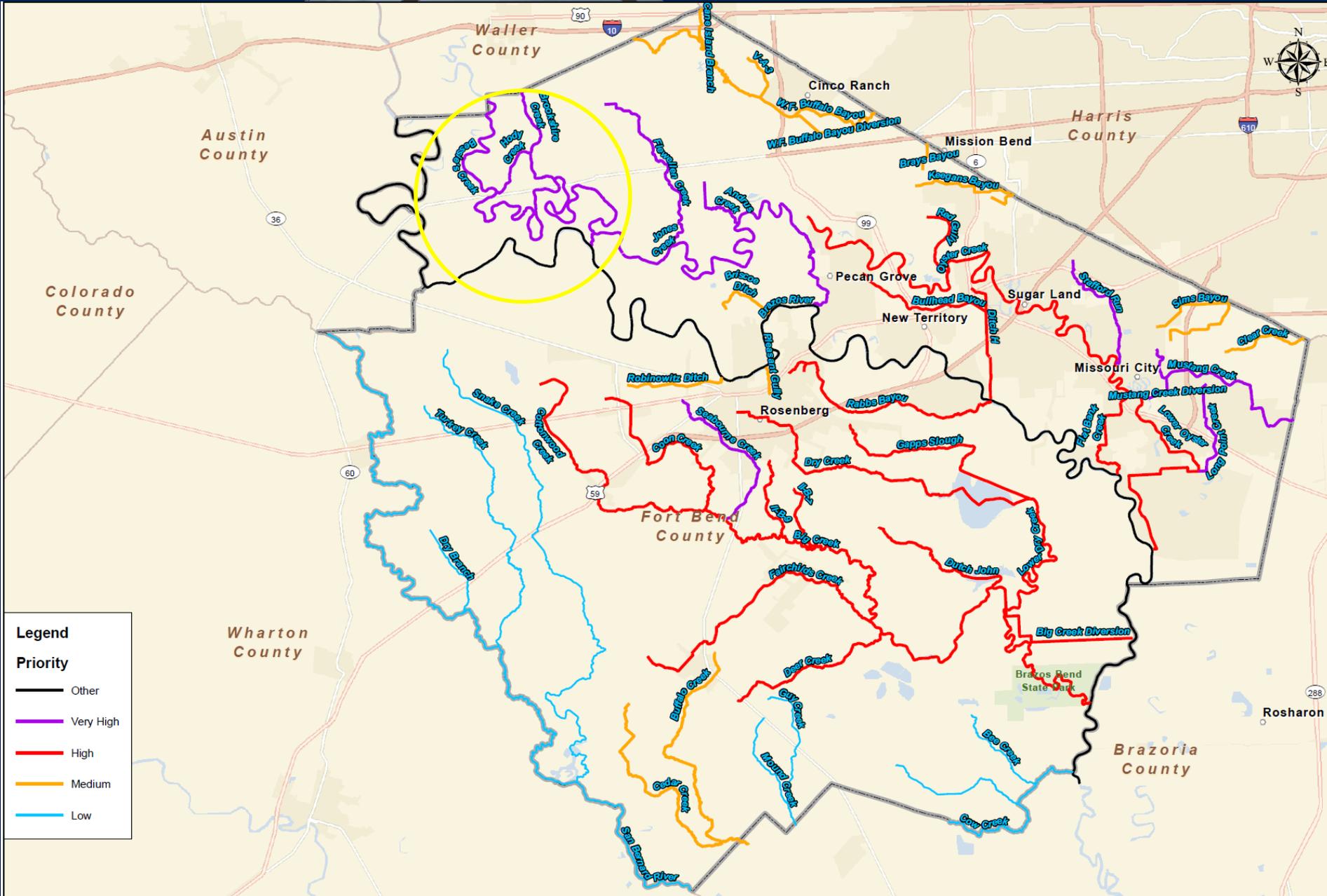
# FORT BEND COUNTY WATERSHED STUDY

## Bessie's Creek Watershed

Mark Vogler

July 30, 2020

# Develop and Update Master Drainage Plans



**Legend**

**Priority**

- Other
- Very High
- High
- Medium
- Low

# Overview

- ▣ Based on the draft result of Bessie's Creek study submittal (May 1, 2020)
- ▣ Study consultant: Freese & Nichols, Inc.
- ▣ Hydrology – HEC-HMS 4.3
- ▣ Hydraulic – HRC-RAS 5.07
  - 1D 2D unsteady flow

## MASTER DRAINAGE PLAN FOR FORT BEND COUNTY, TEXAS

### Bessie's Creek

May 1, 2020

Prepared for:

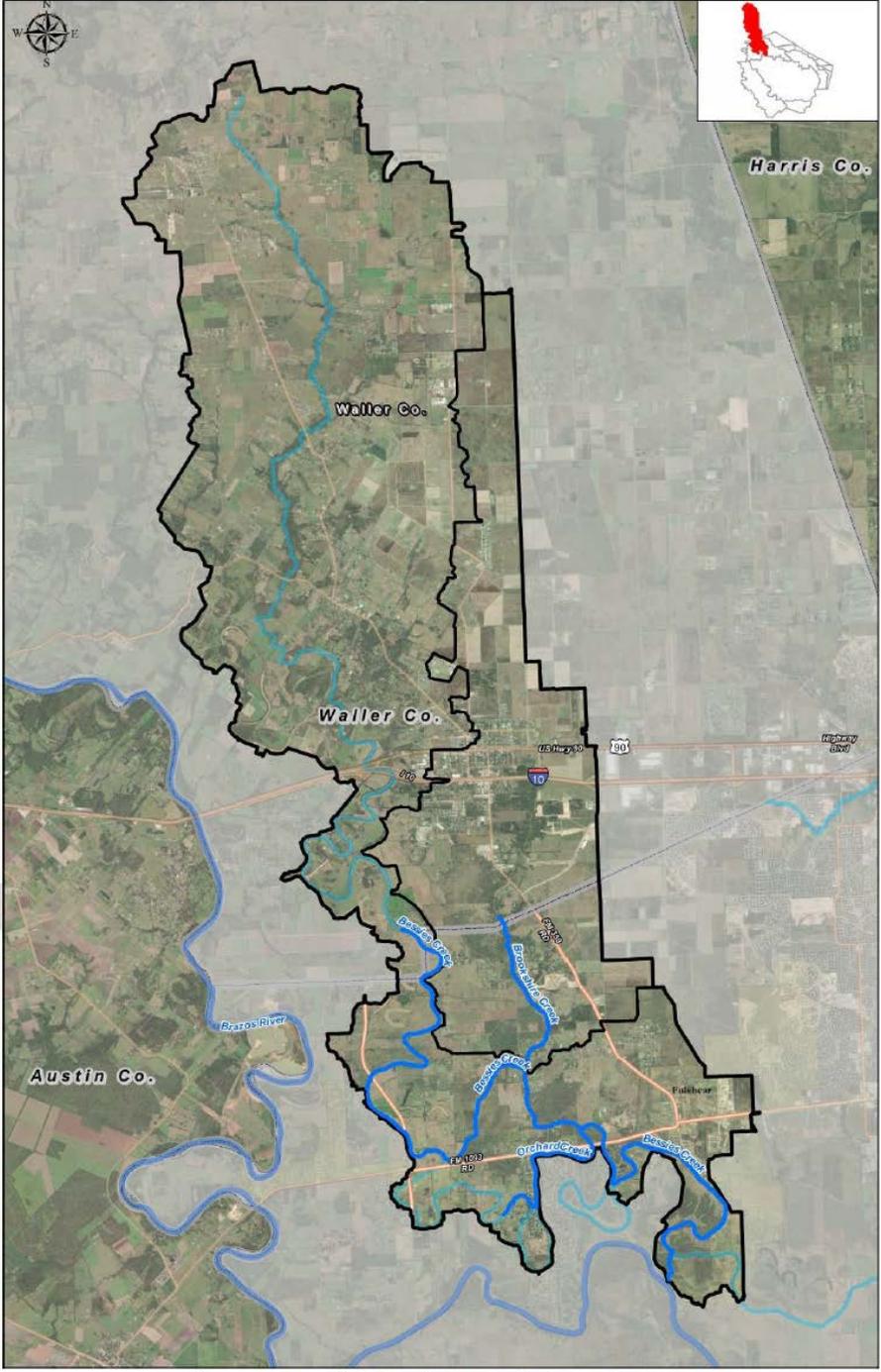
**Fort Bend County Drainage District**



Prepared by:



**FREESE AND NICHOLS, INC.**  
10497 Town and Country Way, Suite 500  
Houston, Texas 77024  
713-600-6800



# Overview

- ❑ Watershed 106 square miles (29 sqmi in Fort Bend County, 77 sqmi in Waller county)
- ❑ Approximately 18.72 miles long with 6.52 miles of tributaries
- ❑ Study to evaluate existing conditions and future channel sizing for 100yr flow
- ❑ Atlas Rainfall 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr and 500-yr storms
- ❑ 1D reaches and 2D area hydraulic model to evaluate the water surface elevation and floodplain
- ❑ NAVD 88

