

Clear Creek Drainage Bond Citizen Advisory Team *Evaluation and Recommendation*



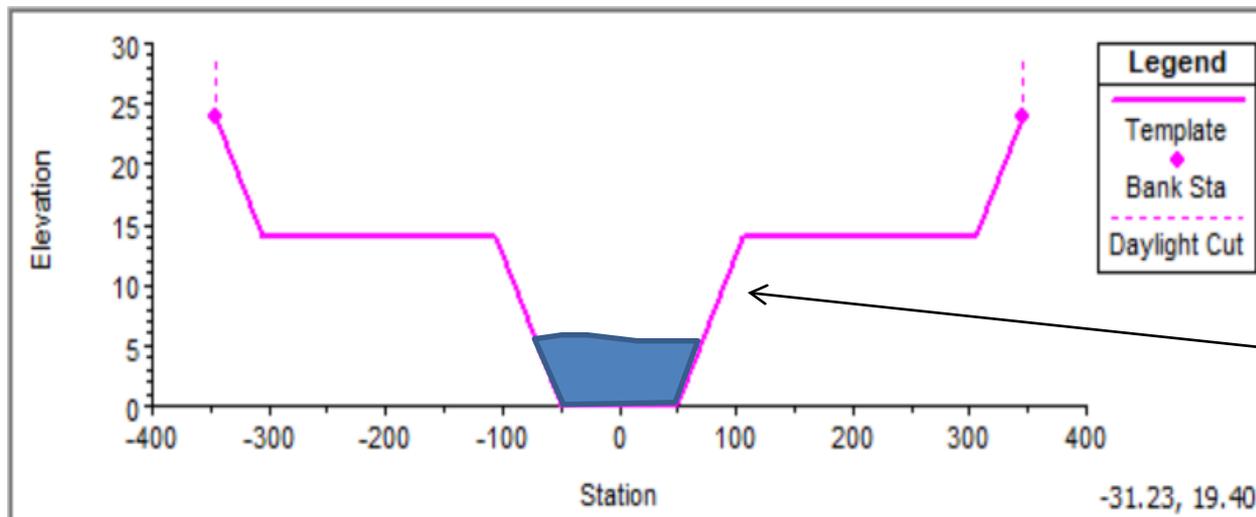
Inputs from the Subcommittee to the Citizen Advisory Team:



Terracing - Method

Input from Subcommittee:

- Based on the terracing design, extend a 200 ft terrace to both sides
- Channel meanders remain intact (i.e., no channel straightening)
- Grass terracing has a roughness coefficient of 0.04 on its terraces.