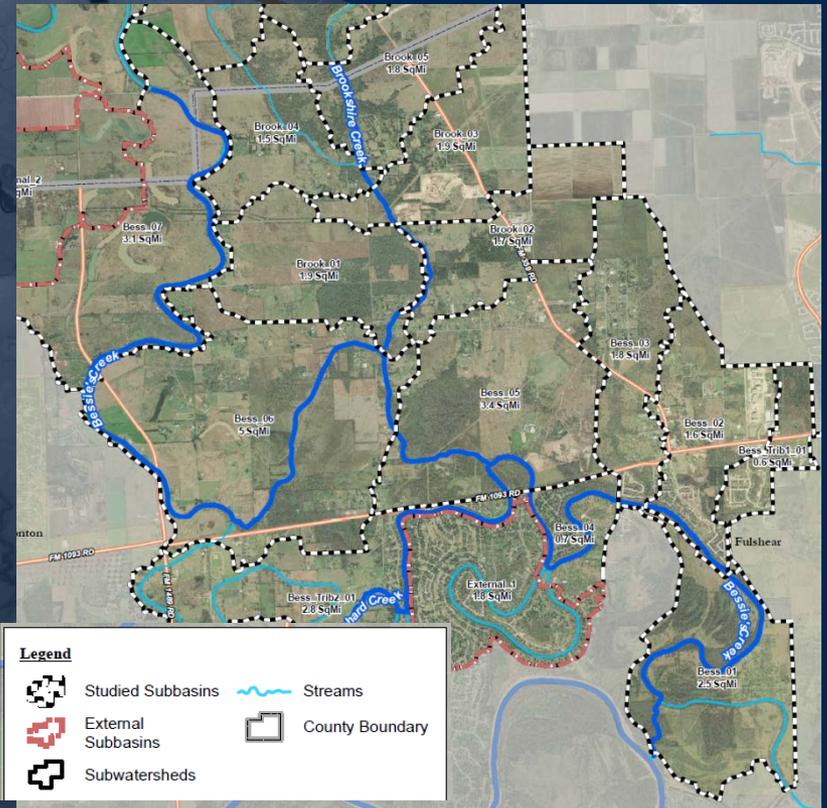
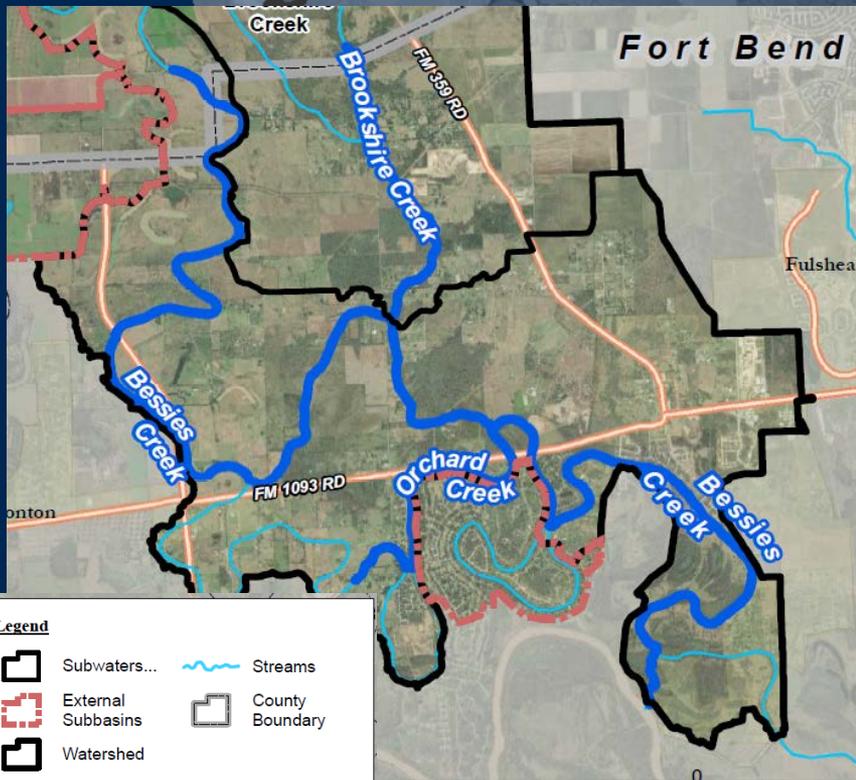
Table B2. Summary of Discharges

Subbasin	Area (mi <sup>2</sup> )	2-yr Qp (cfs)	5-yr Qp (cfs)	10-yr Qp (cfs)	25-yr Qp (cfs)	50-yr Qp (cfs)	100-yr Qp (cfs)	500-yr Qp (cfs)
<b>Bessie's Creek</b>								
Bess_01	2.49	410	566	726	976	1,207	1,472	2,214
Bess_02	1.64	561	742	919	1,189	1,430	1,705	2,467
Bess_03	1.78	537	720	900	1,175	1,420	1,702	2,485
Bess_04	0.70	241	321	399	517	621	742	1,075
Bess_05	3.35	609	833	1,063	1,420	1,749	2,125	3,179
Bess_06	5.00	731	1,013	1,302	1,755	2,177	2,659	4,014
Bess_07	3.08	506	693	884	1,182	1,458	1,775	2,662
Bess_08	3.50	551	764	971	1,294	1,574	1,901	2,839
Bess_09	2.13	498	680	854	1,119	1,343	1,601	2,360
Bess_10	3.16	363	513	662	897	1,104	1,345	2,033
Bess_11	2.39	413	574	729	971	1,180	1,423	2,125
Bess_12	28.28	1,759	2,564	3,385	4,700	5,879	7,257	11,099
Bess_Trib1_01	0.61	314	409	499	632	747	876	1,231
Bess_Trib2_01	2.84	436	600	768	1,029	1,273	1,552	2,335
Bess_Trib3_01	2.28	664	899	1,119	1,451	1,726	2,039	2,977
Bess_Trib4_01	5.36	278	443	621	955	1,273	1,689	3,013
Bess_Trib5_01	2.18	294	410	523	702	858	1,040	1,561
Bess_Trib6_01	1.16	93	145	200	300	394	514	891
Bess_Trib6_02	2.10	361	503	641	856	1,041	1,256	1,878
Bess_Trib6_03	3.13	172	270	375	569	753	989	1,732
Bess_Trib7_01	1.82	444	609	764	1,001	1,199	1,430	2,106
<b>Brookshire Creek</b>								
Brook_01	1.91	397	544	692	922	1,131	1,373	2,044
Brook_02	1.72	151	235	325	491	654	863	1,513
Brook_03	1.92	169	257	352	523	691	903	1,557
Brook_04	1.54	409	553	695	915	1,114	1,340	1,972
Brook_05	1.83	490	663	835	1,097	1,334	1,606	2,362
Brook_06	2.36	521	713	898	1,181	1,422	1,698	2,511
Brook_07	2.91	617	845	1,063	1,402	1,690	2,022	2,994
Brook_08	9.38	383	614	864	1,334	1,786	2,377	4,255
Brook_Trib1_01	3.20	1,020	1,371	1,698	2,192	2,601	3,068	4,449
<b>External</b>								
External_1	1.84	347	469	593	785	964	1,167	1,738
External_2	3.03	344	488	631	856	1,055	1,287	1,949
External_3	2.42	298	422	543	735	904	1,101	1,662
External_4	4.28	429	611	794	1,083	1,340	1,639	2,489
External_5	1.48	217	305	390	524	641	776	1,167

Existing  
Conditions

Summary of  
Discharge

# Bessie's Creek Watershed



# Hydrology Parameter – Atlas 14 Rainfall

**Table 1. Rainfall Distribution used in this Drainage Master Plan (Fort Bend County)**

Duration	Rainfall Depth (in)						
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	500 yr
5 min	0.59	0.73	0.84	1.00	1.13	1.26	1.57
15 min	1.19	1.46	1.69	2.00	2.25	2.50	3.11
1 hr	2.26	2.78	3.22	3.83	4.30	4.80	6.20
2 hr	2.83	3.53	4.19	5.16	5.99	6.91	9.45
3 hr	3.17	4.00	4.82	6.08	7.19	8.47	12.00
6 hr	3.77	4.86	5.97	7.72	9.33	11.20	16.30
12 hr	4.40	5.79	7.20	9.41	11.40	13.80	20.50
1 day	5.09	6.82	8.55	11.20	13.70	16.50	24.50

**Table 2. Rainfall Distribution used in this Drainage Master Plan (Waller County)**

Duration	Rainfall Depth (in)						
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	500 yr
5 min	0.56	0.69	0.80	0.94	1.05	1.16	1.43
15 min	1.13	1.38	1.59	1.87	2.08	2.29	2.82
1 hr	2.13	2.61	3.00	3.54	3.94	4.36	5.58
2 hr	2.65	3.33	3.93	4.78	5.45	6.20	8.52
3 hr	2.96	3.79	4.53	5.64	6.54	7.57	10.80
6 hr	3.51	4.59	5.62	7.18	8.51	10.10	14.80
12 hr	4.09	5.42	6.73	8.76	10.50	12.60	18.70
1 day	4.72	6.32	7.93	10.50	12.80	15.40	22.40

# Hydrology Parameter

## ▣ Loss Method - Green Ampt

**Table 3. Green and Ampt Loss Parameters Developed for Fort Bend County**

Zone	Initial Canopy Storage (%)	Max Canopy Storage (in)	Crop Coefficient	Initial Loss (in)	Saturated Content	Suction (in)	Hydraulic Connectivity (in/hr)
Zone 1	0	0.1	1	0.075	0.46	12.45	0.024