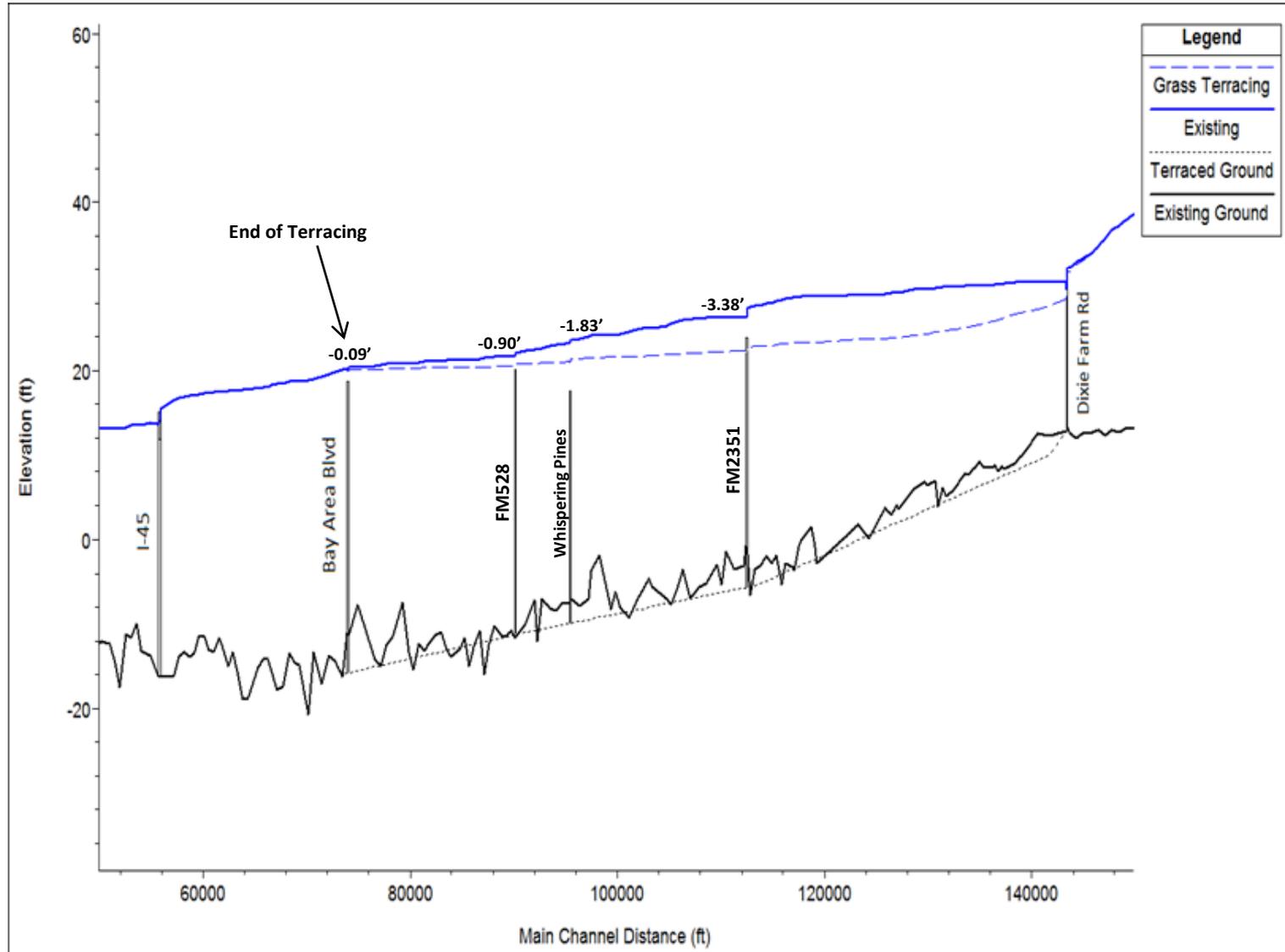
Advisory Team Note:
The Lab simulations included the trapezoid channel. The trapezoid is not included in the cost – just the terracing.

Bottom Width	Channel Depth	Side Slope (H:V)	Terracing Distance (each side)	Terracing Depth	Manning's n (channel)	Manning's n (grass terracing)
60 ft	14 ft	4	200 ft	10 ft	0.015	0.04

Input from Subcommittee:

Effect of the Channel and Grass Terrace

(Expected to save ~1,000 structures out of ~2,800 that flooded)



Lab Results

Table VII.1. Summary table for Harvey (stream elevation reduction in ft)

Watch Point Location	Change in Peak WSEL (ft)									
	3-Bridge Removal	De-Snap	Terracing to BAB	Terracing to I45	50% Diversion at BAB	Turkey Creek Diversion	Detention	FM 2351 + Terracing	Terracing to BAB + 50% Diversion	Terracing to I45 + 50% Diversion
1: US FM 2351	-0.79	-0.86	-3.78	-4.64	-0.11	-0.35	-0.03	-4.11	-5.24	-6.67
2: DS FM 2351	-0.09	-1.47	-3.38	-4.38	-0.15	-0.40	-0.04	-3.37	-5.00	-6.54
3: US Whispering Pines	-0.20	-0.87	-1.83	-3.07	-0.38	-0.31	-0.04	-1.83	-3.87	-6.11
4: DS Whispering Pines	-0.19	-0.75	-1.56	-3.00	-0.47	-0.29	-0.04	-1.56	-3.93	-6.37
5: US FM 528	-0.19	-0.44	-1.10	-2.57	-0.74	-0.26	-0.05	-1.10	-3.52	-6.07
6: DS FM 528	0.00	-0.37	-0.90	-2.51	-1.03	-0.25	-0.06	-0.90	-3.48	-6.27
7: DS Bay Area Blvd	0.00	0.00	-0.09	-1.94	-2.9	-0.16	-0.09	-0.09	-3.13	-6.88
8: DS I-45	0.00	0.00	0.00	0.00	-3.62	0.01	-0.06	0.00	-3.62	-3.62
9: Clear Lake	0.00	0.00	0.00	0.00	-1.52	0.02	-0.04	0.00	-1.52	-1.52



Best option that is isolated to within Friendswood boundaries. Note: The data show that no additional homes are saved by replacing the bridge at FM2351.

Input from
Subcommittee:

Subcommittee Input to the CAT: Estimated Costs of Projects with the Best Benefit

#	Mitigation Types	Details	TOTAL COST	COF %	Cost to COF	Years to Complete
1	De-Snagging	200 ft	\$ 3,000,000	10%	\$ 300,000	2
2	Bridge/Road Raising	FM 2351 - East Edgewood Drive	\$ 20,000,000	10%	\$ 2,000,000	10
3	Bridge/Road Raising	FM 528 - East Parkwood Ave	\$ 20,000,000	10%	\$ 2,000,000	10
4	Terracing	Dixie Farm Road to FM 2351	\$ 28,000,000	20%	\$ 5,600,000	15
5	Terracing	FM 2351 to Whispering Pines Ave	\$ 22,000,000	20%	\$ 4,400,000	15
6	Terracing	Whispering Pines Ave to FM 528	\$ 10,000,000	20%	\$ 2,000,000	15
7	Terracing	FM 528 to West Bay Area Blvd	\$ 30,000,000	20%	\$ 6,000,000	15
8	Buy Outs	Associated with all Projects	\$ 30,000,000	25%	\$ 7,500,000	5
9	Engineering	Engineering and environmental Impact Studies	\$ 10,000,000	20%	\$ 2,000,000	4
TOTAL -->			\$ 173,000,000	18%	\$ 31,800,000	

1. Costs based on engineering estimates for similar work.
2. While Dr. Bedient's work showed the FM2351 Bridge that while raising has a bigger impact, we believe for public safety two bridges should be elevated. But also note the terracing should reduce the flood heights which also help bridges stay passable

Input from Subcommittee:

Terracing Cost Basis

Stretch	Distance (MI)	Volume (CY)	Units	Cost Per Unit	Estimate	Estimate with Contingency
Dixie Farm Road to FM 2351	3.00	2,112,000	CY	\$ 10	\$21,120,000	\$ 27,456,000
FM 2351 to Whispering Pines Ave	2.25	1,584,000	CY	\$ 10	\$15,840,000	\$ 20,592,000
Whispering Pines Ave to FM 528	1.20	844,800	CY	\$ 10	\$ 8,448,000	\$ 10,982,400
FM 528 to West Bay Area Blvd	3.10	2,182,400	CY	\$ 10	\$21,824,000	\$ 28,371,200

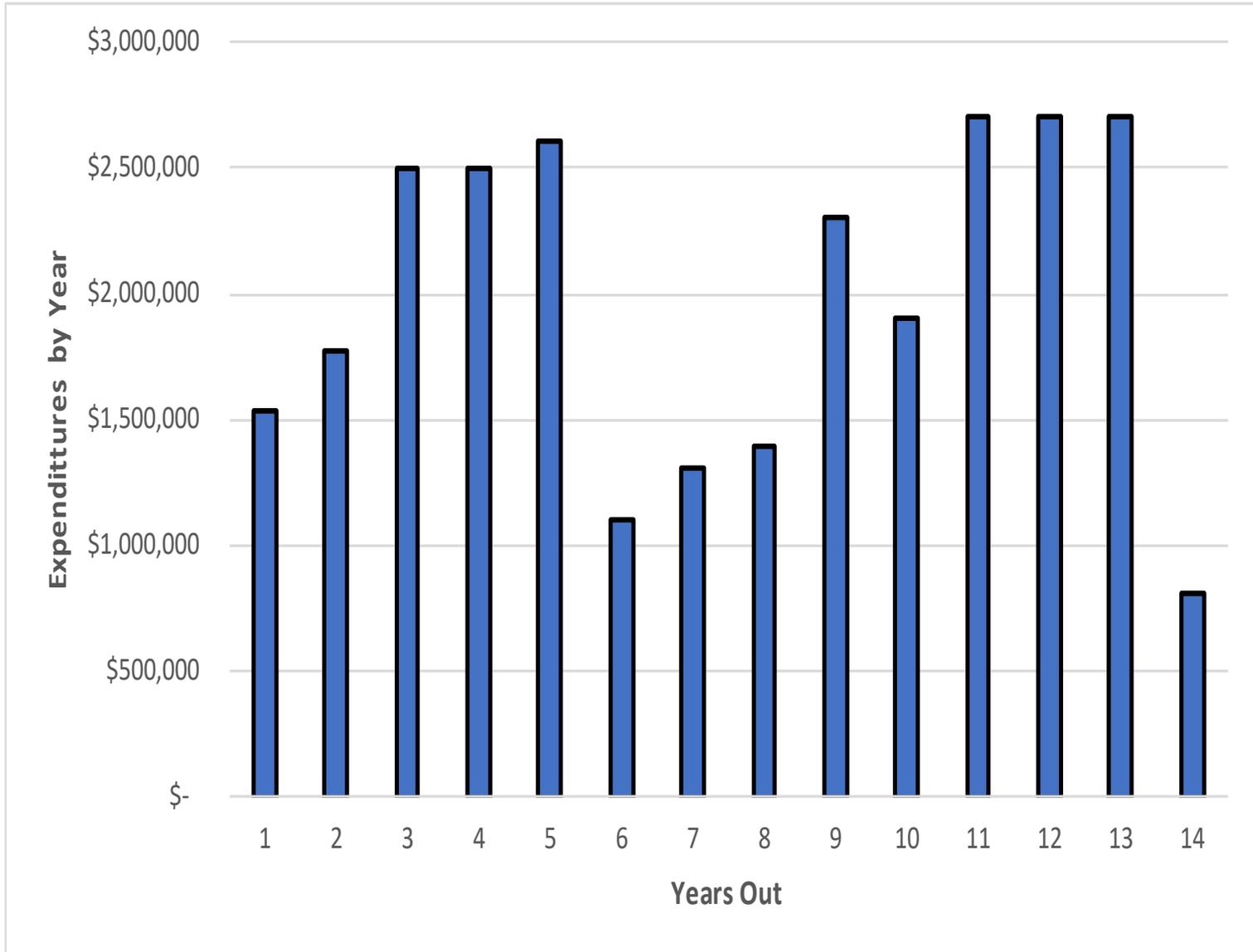
- 1 - Cost per unit was derived from the Harris County Flood Control District - see "HCFCD - Cubic Yard Estimate.PDF"
- 2 - Cross-sectional area of terracing one side of the Clear Creek approximately 1,800 SF
- 3 - Above estimates do not include land acquisition costs