## ▣ Transform Methods

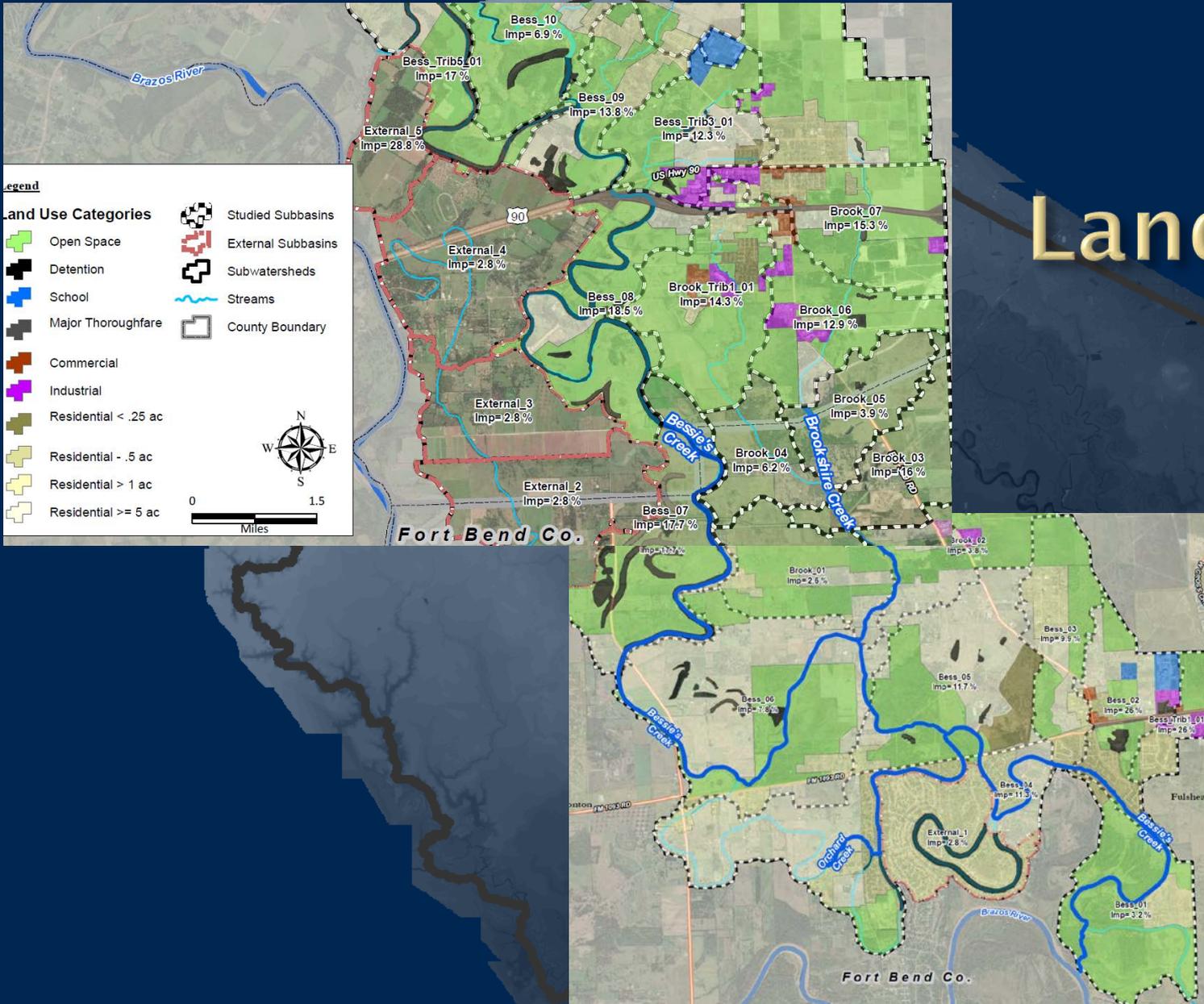
- ▣ Basin Development Factor (BDF) method to determine the Clark Unit Hydrograph parameters

# Hydrology Parameter

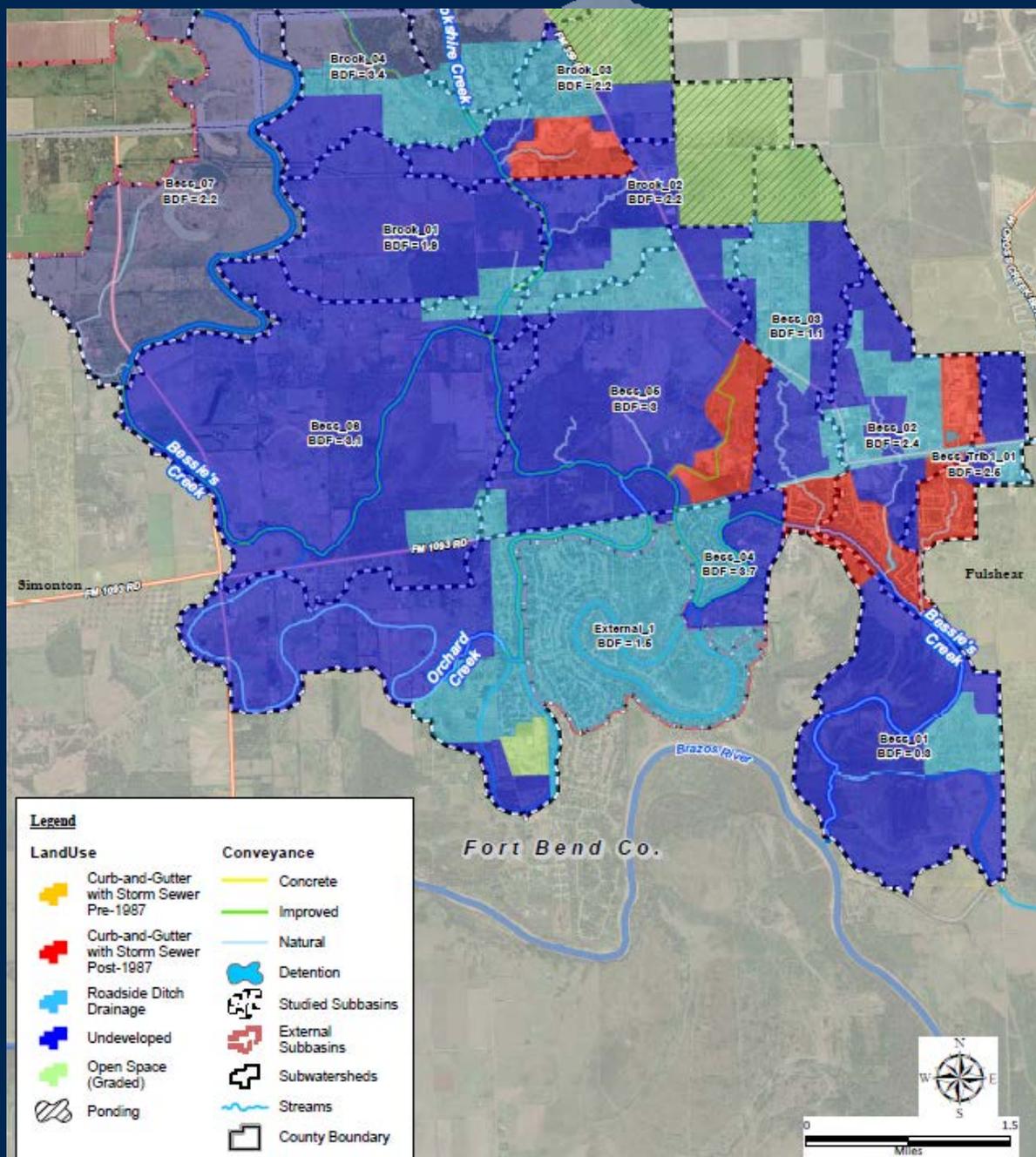
Table B1. Hydrologic Parameters Summary Table

Subbasin	Area (acres)	Area (mi2)	Composite BDF	Channel Slope (ft./mi)	Overland Slope (ft./mi.)	Slope Adj.	Detention Rate (ac-ft/mi2)	Detention Adj.	Ponding (%)	Imp (%)	TC'' (hrs)	R'' (hrs)	Ponding Adjustments for Storage Values (R'')						
				S	So	Ks	DR	Cf	DPP				50% (2-Yr)	20% (5-Yr)	10% (10-Yr)	4% (25-Yr)	2% (50-Yr)	1% (100-Yr)	0.2% (500-Yr)
<b>Bessie's Creek</b>																			
Bess_01	1594	2.49	0.28	3.26	23.21	0.82	0.00	1.00	0.00	3.21	3.48	9.36	9.36	9.36	9.36	9.36	9.36	9.36	9.36
Bess_02	1047	1.64	2.38	10.99	35.70	0.56	33.88	1.00	0.00	25.99	1.61	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22
Bess_03	1141	1.78	1.13	25.15	18.83	0.53	0.00	1.00	18.00	9.88	1.78	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76
Bess_04	449	0.70	3.66	1.79	32.75	0.86	0.00	1.00	0.00	11.26	1.55	4.07	4.07	4.07	4.07	4.07	4.07	4.07	4.07
Bess_05	2147	3.35	3.01	1.27	31.81	0.92	0.00	1.00	0.00	11.70	3.42	8.58	8.58	8.58	8.58	8.58	8.58	8.58	8.58
Bess_06	3197	5.00	3.06	0.81	15.94	1.00	0.00	1.00	0.00	7.77	4.37	10.76	10.76	10.76	10.76	10.76	10.76	10.76	10.76
Bess_07	1974	3.08	2.21	0.14	12.54	1.00	0.00	1.00	0.00	17.68	3.85	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86
Bess_08	2239	3.50	3.11	0.35	23.80	1.00	0.00	1.00	0.00	18.47	3.74	9.33	9.33	9.33	9.33	9.33	9.33	9.33	9.33
Bess_09	1364	2.13	0.49	9.37	40.64	0.56	0.00	1.00	0.00	13.80	2.18	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
Bess_10	2020	3.16	0.12	0.29	32.00	1.00	0.00	1.00	0.00	6.87	4.76	12.71	12.71	12.71	12.71	12.71	12.71	12.71	12.71
Bess_11	1529	2.39	0.13	2.72	54.83	0.71	0.00	1.00	13.00	7.21	3.01	8.12	8.12	8.12	8.12	8.12	8.12	8.12	8.12
Bess_12	18099	28.28	0.17	3.92	21.71	0.80	1.21	1.00	5.00	3.31	9.61	23.64	23.64	23.64	23.64	23.64	23.64	23.64	23.64
Bess Trib1_01	392	0.61	2.53	22.44	25.93	0.49	0.00	1.00	0.00	26.05	0.92	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51
Bess Trib2_01	1817	2.84	1.39	1.40	15.92	1.00	0.00	1.00	0.00	14.34	4.02	10.52	10.52	10.52	10.52	10.52	10.52	10.52	10.52
Bess Trib3_01	1458	2.28	1.75	19.61	31.32	0.48	0.00	1.00	0.00	12.33	1.71	4.48	4.48	4.48	4.48	4.48	4.48	4.48	4.48
Bess Trib4_01	3429	5.36	1.00	14.13	13.13	0.68	0.00	1.00	43.00	2.60	3.69	9.52	31.46	27.89	25.75	22.63	20.81	18.92	15.39
Bess Trib5_01	1393	2.18	0.03	0.00	15.61	1.00	0.00	1.00	0.00	16.97	4.10	11.12	11.12	11.12	11.12	11.12	11.12	11.12	11.12
Bess Trib6_01	740	1.16	0.00	5.41	24.62	0.73	0.00	1.00	32.00	3.43	2.31	6.39	19.66	17.58	16.31	14.45	13.36	12.22	10.07
Bess Trib6_02	1343	2.10	0.00	5.62	24.01	0.73	0.00	1.00	0.00	2.65	2.95	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02
Bess Trib6_03	2002	3.13	0.25	6.84	11.50	0.82	0.00	1.00	25.00	2.43	3.82	10.17	29.49	26.54	24.71	22.05	20.48	18.83	15.70
Bess Trib7_01	1166	1.82	0.28	11.57	37.58	0.54	0.00	1.00	0.00	5.09	2.00	5.44	5.44	5.44	5.44	5.44	5.44	5.44	5.44
<b>Brookshire Creek</b>																			
Brook_01	1223	1.91	1.88	5.39	12.71	0.84	0.00	1.00	0.00	2.56	2.72	7.15	7.15	7.15	7.15	7.15	7.15	7.15	7.15
Brook_02	1101	1.72	2.18	4.00	28.94	0.75	0.00	1.00	44.00	3.79	2.27	5.96	19.80	17.54	16.20	14.23	13.08	11.88	9.65
Brook_03	1228	1.92	2.25	2.94	20.51	0.86	0.00	1.00	27.00	15.96	2.69	7.03	20.75	18.63	17.33	15.43	14.31	13.13	10.91
Brook_04	985	1.54	3.42	2.87	25.39	0.83	0.00	1.00	0.00	6.21	2.12	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43
Brook_05	1172	1.83	1.84	5.94	39.82	0.64	0.00	1.00	5.00	3.95	2.04	5.37	5.37	5.37	5.37	5.37	5.37	5.37	5.37
Brook_06	1511	2.36	2.12	5.47	30.63	0.69	0.00	1.00	0.00	12.85	2.40	6.23	6.23	6.23	6.23	6.23	6.23	6.23	6.23
Brook_07	1864	2.91	3.60	6.17	14.02	0.80	0.00	1.00	17.00	15.31	2.64	6.57	6.57	6.57	6.57	6.57	6.57	6.57	6.57
Brook_08	6005	9.38	3.58	5.01	5.68	0.98	5.25	1.00	38.00	4.19	5.36	12.67	40.64	36.15	33.45	29.50	27.19	24.78	20.27
Brook Trib1_01	2049	3.20	3.59	16.07	39.79	0.48	11.51	0.99	0.00	14.33	1.63	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03
<b>External</b>																			
External_1	1178	1.84	1.50	0.00	0.00	1.00	0.00	1.00	0.00	28.76	3.31	8.78	8.78	8.78	8.78	8.78	8.78	8.78	8.78
External_2	1939	3.03	0.00	0.00	0.00	1.00	0.00	1.00	0.00	2.80	4.73	12.68	12.68	12.68	12.68	12.68	12.68	12.68	12.68
External_3	1551	2.42	0.00	0.00	0.00	1.00	0.00	1.00	0.00	2.80	4.31	11.64	11.64	11.64	11.64	11.64	11.64	11.64	11.64
External_4	2740	4.28	0.00	0.00	0.00	1.00	0.00	1.00	0.00	2.80	5.47	14.49	14.49	14.49	14.49	14.49	14.49	14.49	14.49
External_5	949	1.48	0.00	0.00	0.00	1.00	0.00	1.00	0.00	2.80	3.50	9.63	9.63	9.63	9.63	9.63	9.63	9.63	9.63

# Land use



# BDF Calculations





# Hydraulic Parameter 2-D Roughness Coefficients

**Table 5. 2D Manning's n Values**

Land Use	HGAC Code	Manning's n Values
Open Water	1	0.02
Developed High Intensity	2	0.03
Developed Med Intensity	3	0.12
Developed Low Intensity	4	0.1
Developed Open Space	5	0.05
Barren Lands	6	0.03
Forest/Shrubs	7	0.15
Pasture/Grasslands	8	0.08
Cultivated Crops	9	0.08
Wetlands	10	0.15
Building	N/A	10
Pavement	N/A	0.02

**Table 6. Manning's n Value Override Regions**

Region	Manning's n Values
Region 1	0.04
Brookshire Wetland	0.08
Orchard Wetland	0.065
Orchard Wetland 2	0.065
Orchard Wetland 3	0.06
Channel 1	0.065
Oxbow	0.08
Oxbow 2	0.08
Lake	0.01
Lake 2	0.01
Twinwood Wetland	0.08
Twinwood Wetland 2	0.08
Fence	0.3

# Analysis Results

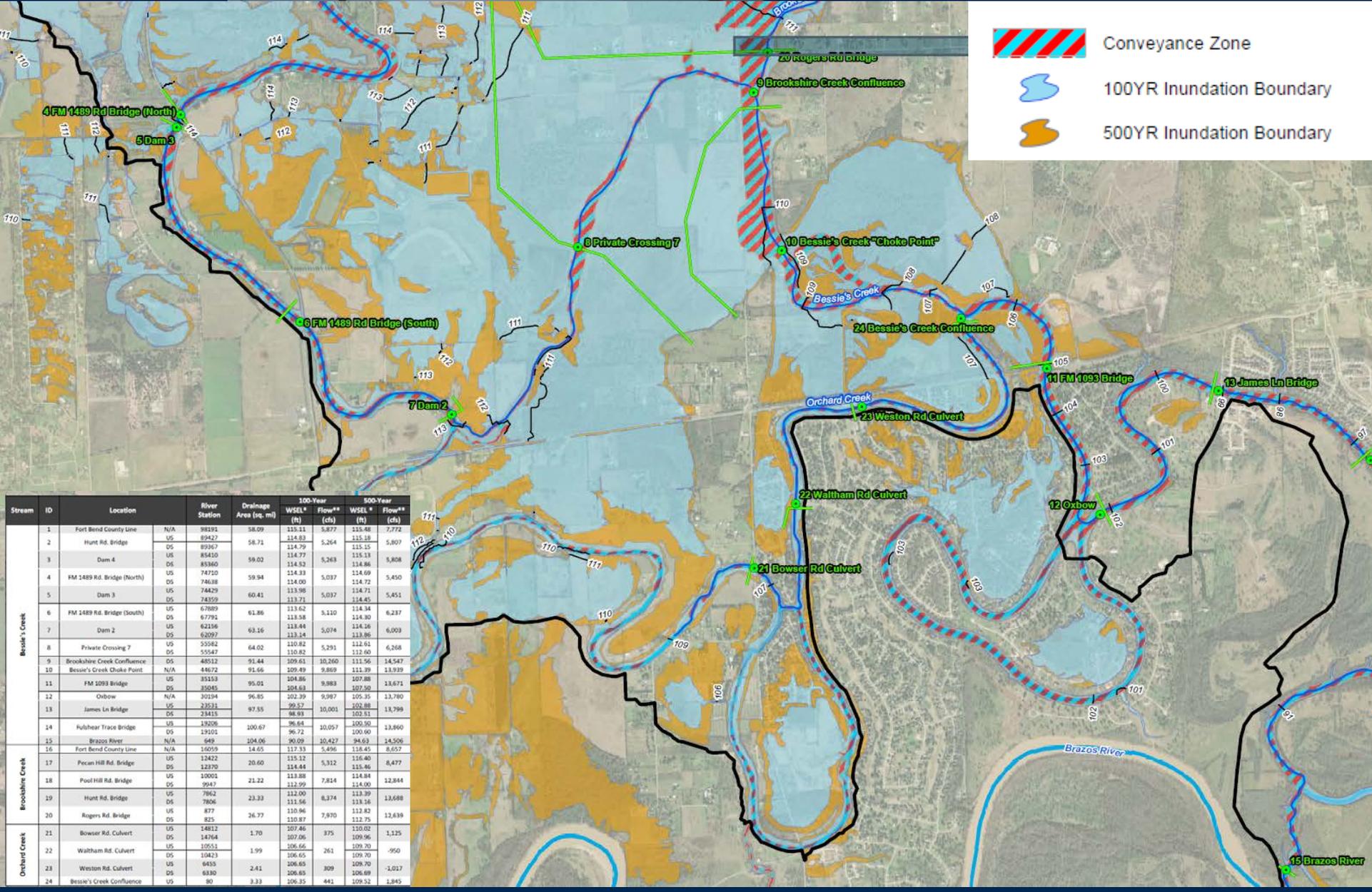
Table 9. Existing Conditions Results at Key Locations