TERRACING CROSS-SECTION
 1/2 OF THE CREEK



Subcommittee Input to the CAT: Estimated Spend Rate for Projects Listed

Input from
Subcommittee:



Citizen Advisory Team

Evaluation & Recommendation



Revised Cost Summary

(Provided by the Citizen Advisory Team)

#	Mitigation Type	Details	Total Cost	COF%	Cost to COF	Years to Complete
1	De-Snagging	200 ft - Deleted	0	0	-	0
2	Bridge /Road Raising	FM2351 - Deleted	0	0	-	0
3	Bridge /Road Raising	FM528 - Deleted	0	0	-	0
4	Terracing	Dixie Farm Road to FM2351	28,000,000	25%	7,000,000	15
5	Terracing	FM2351 to Whispering Pines	22,000,000	25%	5,500,000	15
6	Terracing	Whispering Pines to FM528	10,000,000	25%	2,500,000	15
7	Terracing	FM528 to Bay Area Blvd	30,000,000	25%	7,500,000	15
8	Buy Outs	Associated with all Projects	48,000,000	25%	12,000,000	15
9	Engineering	Engineering/Park Design and environmental impact studies	14,500,000	25%	3,625,000	4
		Sub Total	152,500,000		38,125,000	
		3% Inflation over 15 Years	37,388,371		9,347,093	
		Total	189,888,371		47,472,093	

Cost of Debt by Year w/Inflation and Projected Tax

(Provided by the Citizen Advisory Team)