Stream	ID	Location		River Station	Drainage Area* (sq.mi)	2-Year		5-Year		10-Year		25-Year		50-Year		100-Year		500-Year		
						WSEL* (ft)	Flow** (cfs)													
Bessie's Creek	1	Fort Bend County Line		N/A	98191	111.33	1,566	112.00	2,346	112.90	3,136	114.15	4,286	114.74	5,031	115.10	5,869	115.44	7,768	
	2	Hunt Rd. Bridge	US	89427	58.71	111.28	1,506	111.90	2,250	112.76	3,036	113.96	4,061	114.51	4,664	114.83	5,267	115.15	5,827	
			DS	89367		111.25		111.85		112.68		113.85		114.46		114.78		115.11		
	3	Dam 4	US	85410	59.02	111.25	1,505	111.86	2,250	112.70	3,031	113.89	4,059	114.45	4,664	114.77	5,265	115.09	5,828	
			DS	85360		111.11		111.68		112.50		113.67		114.22		114.51		114.82		115.11
	4	FM 1489 Rd. Bridge (North)	US	74710	59.94	111.07	1,513	111.61	2,266	112.41	3,039	113.52	4,020	114.05	4,516	114.33	4,939	114.65	5,408	
			DS	74638		110.58		111.12		111.92		113.04		113.98		114.68		115.11		
	5	Dam 3	US	74429	60.41	110.57	1,513	111.10	2,266	111.90	3,039	113.02	4,020	113.55	4,517	113.97	4,939	114.67	5,409	
			DS	74359		108.32		110.36		111.60		112.74		113.27		113.70		114.42		114.91
	6	FM 1489 Rd. Bridge (South)	US	67889	61.86	108.27	1,518	110.31	2,269	111.55	3,029	112.67	4,031	113.20	4,561	113.61	4,997	114.31	6,099	
			DS	67791		108.26		110.30		111.53		112.65		113.17		113.58		114.27		114.77
	7	Dam 2	US	62156	63.16	108.20	1,517	110.23	2,269	111.46	3,026	112.55	4,021	113.05	4,546	113.44	4,958	114.13	5,871	
			DS	62097		107.93		109.99		111.22		112.28		112.77		113.15		113.84		114.31
	8	Private Crossing 7	US	55582	64.02	105.55	1,516	107.69	2,221	108.55	2,947	109.25	3,864	109.88	4,612	110.63	5,299	112.46	6,270	
			DS	55547		105.42		107.68		108.56		109.25		109.88		110.63		112.46		
9	Brookshire Creek Confluence	DS	48512	91.44	104.47	2,661	106.26	3,917	107.4	5,194	108.65	7,198	109.54	8,674	110.4	10,344	112.34	15,185		
10	Bessie's Creek "Choke Point"	N/A	44672	91.66	102.69	2,652	104.38	3,875	105.78	5,091	107.61	6,969	108.80	8,376	109.79	9,969	111.76	14,633		
11	FM 1093 Bridge	US	35153	95.01	98.16	3,005	99.53	4,184	100.79	5,397	102.56	7,314	103.77	8,725	104.99	10,113	108.17	14,053		
		DS	35045		97.99		99.37		100.63		102.40		103.61		104.74		105.87			
12	Oxbow	N/A	30194	96.85	94.59	3,002	96.15	4,183	97.59	5,396	99.57	7,310	100.91	8,724	102.14	10,122	105.32	14,134		
13	James Ln Bridge	US	23531	97.55	91.10	3,053	92.75	4,195	94.41	5,402	96.75	7,320	98.33	8,742	99.73	10,139	103.22	14,199		
		DS	23415		90.34		92.02		93.69		96.07		97.67		99.09		102.91			
14	Fulshear Trace Bridge	US	19206	100.67	87.44	3,201	89.31	4,237	90.93	5,429	93.54	7,365	95.28	8,808	96.82	10,199	100.90	14,297		
		DS	19101		87.21		89.25		90.94		93.60		95.36		96.91		101.01			
15	Brazos River	N/A	649	104.06	79.92	3,589	82.12	4,755	83.82	5,780	86.47	7,591	88.53	9,157	90.39	10,680	95.04	14,901		
Brookshire Creek	16	Fort Bend County Line		N/A	16059	14.65	115.27	1,207	115.87	1,764	116.15	2,327	116.53	3,395	116.89	4,366	117.33	5,490	118.43	8,653
	17	Pecan Hill Rd. Bridge	US	12422	20.60	112.17	1,178	112.89	1,764	113.36	2,330	114.00	3,303	114.49	4,218	115.01	5,329	116.22	8,491	
			DS	12370		111.72		112.47		112.91		113.45		113.85		114.27		115.19		
	18	Pool Hill Rd. Bridge	US	10001	21.22	110.58	1,322	111.71	2,215	112.31	3,207	112.88	4,801	113.28	6,263	113.67	8,098	114.51	13,171	
			DS	9947		110.08		110.97		111.58		112.11		112.48		112.82		113.67		
	19	Hunt Rd. Bridge	US	7862	23.33	109.17	1,445	109.99	2,289	110.67	3,376	111.19	5,044	111.53	6,730	111.89	8,739	113.10	14,145	
DS			7806	109.01		109.86		110.44		110.86		111.13		111.46		112.92				
20	Rogers Rd. Bridge	US	877	26.77	105.18	1,759	107.01	2,340	108.08	3,253	109.23	4,990	109.97	6,712	110.75	8,635	112.65	13,555		
		DS	825		105.10		106.75		107.83		109.02		109.85		110.66		112.59			

Stream	ID	Location		River Station	Drainage Area* (sq.mi)	2-Year		5-Year		10-Year		25-Year		50-Year		100-Year		500-Year	
						WSEL* (ft)	Flow** (cfs)												
Orchard Creek	21	Bowser Rd. Culvert	US	14812	1.70	106.66	52	107.00	109	107.13	162	107.26	235	107.36	297	107.55	417	110.04	1,087
			DS	14764		100.58		102.09		103.31		104.71		106.07		107.20		109.99	
	22	Waltham Rd. Culvert	US	10551	1.99	100.47	68	102.05	-95	103.27	-130	104.58	189	105.64	230	106.75	263	109.74	-1,229
			DS	10423		100.45		102.04		103.25		104.61		105.62		106.74		109.77	
	23	Weston Rd. Culvert	US	6455	2.41	100.45	106	102.03	104	103.25	115	104.61	213	105.61	269	106.74	312	109.77	-1,276
DS			6330	100.40		101.98		103.21		104.60		105.61		106.74		109.78			
24	Bessie's Creek Confluence	US	80	3.33	99.70	-192	101.14	-255	102.39	-337	104.11	-411	105.28	-419	106.47	447	109.65	1,449	

+ Drainage areas based on drainage area delineations, but location may be impacted by overflows/diversions  
 \*Water surface elevations reported are from HEC-RAS cross sections  
 \*\*Flows determined from profiles lines in RAS Mapper drawn across the HEC-RAS 1D/2D model extents  
 \*\*Negative flows indicate water flowing from downstream to upstream

# Bessie's Creek Inundation Map



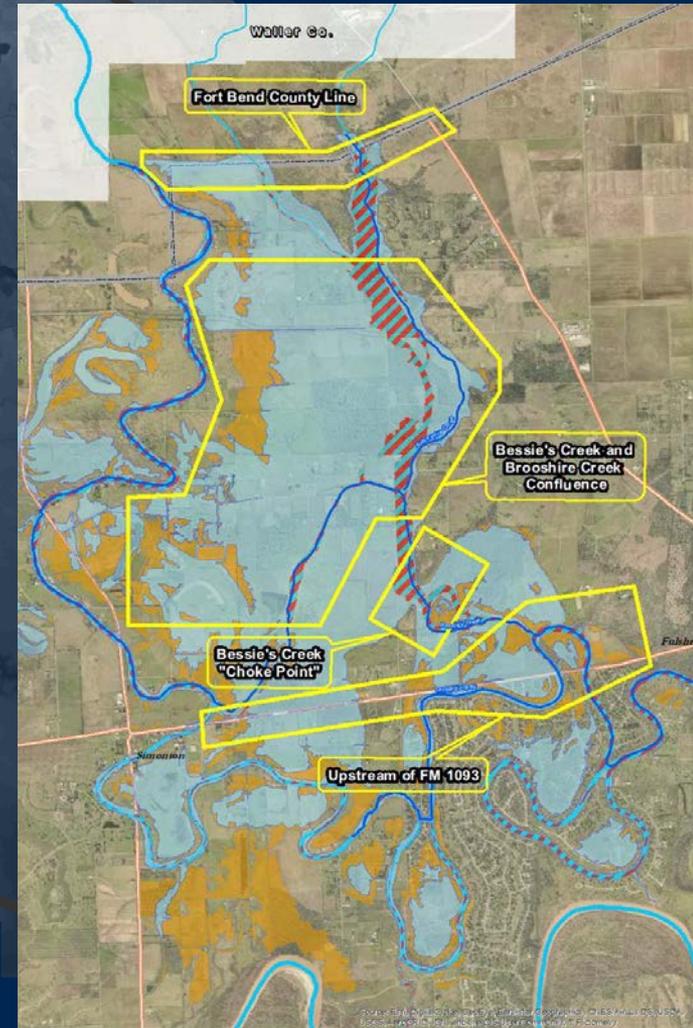
# Model Verification

Table 10. 2017 CLOMR Study and 2015 FEMA Effective Model vs Updated MDP Results

Stream	Location		2017 CLOMR		2015 FEMA	2020 MDP		2020 MDP - 2017 CLOMR			2020 MDP - 2015 FEMA
			100-Year		100-Year	100-Year		WSEL (ft)	Flow (cfs)	Flow (%)	WSEL (ft)
			WSEL (ft)	Flow (cfs)	WSEL (ft)	WSEL (ft)	Flow (cfs)	WSEL (ft)	Flow (cfs)	Flow (%)	WSEL (ft)
Bessie's Creek	Brookshire Creek Confluence	DS	108.72	8,000	110.50	110.40	10,344	1.68	2,344	29%	-0.10
	Bessie's Creek "Choke Point"	N/A	107.65	8,000	109.50	109.79	9,969	2.14	1,969	25%	0.29
	Orchard Creek Confluence	DS	105.36	8,411	108.20	106.47	9,805	1.11	1,394	17%	-1.73
	FM 1093 Bridge	US	104.44	8,452	106.00	104.99	10,113	0.55	1,661	20%	-1.01
	Oxbow	N/A	102.92	8,452	102.00	102.14	10,122	-0.78	1,670	20%	0.14
	James Ln Bridge	US	102.08	8,452	101.50	99.73	10,139	-2.35	1,687	20%	-1.77
	Fulshear Trace Bridge	US	101.21	8,662	101.50	96.82	10,199	-4.39	1,537	18%	-4.68
	Brazos River	N/A	96.65	8,944	101.50	90.39	10,680	-6.26	1,736	19%	-11.11

# Specific Items for this Watershed

- ❑ the Fort Bend County line due to influence from Waller County
- ❑ Bessie's Creek and Brookshire Creeks' confluence
- ❑ the Bessie's Creek "Choke Point", and
- ❑ the area downstream of the FM 1093 adjacent to Bessie's Creek and Orchard Creek confluence.



# Cost Analysis

Table 11. Existing 100-Year Level of Service Channel Improvements

Segment	Extents	Description/Configuration	ROW Required (acres)	Estimated Construction Cost
Bessie's 1	Pecan Hill Dr to 1,400 LF DS of Hunt Rd	- Channel Length = 1.34 mi long - Channel longitudinal slope = 0.00005 - Flowline Adjustment = None - Side Slope = 4:1 - No TOB Widening - Average Top Width = 380 ft - Channel bottom width = 200 ft - Maintenance Berm = 60 ft, 30 ft on each side	65.1	\$13,896,933
Bessie's 2	Private Cross US of FM 1489 (Simonton Rd) to FM 1489 (Simonton Rd)	- Channel Length = 1.65 mi long - Channel longitudinal slope = 0.00003 - Flowline Adjustment = None - Side Slope = 4:1 - No TOB Widening - Average Top Width = 345 ft - Channel bottom width = 200 ft - Maintenance Berm = 60 ft, 30 ft on each side	87.4	\$22,218,731
Bessie's 3	FM 1489 (Simonton Rd) to 3,500 LF DS of Dam 2	- Channel Length = 1.88 mi long - Channel longitudinal slope = 0.0004 - Flowline Adjustment = None - Side Slope = 4:1 - No TOB Widening - Average Top Width = 235 ft - Channel bottom width = 100 ft - Maintenance Berm = 60 ft, 30 ft on each side	68.8	\$19,595,984
			(acres)	Cost
Bessie's 4*	3,500 LF DS of Dam 2 to Brookshire Creek Confluence	- Channel Length = 1.93 mi long - Channel longitudinal slope = 0.0004 - Flowline Adjustment = None - Side Slope = 4:1 - 1.5' to 6.5' of fill - 60' to 100' of additional top width on each bank - Average Top Width = 290 ft - Channel bottom width = 150 ft - Maintenance Berm = 60 ft, 30 ft on each side	87.4	\$25,607,027
Bessie's 5*	Brookshire Creek Confluence to 3,500 LF DS of Confluence	- Channel Length = 0.66 mi long - Channel longitudinal slope = 0.0004 - Flowline Adjustment = None - Side Slope = 4:1 - 6.5' of fill near confluence - 120' of additional top width on each bank - Average Top Width = 400 ft - Channel bottom width = 250 ft - Maintenance Berm = 60 ft, 30 ft on each side	42	\$16,474,872
Bessie's 6	3,500 LF DS of Confluence to 1,300 LF US of Orchard Creek	- Channel Length = 0.63 mi long - Channel longitudinal slope = 0.00014 - Flowline Adjustment = None - Side Slope = 4:1 - 80' of additional top width on each bank - Average Top Width = 375 ft - Channel bottom width = 225 ft - Maintenance Berm = 60 ft, 30 ft on each side	32.8	\$12,642,510

\* Area of significant existing floodplain that requires fill to contain 100-year flows within the proposed channel. Additional mitigation and coordination with FBCDD will be required.

# Cost Analysis

Table 11. Existing 100-Year Level of Service Channel Improvements

Segment	Extents	Description/Configuration	ROW Required (acres)	Estimated Construction Cost
Bessie's 7	1,300 LF US of Orchard Creek to FM 1093	<ul style="list-style-type: none"> <li>- Channel Length = 1.29 mi long</li> <li>- Channel longitudinal slope = 0.00014</li> <li>- Flowline Adjustment = None</li> <li>- Side Slope = 4:1</li> <li>- No TOB Widening- Average Top Width = 350 ft</li> <li>- Channel bottom width = 175 ft</li> <li>- Maintenance Berm = 60 ft, 30 ft on each side</li> </ul>	65.1	\$19,453,846
Bessie's 8	FM 1093 to Bend at Oxbow	<ul style="list-style-type: none"> <li>- Channel Length = 0.83 mi long</li> <li>- Channel longitudinal slope = 0.0011</li> <li>- Flowline Adjustment = None</li> <li>- Side Slope = 4:1</li> <li>- No TOB Widening</li> <li>- Average Top Width = 330 ft</li> <li>- Channel bottom width = 150 ft</li> <li>- Maintenance Berm = 60 ft, 30 ft on each side</li> </ul>	52.9	\$9,335,763
Bessie's 9	Bend at Oxbow to James Ln	<ul style="list-style-type: none"> <li>- Channel Length = 1.38 mi long</li> <li>- Channel longitudinal slope = 0.0011</li> <li>- Flowline Adjustment = None</li> <li>- Side Slope = 4:1</li> <li>- No TOB Widening</li> <li>- Average Top Width = 335 ft</li> <li>- Channel bottom width = 100 ft</li> <li>- Maintenance Berm = 60 ft, 30 ft on each side</li> </ul>	69.5	\$21,092,174
Bessie's 10	James Ln to Fulshear Trace Blvd	<ul style="list-style-type: none"> <li>- Channel Length = 0.83 mi long</li> <li>- Channel longitudinal slope = 0.0011</li> <li>- Flowline Adjustment = None</li> <li>- Side Slope = 4:1</li> <li>- No TOB Widening</li> <li>- Average Top Width = 320 ft</li> <li>- Channel bottom width = 50 ft</li> <li>- Maintenance Berm = 60 ft, 30 ft on each side</li> </ul>	42.5	\$12,352,871
Bessie's 11	Fulshear Trace Blvd to Redbird Ln	<ul style="list-style-type: none"> <li>- Channel Length = 2.99 mi long</li> <li>- Channel longitudinal slope = 0.0011, 0.00043</li> <li>- Flowline Adjustment = None</li> <li>- Side Slope = 4:1</li> <li>- 30' to 60' of additional top width on each bank</li> <li>- Average Top Width = 375 ft</li> <li>- Channel bottom width = 50 ft</li> <li>- Maintenance Berm = 60 ft, 30 ft on each side</li> </ul>	170.6	\$63,618,688
Brookshire 1	County Line to Hunt Rd	<ul style="list-style-type: none"> <li>- Channel Length = 1.67 mi long</li> <li>- Channel longitudinal slope = 0.001</li> <li>- Flowline Adjustment = None</li> <li>- Side Slope = 4:1</li> <li>- 1.5' to 4.0' of fill</li> <li>- 50' to 110' of additional top width on each bank</li> <li>- Average Top Width = 200 ft</li> <li>- Channel bottom width = 100 ft</li> <li>- Maintenance Berm = 60 ft, 30 ft on each side</li> </ul>	38.2	\$20,390,469
Brookshire 2	Hunt Rd to Confluence near Pool Hill Rd	<ul style="list-style-type: none"> <li>- Channel Length = 1.48 mi long</li> <li>- Channel longitudinal slope = 0.0006, 0.0015, 0.0005</li> <li>- Flowline Adjustment = None</li> <li>- Side Slope = 4:1</li> <li>- 1.5' to 6.0' of fill</li> <li>- 100' to 220' of additional top width (mostly west bank)</li> <li>- Average Top Width = 310 ft</li> <li>- Channel bottom width = 200 ft</li> <li>- Maintenance Berm = 60 ft, 30 ft on each side</li> </ul>	78.2	\$28,015,981



# Alternative Analysis – Diversions

All diversion locations were evaluated with channels of 100-foot bottom width, 3 to 1 side slopes, and varying depths. The reduction in water surface elevation as a result of the diversion channels is summarized in Table 13 below.

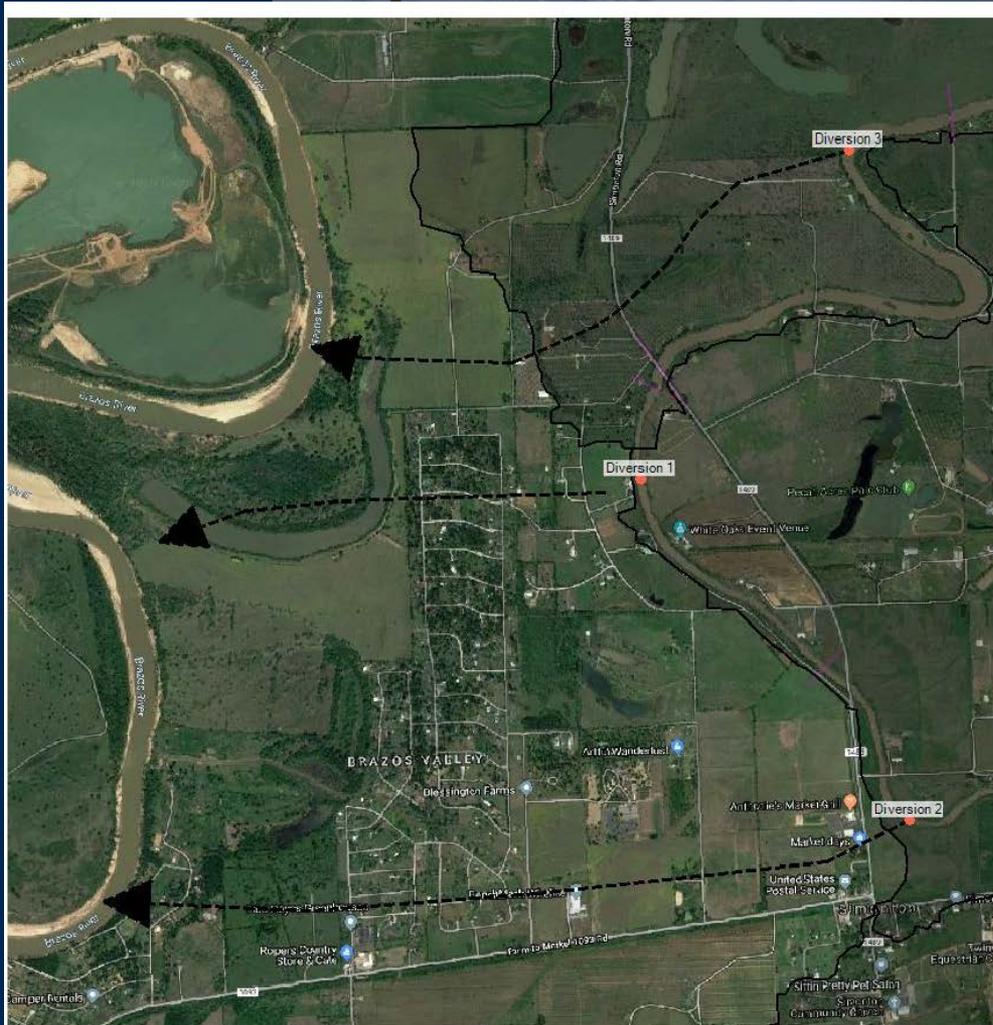


Figure 2 - Diversion Locations

Table 12. Diversion Channel Results

Diversion	Profile Location	WSE Reduction
Diversion 1	DS Confluence Brookshire & Bessie's	0.59
	Bessie's "Choke Point"	0.92
	US FM 1093 at Bessie's	0.92
	DS Confluence Orchard & Bessie's	0.90
Diversion 2	DS Confluence Brookshire & Bessie's	0.59
	Choke Point	0.92
	US FM 1093 at Bessie's	0.92
	DS Confluence Orchard & Bessie's	0.90
Diversion 3	DS Confluence Brookshire & Bessie's	0.12
	Choke Point	0.39
	US FM 1093 at Bessie's	0.32
	DS Confluence Orchard & Bessie's	0.31

# Environmental Assessment

- Potential Encroachment
- Threatened and Endangered Species
- Cultural Resources/Archaeology
- Other Environmental Concerns