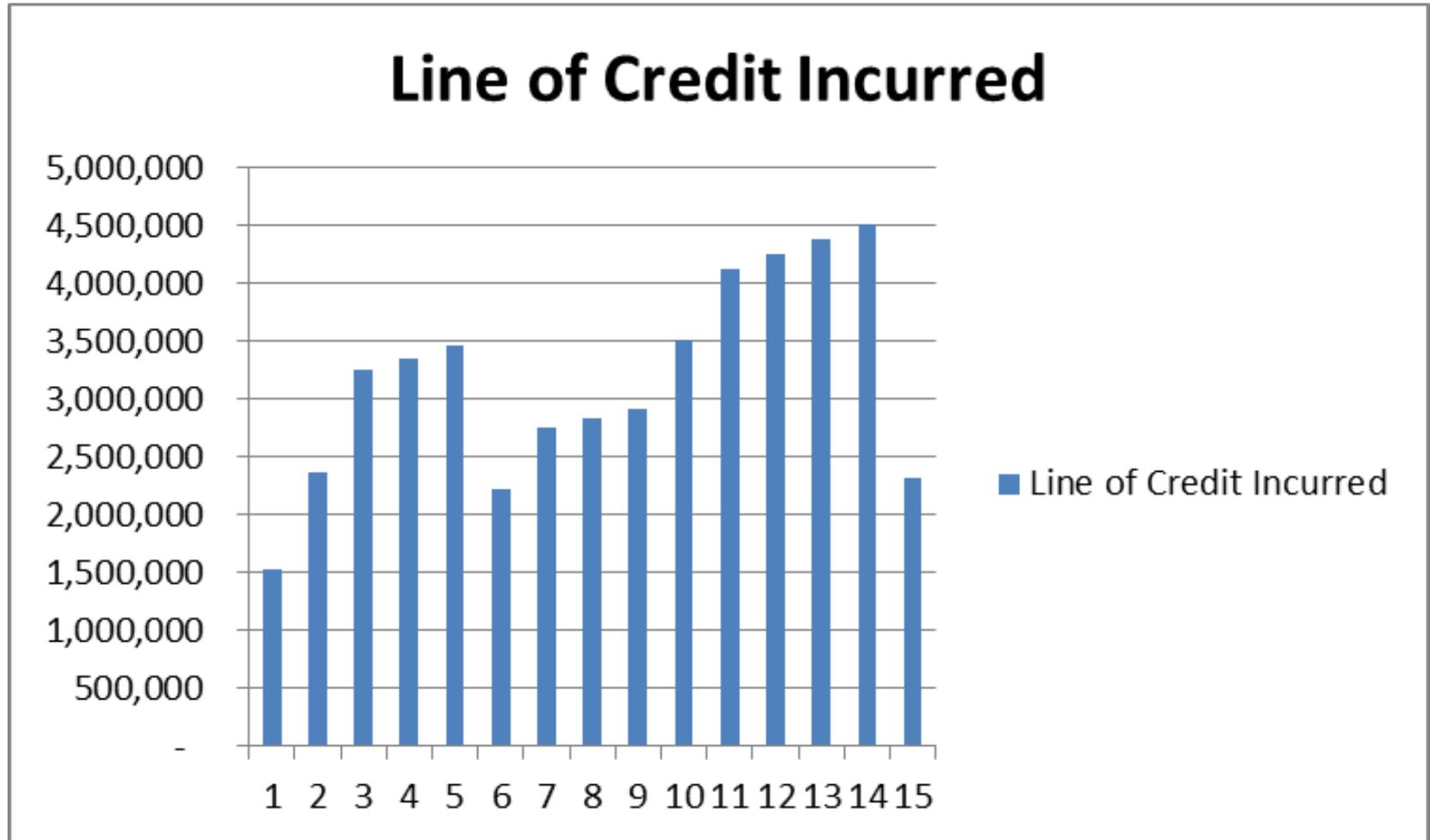
Year	% of Project	Total Cost in Current \$s	Cost Share in Current \$s	Inflation	Line of Credit Incurred	Cummulative Debt	Projected Tax/mo. on a \$300K Appraised Property*
2020	4%	6,100,000	1,525,000	1	1,525,000	1,525,000	\$ 0.34
2021	6%	9,150,000	2,287,500	1.03	2,356,125	3,881,125	\$ 0.86
2022	8%	12,200,000	3,050,000	1.0609	3,235,745	7,116,870	\$ 1.58
2023	8%	12,200,000	3,050,000	1.092727	3,332,817	10,449,687	\$ 2.32
2024	8%	12,200,000	3,050,000	1.12550881	3,432,802	13,882,489	\$ 3.08
2025	5%	7,625,000	1,906,250	1.15927407	2,209,866	16,092,355	\$ 3.58
2026	6%	9,150,000	2,287,500	1.1940523	2,731,395	18,823,750	\$ 4.18
2027	6%	9,150,000	2,287,500	1.22987387	2,813,336	21,637,087	\$ 4.81
2028	6%	9,150,000	2,287,500	1.26677008	2,897,737	24,534,823	\$ 5.45
2029	7%	10,675,000	2,668,750	1.30477318	3,482,113	28,016,937	\$ 6.23
2030	8%	12,200,000	3,050,000	1.34391638	4,098,945	32,115,881	\$ 7.14
2031	8%	12,200,000	3,050,000	1.38423387	4,221,913	36,337,795	\$ 8.08
2032	8%	12,200,000	3,050,000	1.42576089	4,348,571	40,686,365	\$ 9.04
2033	8%	12,200,000	3,050,000	1.46853371	4,479,028	45,165,393	\$ 10.04
2034	4%	6,100,000	1,525,000	1.51258972	2,306,699	47,472,093	\$ 10.55
	100%	152,500,000	38,125,000				

* Assumes the guideline provided to the CAT of \$10/month for a \$45M Bond.