**Table 14. Potential Pipeline Encroachments**

Pipeline Owner	Pipeline
Trunkline Gas Company, LLC	Edna Discharge
Natural Gas P/L Co of Amer LLC	Gulf Coast Mainline #1 Gulf Coast Mainline #2
Tennessee Gas Pipeline Company	18E - 100 Randon TGP 100 SYSTEM 100-1 TGP 100 SYSTEM 100-2 TGP 100 SYSTEM 100-3
Kinder Morgan Texas Pipeline LLC	Rancho La Grange-Genoa Junction
Dow Pipeline Company	KS

**Table 13. Potential Encroachment into existing Wetlands**

Segment	Extents	Wetlands Encroached
Bessie's 4	3,500 LF DS of Dam 2 to Brookshire Creek Confluence	0.20 ac of Freshwater Forested/ Shrub Wetland
Bessie's 6	3,500 LF DS of Confluence to 1,300 LF US of Orchard Creek	0.34 ac of Freshwater Forested/ Shrub Wetland
Bessie's 7	1,300 LF US of Orchard Creek to FM 1093	0.11 ac of Freshwater Forested/ Shrub Wetland
Bessie's 8	FM 1093 to Bend at Oxbow	1.94 ac of Freshwater Forested/ Shrub Wetland
Bessie's 10	James Ln to Fulshear Trace Blvd	1.0 ac of Freshwater Forested/ Shrub Wetland
Bessie's 11	Fulshear Trace Blvd to Redbird Ln	0.55 ac of Freshwater Forested/ Shrub Wetland
Brookshire 1	County Line to Hunt Road	0.50 ac of Freshwater Emergent Wetland 0.90 ac of Freshwater Pond

**Table 15. Potential Wastewater Outfall Encroachments**

Segment	Extents	Wastewater Outfalls
Bessie's 6	Brookshire Creek Confluence to Orchard Creek Confluence	Land Tejas Company LTD Outfall
Brookshire 1	County Line to Hunt Road	Fulshear Lakes WW Outfall

# BESSIE'S CREEK SEGMENT-1 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 1 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE PECAN HILL DR. TO 1,400 LF DS OF HUNT RD.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (65.1 acres)	1	LS	\$ 913,000	\$1,400,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 122,473.75	\$122,474
3	Clearing and Grubbing	66	AC	\$ 6,500	\$429,000
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 61,236.88	\$61,237
5	Stormwater Pollution Prevention Plan	7,050	LF	\$ 7.50	\$52,875
6	Turf Est. - Hydroseeding w/ Mulch	23,200	SY	\$ 0.50	\$11,600
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	163,000	CY	\$ 12.00	\$1,956,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	7,050	LF	\$ 1,000.00	\$7,050,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$1,400,000
GENERAL CIVIL SUBTOTAL:					\$677,186
NEW CONSTRUCTION SUBTOTAL:					\$1,956,000
MISC COSTS:					\$8,050,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$12,083,000</b>
ENGINEERING				15%	\$394,977.8
CONSTRUCTION MGMT				8%	\$210,654.9
CONTINGENCY				10%	\$1,208,300.0
<b>PROJECT TOTAL</b>					<b>\$13,896,933</b>

### NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-2 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 2 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE PRIVATE CROSSING US OF SIMONTON RD. TO SIMONTON RD.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (87.4 acres)	1	LS	\$ 2,200,000	\$3,270,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 181,927.50	\$181,928
3	Clearing and Grubbing	82	AC	\$ 6,500	\$533,000
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 90,963.75	\$90,964
5	Stormwater Pollution Prevention Plan	8,700	LF	\$ 7.50	\$65,250
6	Turf Est. - Hydroseeding w/ Mulch	56,600	SY	\$ 0.50	\$28,300
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	251,000	CY	\$ 12.00	\$3,012,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	8,700	LF	\$ 1,000.00	\$8,700,000
10	Utility and Pipeline Adjustment	3	EA	\$ 500,000.00	\$1,500,000
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	2	EA	\$ 1,000,000.00	\$2,000,000
LAND ACQUISITION SUBTOTAL:					\$3,270,000
GENERAL CIVIL SUBTOTAL:					\$899,441
NEW CONSTRUCTION SUBTOTAL:					\$3,012,000
MISC COSTS:					\$12,200,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$19,381,000</b>
ENGINEERING				15%	\$586,716.2
CONSTRUCTION MGMT				8%	\$312,915.3
CONTINGENCY				10%	\$1,938,100.0
<b>PROJECT TOTAL</b>					<b>\$22,218,731</b>

**NOTES:**

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-3 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 3 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE SIMONTON RD. TO 3,500 LF DS OF DAM 2

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (68.8 acres)	1	LS	\$ 1,400,000	\$1,080,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 243,697.50	\$243,698
3	Clearing and Grubbing	68	AC	\$ 6,500	\$440,700
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 121,848.75	\$121,849
5	Stormwater Pollution Prevention Plan	9,900	LF	\$ 7.50	\$74,250
6	Turf Est. - Hydroseeding w/ Mulch	150,000	SY	\$ 0.50	\$75,000
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	357,000	CY	\$ 12.00	\$4,284,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	9,900	LF	\$ 1,000.00	\$9,900,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	1	EA	\$ 500,000.00	\$500,000
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$1,080,000
GENERAL CIVIL SUBTOTAL:					\$955,496
NEW CONSTRUCTION SUBTOTAL:					\$4,284,000
MISC COSTS:					\$10,400,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$16,719,000</b>
ENGINEERING				15%	\$785,924.4
CONSTRUCTION MGMT				8%	\$419,159.7
CONTINGENCY				10%	\$1,671,900.0
<b>PROJECT TOTAL</b>					<b>\$19,595,984</b>

### NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-4 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 4 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE 3,500 LF DS OF DAM 2 TO BROOKSHIRE CREEK CONFLUENCE

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (87.4 acres)	1	LS	\$ 3,270,000	\$1,015,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 421,785.00	\$421,785
3	Clearing and Grubbing	82	AC	\$ 6,500	\$531,700
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 210,892.50	\$210,893
5	Stormwater Pollution Prevention Plan	10,200	LF	\$ 7.50	\$76,500
6	Turf Est. - Hydroseeding w/ Mulch	55,000	SY	\$ 0.50	\$27,500
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	650,000	CY	\$ 12.00	\$7,800,000
8	On-site Fill	51,000	CY	\$ 5.00	\$255,000
<b>MISC COSTS</b>					
9	Wetland Mitigation	1.0	AC	\$ 100,000.00	\$100,000
10	Stream Mitigation	10,200	LF	\$ 1,000.00	\$10,200,000
11	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
12	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
13	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$1,015,000
GENERAL CIVIL SUBTOTAL:					\$1,268,378
NEW CONSTRUCTION SUBTOTAL:					\$7,800,000
MISC COSTS:					\$11,300,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$21,383,000</b>
ENGINEERING				15%	\$1,360,256.6
CONSTRUCTION MGMT				8%	\$725,470.2
CONTINGENCY				10%	\$2,138,300.0
<b>PROJECT TOTAL</b>					<b>\$25,607,027</b>

**NOTES:**

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-5 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 5

### EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE

#### BROOKSHIRE CREEK CONFLUENCE TO 3,500 LF DS OF CONFLUENCE

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (42 acres)	1	LS	\$ 1,080,000	\$1,730,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 355,727.50	\$355,728
3	Clearing and Grubbing	37	AC	\$ 6,500	\$240,500
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 177,863.75	\$177,864
5	Stormwater Pollution Prevention Plan	3,500	LF	\$ 7.50	\$26,250
6	Turf Est. - Hydroseeding w/ Mulch	15,600	SY	\$ 0.50	\$7,800
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	570,000	CY	\$ 12.00	\$6,840,000
8	On-site Fill	52,000	CY	\$ 5.00	\$260,000
<b>MISC COSTS</b>					
9	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
10	Stream Mitigation	3,500	LF	\$ 1,000.00	\$3,500,000
11	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
12	Minor Roadway Channel Crossing Adjustment	1	EA	\$ 500,000.00	\$500,000
13	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$1,730,000
GENERAL CIVIL SUBTOTAL:					\$808,141
NEW CONSTRUCTION SUBTOTAL:					\$6,840,000
MISC COSTS:					\$4,000,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$13,378,000</b>
ENGINEERING				15%	\$1,147,221.2
CONSTRUCTION MGMT				8%	\$611,851.3
CONTINGENCY				10%	\$1,337,800.0
<b>PROJECT TOTAL</b>					<b>\$16,474,872</b>

#### NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-6 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 6

### EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE

### 3,500 LF DS OF CONFLUENCE TO 1,300 LF US OF ORCHARD CREEK

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (32.8 acres)	1	LS	\$ 1,010,000	\$935,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 219,597.50	\$219,598
3	Clearing and Grubbing	33	AC	\$ 6,500	\$213,200
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 109,798.75	\$109,799
5	Stormwater Pollution Prevention Plan	3,300	LF	\$ 7.50	\$24,750
6	Turf Est. - Hydroseeding w/ Mulch	52,000	SY	\$ 0.50	\$26,000
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	344,000	CY	\$ 12.00	\$4,128,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	0.5	AC	\$ 100,000.00	\$50,000
9	Stream Mitigation	3,300	LF	\$ 1,000.00	\$3,300,000
10	Utility and Pipeline Adjustment	3	EA	\$ 500,000.00	\$1,500,000
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$935,000
GENERAL CIVIL SUBTOTAL:					\$593,346
NEW CONSTRUCTION SUBTOTAL:					\$4,128,000
MISC COSTS:					\$4,850,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$10,506,000</b>
ENGINEERING				15%	\$708,201.9
CONSTRUCTION MGMT				8%	\$377,707.7
CONTINGENCY				10%	\$1,050,600.0
<b>PROJECT TOTAL</b>					<b>\$12,642,510</b>

#### NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-7 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 7 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE 1,300 LF US OF ORCHARD CREEK TO FM 1093

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (65.1 acres)	1	LS	\$ 1,730,000	\$1,440,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 303,710.00	\$303,710
3	Clearing and Grubbing	64	AC	\$ 6,500	\$414,700
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 151,855.00	\$151,855
5	Stormwater Pollution Prevention Plan	6,800	LF	\$ 7.50	\$51,000
6	Turf Est. - Hydroseeding w/ Mulch	81,000	SY	\$ 0.50	\$40,500
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	464,000	CY	\$ 12.00	\$5,568,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	0.5	AC	\$ 100,000.00	\$50,000
9	Stream Mitigation	6,800	LF	\$ 1,000.00	\$6,800,000
10	Utility and Pipeline Adjustment	1	EA	\$ 500,000.00	\$500,000
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$1,440,000
GENERAL CIVIL SUBTOTAL:					\$961,765
NEW CONSTRUCTION SUBTOTAL:					\$5,568,000
MISC COSTS:					\$8,350,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$16,320,000</b>
ENGINEERING				15%	\$979,464.8
CONSTRUCTION MGMT				8%	\$522,381.2
CONTINGENCY				10%	\$1,632,000.0
<b>PROJECT TOTAL</b>					<b>\$19,453,846</b>

### NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-8 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 8 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE FM 1093 TO BEND AT OXBOW

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (52.9 acres)	1	LS	\$ 932,000	\$1,400,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 95,665.00	\$95,665
3	Clearing and Grubbing	40	AC	\$ 6,500	\$261,300
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 47,832.50	\$47,833
5	Stormwater Pollution Prevention Plan	4,400	LF	\$ 7.50	\$33,000
6	Turf Est. - Hydroseeding w/ Mulch	46,000	SY	\$ 0.50	\$23,000
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	133,000	CY	\$ 12.00	\$1,596,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	2.0	AC	\$ 100,000.00	\$200,000
9	Stream Mitigation	4,400	LF	\$ 1,000.00	\$4,400,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$1,400,000
GENERAL CIVIL SUBTOTAL:					\$460,798
NEW CONSTRUCTION SUBTOTAL:					\$1,596,000
MISC COSTS:					\$4,600,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$8,057,000</b>
ENGINEERING				15%	\$308,519.6
CONSTRUCTION MGMT				8%	\$164,543.8
CONTINGENCY				10%	\$805,700.0
<b>PROJECT TOTAL</b>					<b>\$9,335,763</b>

### NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-9 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 9 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE BEND AT OXBOW TO JAMES LN.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (69.5 acres)	1	LS	\$ 1,440,000	\$4,452,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 247,072.50	\$247,073
3	Clearing and Grubbing	67	AC	\$ 6,500	\$434,200
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 123,536.25	\$123,536
5	Stormwater Pollution Prevention Plan	7,300	LF	\$ 7.50	\$54,750
6	Turf Est. - Hydroseeding w/ Mulch	121,000	SY	\$ 0.50	\$60,500
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	366,000	CY	\$ 12.00	\$4,392,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	-	AC	\$ 100,000.00	\$0
9	Stream Mitigation	7,300	LF	\$ 1,000.00	\$7,300,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$4,452,000
GENERAL CIVIL SUBTOTAL:					\$920,059
NEW CONSTRUCTION SUBTOTAL:					\$4,392,000
MISC COSTS:					\$8,300,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$18,064,000</b>
ENGINEERING				15%	\$796,808.8
CONSTRUCTION MGMT				8%	\$424,964.7
CONTINGENCY				10%	\$1,806,400.0
<b>PROJECT TOTAL</b>					<b>\$21,092,174</b>

**NOTES:**

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-10 COST ESTIMATE

## BESSIE'S CREEK - SEGMENT 10 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE JAMES LN. TO FULSHEAR TRACE BLVD

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (42.5 acres)	1	LS	\$ 1,400,000	\$2,030,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 142,340.00	\$142,340
3	Clearing and Grubbing	38	AC	\$ 6,500	\$248,300
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 71,170.00	\$71,170
5	Stormwater Pollution Prevention Plan	4,400	LF	\$ 7.50	\$33,000
6	Turf Est. - Hydroseeding w/ Mulch	67,000	SY	\$ 0.50	\$33,500
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	211,000	CY	\$ 12.00	\$2,532,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	1	AC	\$ 100,000.00	\$100,000
9	Stream Mitigation	4,400	LF	\$ 1,000.00	\$4,400,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	-	EA	\$ 500,000.00	\$0
12	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$2,030,000
GENERAL CIVIL SUBTOTAL:					\$528,310
NEW CONSTRUCTION SUBTOTAL:					\$2,532,000
MISC COSTS:					\$5,500,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$10,590,000</b>
ENGINEERING				15%	\$459,046.5
CONSTRUCTION MGMT				8%	\$244,824.8
CONTINGENCY				10%	\$1,059,000.0
<b>PROJECT TOTAL</b>					<b>\$12,352,871</b>

### NOTES:

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BESSIE'S CREEK SEGMENT-11 COST ESTIMATE

**BESSIE'S CREEK - SEGMENT 11  
EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE  
FULSHEAR TRACE BLVD TO REDBIRD LN.**

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (170.6 acres)	1	LS	\$ 4,450,000	\$7,640,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 1,301,575.00	\$1,301,575
3	Clearing and Grubbing	160	AC	\$ 6,500	\$1,040,000
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 650,787.50	\$650,788
5	Stormwater Pollution Prevention Plan	15,800	LF	\$ 7.50	\$118,500
6	Turf Est. - Hydroseeding w/ Mulch	354,000	SY	\$ 0.50	\$177,000
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	2,058,000	CY	\$ 12.00	\$24,696,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	0.6	AC	\$ 100,000.00	\$60,000
9	Stream Mitigation	15,800	LF	\$ 1,000.00	\$15,800,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	1	EA	\$ 500,000.00	\$500,000
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$7,640,000
GENERAL CIVIL SUBTOTAL:					\$3,287,863
NEW CONSTRUCTION SUBTOTAL:					\$24,696,000
MISC COSTS:					\$16,360,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$51,984,000</b>
ENGINEERING				15%	\$4,197,579.4
CONSTRUCTION MGMT				8%	\$2,238,709.0
CONTINGENCY				10%	\$5,198,400.0
<b>PROJECT TOTAL</b>					<b>\$63,618,688</b>

**NOTES:**

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BROOKSHIRE CREEK SEGMENT-1 COST ESTIMATE

## BROOKSHIRE CREEK CREEK - SEGMENT 1 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE COUNTY LINE TO HUNT RD

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (38.2 acres)	1	LS	\$ 2,030,000	\$920,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 202,602.50	\$202,603
3	Clearing and Grubbing	49	AC	\$ 6,500	\$316,550
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 101,301.25	\$101,301
5	Stormwater Pollution Prevention Plan	8,200	LF	\$ 7.50	\$61,500
6	Turf Est. - Hydroseeding w/ Mulch	28,000	SY	\$ 0.50	\$14,000
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	305,000	CY	\$ 12.00	\$3,660,000
8	On-site Fill	57,000	CY	\$ 5.00	\$285,000
<b>MISC COSTS</b>					
9	Wetland Mitigation	1.5	AC	\$ 100,000.00	\$150,000
10	Stream Mitigation	8,200	LF	\$ 1,000.00	\$8,200,000
11	Utility and Pipeline Adjustment	4	EA	\$ 500,000.00	\$2,000,000
12	Minor Roadway Channel Crossing Adjustment	2	EA	\$ 500,000.00	\$1,000,000
13	Major Roadway Channel Crossing Adjustment	1	EA	\$ 1,000,000.00	\$1,000,000
LAND ACQUISITION SUBTOTAL:					\$920,000
GENERAL CIVIL SUBTOTAL:					\$695,954
NEW CONSTRUCTION SUBTOTAL:					\$3,660,000
MISC COSTS:					\$12,350,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$17,626,000</b>
ENGINEERING					15% \$653,393.1
CONSTRUCTION MGMT					8% \$348,476.3
CONTINGENCY					10% \$1,762,600.0
<b>PROJECT TOTAL</b>					<b>\$20,390,469</b>

**NOTES:**

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING

# BROOKSHIRE CREEK SEGMENT-2 COST ESTIMATE

## BROOKSHIRE CREEK - SEGMENT 2 EXISTING 100-YEAR LEVEL OF SERVICE COST ESTIMATE HUNT RD TO BESSIE'S CONFLUENCE NEAR POOL HILL RD

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>LAND ACQUISITION</b>					
1	Total area (78.2 acres)	1	LS	\$ 7,640,000	\$2,200,000
<b>GENERAL CIVIL</b>					
2	Site Preparation (Mobilization, Demolition, Utility Coordination, Final Grading) (NTE 5% of Overall Construction Cost)	1	LS	\$ 529,662.50	\$529,663
3	Clearing and Grubbing	75	AC	\$ 6,500	\$487,500
4	Care and Control of Water (NTE 2.5% of Overall Construction Cost)	1	LS	\$ 264,831.25	\$264,831
5	Stormwater Pollution Prevention Plan	8,500	LF	\$ 7.50	\$63,750
6	Turf Est. - Hydroseeding w/ Mulch	20,000	SY	\$ 0.50	\$10,000
<b>NEW CONSTRUCTION</b>					
7	Excavation & Off-site Disposal	836,000	CY	\$ 12.00	\$10,032,000
8	On-site Fill	57,000	CY	\$ 5.00	\$285,000
<b>MISC COSTS</b>					
8	Wetland Mitigation	0.0	AC	\$ 100,000.00	\$0
9	Stream Mitigation	8,500	LF	\$ 1,000.00	\$8,500,000
10	Utility and Pipeline Adjustment	-	EA	\$ 500,000.00	\$0
11	Minor Roadway Channel Crossing Adjustment	2	EA	\$ 500,000.00	\$1,000,000
12	Major Roadway Channel Crossing Adjustment	-	EA	\$ 1,000,000.00	\$0
LAND ACQUISITION SUBTOTAL:					\$2,200,000
GENERAL CIVIL SUBTOTAL:					\$1,355,744
NEW CONSTRUCTION SUBTOTAL:					\$10,032,000
MISC COSTS:					\$9,500,000
<b>OPINION OF PROBABLE CONSTRUCTION COST</b>					<b>\$23,088,000</b>
				ENGINEERING 15%	\$1,708,161.6
				CONSTRUCTION MGMT 8%	\$911,019.5
				CONTINGENCY 10%	\$2,308,800.0
<b>PROJECT TOTAL</b>					<b>\$28,015,981</b>

**NOTES:**

ENGINEERING COST INCLUDES THE FOLLOWING: SURVEYING, GEOTECHNICAL INVESTIGATIONS, AND ENGINEERING DESIGN  
CONSTRUCTION MANAGEMENT COSTS INCLUDE INSPECTION AND MATERIAL TESTING



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