\$32M is projected to be reached before completion in 11 years.
 \$47M is projected to be reached upon completion in 15 years.

Cost Share Expenditure by Year

(Provided by the Citizen Advisory Team)



Citizen Advisory Team

Recap of Suggested Changes



- Terracing removes need for de-snagging
- Little benefit to raising bridge
- Meets the 25% cost share requirement

- Allows Excavation on City-owned properties
- Accounts for inflation
- Provides for design of parkland with drainage*

*Park design only – buildout is not covered by this bond.

Payoff from the Citizen Advisory Team Recommendation



- Purchase of approximately 75 homes:
 - Plus improvements in Friendswood
 - saves about 1000 homes (13 to 1 payoff).
 - Plus improvements downstream
 - saves >2,000 homes (>25 to 1 payoff).

Project Rational – Clear Creek Drainage and Flood Mitigation

- **Vision 2020?**
 - A weakness in our city is the flooding problem and a desire of the city is parkland and walking and biking.
- **Enhance Safety?**
 - Clearly the lessening of flood water levels enhances safety for homes/businesses/people. Having bridges above flood water due to lower water levels provides access to emergency services in high-water events.
- **Promote Friendswood as #1 City?**
 - NOT being known as a flood-prone City is a first step, developing a Clear Creek parkland will be an amazing asset.
- **Improve efficiency in operation?**
 - City operations and flood projects cannot both be performed without funding for the latter.
- **Increase attractiveness to prospective businesses?**
 - Yes, a vibrant city without abandoned/damaged homes with a beautiful park and safe from flooding will increase business and desire for living here.
- **Improve quality of life?**
 - Yes. Fewer worries of flooding and a new parkland are both highly valued.
- **Improve infrastructure?**
 - Protects infrastructure from flood damage.
- **Prepare Friendswood for build-out?**
 - Improves Clear Creek capacity for new developments to drain their flood water without risk of flooding homes and businesses.
- **Benefit to what percentage of residents?**
 - All residents benefit from improved drainage and increased parkland throughout the City.
 - Reduces probability of flood waters backing up into tributaries, drainage channels, streets, and homes for all residents.
 - Provides parkland for use by all residents.
 - Reduces flood risk for all residents, thereby reducing insurance premiums or obviating the necessity.
- **Increase values of homes and businesses?**
 - Yes. Provides the capacity needed for safe flood water drainage from all properties in Friendswood. Reduces flood risk for all homes and businesses and provides nearby beautiful parkland thereby increasing property values.

DRAFT - Proposition A

“Shall the City Council (the “City Council”) of the City of Friendswood (the “City”) be authorized to issue general obligation bonds of the City in the amount of **\$47,500,000 over 15 years for the purpose of providing funds for permanent public improvement, to wit: planning, designing, constructing, improving, reconstructing, renovating, repairing, replacing and expanding flood protection and storm drainage facilities and improvements, and erosion control, including the acquisition of land therefore and **design for parkland** to improve **Clear Creek drainage of flood water**; said bonds to mature serially over a period of not to exceed thirty (30) years from their date, to be issued in such installments and sold at any price or prices and to bear interest at any rate, as shall be determined within the discretion of the City Council under laws in effect at the time of issuance, and to provide for the payment of the principal of and interest on said bond by levying a tax sufficient to pay the annual interest on and to create a sinking fund sufficient to redeem said bonds as they become due?”**

FAQ Information for DRAFT Proposition A

FAQ Information:

- A vote of YES would provide cost share to partner on flood mitigation programs to lower Clear Creek Stream Elevation to save approximately 1,000 homes in Friendswood from flooding in a Harvey-type rain event.
- When combined with improvements downstream from Friendswood through I-45, the number of homes saved is expected to more than double. It would reduce the number of homes in Friendswood that are within the 100 year and 500 year flood plains on FEMA maps.
- The tax impact when applied to a Friendswood homeowner with an assessed home value of \$300,000 with a homestead exemption would equate to an estimated increase of \$3.08 per month in property taxes at the end of 5 years.
- It will equate to an estimated increase of \$10.55 per month in property taxes at the end of the project in 15 years.

Back up

Input:

Subcommittee input to the CAT: Summary of Scenario Individual Testing – Harvey

#	Watchpoint Location	Change in Peak WSEL (ft)					
		Three-Bridge Raising	Terracing	Bridge Rm + Terracing	De-Snag	50% Diversion	Detention
1	Upstream FM 2351 Bridge	-0.79	-3.78	-4.11	-0.86	-0.11	-0.03
2	Downstream FM 2351 Bridge	-0.09	-3.38	-3.37	-1.47	-0.15	-0.04
3	Upstream Whispering Pines Bridge	-0.20	-1.83	-1.83	-0.87	-0.38	-0.04
4	Downstream Whispering Pines Bridge	-0.19	-1.56	-1.56	-0.75	-0.47	-0.04
5	Upstream FM 528 Bridge	-0.19	-1.10	-1.10	-0.44	-0.74	-0.05
6	Downstream FM 528 Bridge	0.00	-0.90	-0.90	-0.37	-1.03	-0.06
7	Downstream Bay Area Blvd Bridge	0.00	-0.09	-0.09	0.00	-2.9	-0.09
8	Downstream I-45 Bridge	0.00	0.00	0.00	0.00	-3.62	-0.06
9	Clear Lake	0.00	0.00	0.00	0.00	-1.52	-0.04

(Source: Rice University Hydrology Lab)

Cost Basis for Buyouts

(Provided by the Citizen Advisory Team - A cost basis was not available from the Subcommittee)

Algorithm:

- Count of private properties that are in the floodway (e.g. these are used to convey flood water)
- 25% for uncertainty on count
- 25% uncertainty on valuation

Buyouts:	With Structures		Without Structures	
	Galveston County	Harris County	Galveston County	Harris County
Count of Privately Owned Properties in the Floodway (Touch Clear Creek)	46	17	25	20
25% additional	58	21	31	25
Average Cost per Property (incl Demolition, Closing, etc.)	500,000	250,000	100,000	50,000
Raw cost	28,750,000	5,312,500	3,125,000	1,250,000
		SubTotal*		38,437,500
		Cost Uncertainty (25%)		9,609,375
		Grand Total		48,046,875
* Does not include purchase of the Whitcomb property south of FM528.				
		25% Cost Share:		12,011,719

Parkland Buildout Cost Basis for Estimating Engineering, Environmental Studies and Park Design at 11% of Buildout

(Provided by the Citizen Advisory Team – This was not in the Subcommittee Charter)

Drainage and Parkland Buildout Cost (used to Estimate Pre-Construction Engineering and Design Cost at 11% of Buildout):	
Algorithm:	
Park length: ~10 miles	
Sidewalk costs: \$485,760 per mile x 2 sides x 2 for spurs x 10 miles	19,430,400
Bathroom costs: \$300/sq ft x 20' x 20' x 5 x 2 sides	1,200,000
Docks: \$20K/dock x 1 dock per 2 miles x 10 miles x 2 sides	200,000
Small Parking Lots: \$20K/lot x 1 lot per 2 miles x 10 miles x 2 sides	200,000
Grass seeding: \$4K/acre x 10 miles x 5,280 ft x 400 ft width x 1 acre/43,560 sq ft	1,939
Ground cover: \$80/acre x 10% of total acreage x 10 miles x 5,280 ft x 600 ft width x 1 acre/43,560 sq ft	11,636
Trees and shrubs: \$100/unit x 500 units/acre x 10 miles of burms x 5,280 ft x 100 ft w x 2 sides / 43,560	12,121,212
Picnic Tables and Benches: \$2K/table x 50 per side x 2 sides + \$0.5K/bench x 1 bench per 0.25 miles x 10 miles x 2 sides	202,500
	SubTotal
	33,367,688
	Plus 25% Contingency
	<u>8,341,922</u>
	Total Parkland Buildout Cost
	41,709,610
	Terracing Raw Cost
	<u>90,000,000</u>
	Total Combined Terracing and Parkland
	131,709,610
	11% Total Pre-Construction Cost*
	14,488,057

*Same percentage as for Terracing Only. For a parametric, this is the same percentage as for engineering and design of a golf course.

Harris County % Cost Share for Projects in the Clear Creek Watershed

ID	Location	Description	Local Only	Grant Total	Fed Partner Share	Bond Local Match	Planned Expenditures Upstream of Dixie Farm	Planned Expenditures Downstream of Dixie Farm	%
C-03	Upstream	CC Project		295,000,000	225,000,000	70,000,000	295,000,000		0.237288
CI-001	Fwd (Clear Creek)	Restore CC channel conveyance	25,000,000	-				25,000,000	
A-100	Scarsdale	Buyouts		38,800,000	29,100	9,700,000	38,800,000		0.25
CI-039	Nasau Bay	Nasau Bay		150,000	25,000	125,000		150,000	0.833333
CI-013	LaPorte	Restore channel conveyance on A-104	5,000,000	-				5,000,000	
F-01	Upstream	Right of way acquisition-conveyance A-135	2,500,000	-			2,500,000		
CI-003	Fwd (near BAB)	Rehab A214 for channel conveyance		1,000,000	500,000	500,000		1,000,000	0.5
F-02	Upstream	Hughes detention	6,100,000	-			6,100,000		
F-03	Upstream	Dagg Road detention	7,400,000	-			7,400,000		
CI-62	Fwd (528 pond)	Friendswood FM 528 detention		10,000,000	7,500,000	2,500,000		10,000,000	0.25
CI-63	Fwd (DF pond)	Friendswood Dixie Farm detention		10,000,000	7,500,000	2,500,000		10,000,000	0.25
C-05	Upstream	Southbelt Detention - A.K.A. Mudd Gully		15,950,000	11,962,500	3,987,500	15,950,000		0.25
F-76	I-45	Environmental Mitigation Bank	6,000,000	-				6,000,000	
A-ENG	Fwd (El Dorado)	Subdivision Drainage Improvement		12,060,000	9,045,000	3,015,000		12,060,000	0.25
	Dispersed	Storm Repairs in CC Watershed		675,000	540,000	135,000		675,000	0.2
		Total	52,000,000	383,635,000	262,101,600	92,462,500			0.241017
		Grand Total (Local plus Grant Total)				435,635,000	365,750,000	69,885,000	

Approximate effect of Terracing on the count of flooded homes

Projected Count of Homes that will Flood After Terracing in Friendswood.				
	# Homes Flooded in Harvey	Avg. ft Reduction	Avg Inches Reduction	# Homes that will still Flood
Upstream FM2351	166	4	48	10
FM2351 to Whispering Pines	599	2.6	31.2	260
Whispering Pines to FM528	1051	1.3	15.6	714
FM528 to BAB	742	0.4	4.8	720
Total	2558			1704
Approx. 1,500 to 2,000 accounting for error sources				

Projected Count of Homes that will Flood After Terracing in Friendswood plus Terracing to Downstream of I-45.				
	# Homes Flooded in Harvey	Avg. ft Reduction	Avg Inches Reduction	# Homes that will still Flood
Upstream FM2351	166	5.6	67.2	0
FM2351 to Whispering Pines	599	4.7	56.4	68
Whispering Pines to FM528	1051	3.8	45.6	333
FM528 to BAB	742	3.2	38.4	59
Total	2558			471
Approx. 400 to 600 accounting for error sources				

15 Year Cost Spread

(Provided by the Citizen Advisory Team)

#	Mitigation	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1	De-Snagging															
2	Bridge /Road Raising FM2351															
3	Bridge /Road Raising FM528															
4	Terracing IV										696,480	1,760,896	1,678,588	1,598,678	1,521,095	230,650
5	Terracing III						584,871	1,275,428	1,295,949	1,233,495	835,358	50,000	50,000	50,000	50,000	10,000
6	Terracing II					1,378,304	502,621	150,000	60,000	55,000	55,000	55,000	55,000	55,000	55,000	54,736
7	Terracing I	192,634	1,155,365	1,969,760	1,865,495	1,135,963	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
8	Buy Outs	800,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000	860,000
9	Engineering and Park Design	906,250	750,000	750,000	750,000											
	SubTotal	1,898,884	2,765,365	3,579,760	3,475,495	3,374,267	2,047,492	2,385,428	2,315,949	2,248,495	2,546,838	2,825,896	2,743,588	2,663,678	2,586,095	1,255,386
	Total (w/Inflation)	1,898,884	2,848,326	3,797,767	3,797,767	3,797,767	2,373,605	2,848,326	2,848,326	2,848,326	3,323,047	3,797,767	3,797,767	3,797,767	3,797,767	1,898,884
		4%	6%	8%	8%	8%	5%	6%	6%	6%	7%	8%	8%	8%	8%	4%

This is NOT what we want!



STEPHEN BAY
bayimages.net

This is more like what we want!



This is something we'd like to see!

