

Source Materials

Clear Creek Drainage Bond Citizen Advisory Team Evaluation and Recommendation

6/15/19

Clear Creek Drainage Citizen Advisory Team Members

- Linda Jenkins
- Ron Jenkins
- Gail Lovely
- Ron Lovely
- Connie Ratisseau
- Phil Ratisseau
- Marcus Rives
- Richard Sasson
- Sarah Van Riper

Purpose

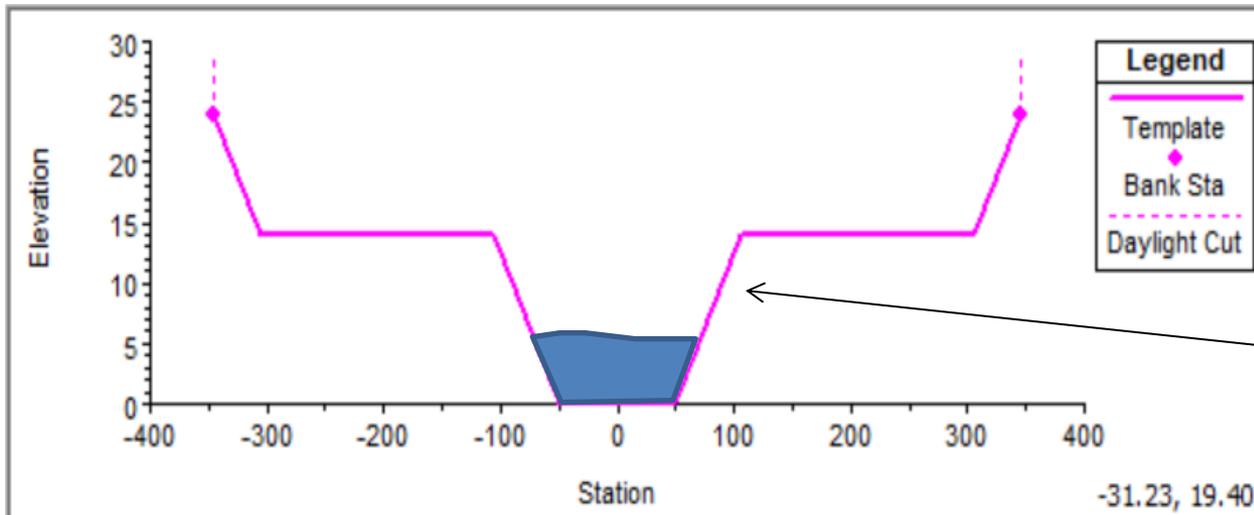
- Problem Statement of the Clear Creek Drainage Subcommittee:
 - ***The City of Friendswood is subject to periodic high intensity historic level flooding events caused by Clear Creek being incapable of containing watershed rainwater within its current banks; backing up tributaries. These events have caused significant property damage, displacement of families, economic impact, disruption of emergency services, and loss of life.***
 - ***A strategy is required to mitigate historic level flood events, which are happening at a regularity greater than rainstorm probabilities predict. The problem requires a plan that should include the engineering, costs, political realities, and will to act to overcome obstacles.***
- Purpose of the Clear Creek Drainage Bond:
 - ***Provide cost share to compete for State and Federal funds to implement the strategy***
- Purpose of the Citizen Advisory Team:
 - ***Evaluate and advise***

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.

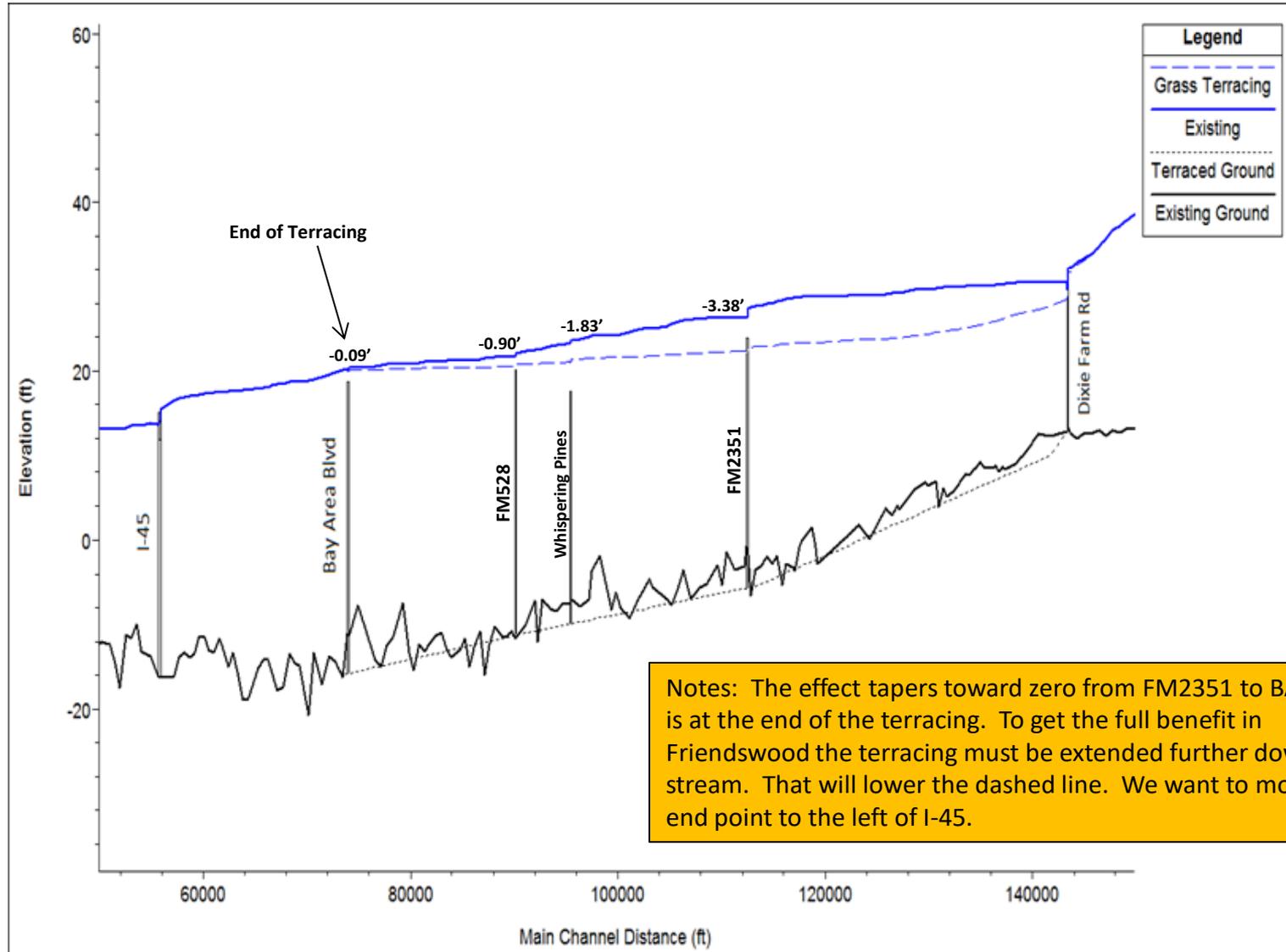
Bottom Width	Channel Depth	Side Slope (H:V)	Terracing Distance (each side)	Terracing Depth	Manning's n (channel)	Manning's n (grass terracing)
60 ft	14 ft	4	200 ft	10 ft	0.015	0.04

Note: The trapezoid channel could increase volume by ~10%. Stream height effect might be a few inches but the simulation without the trapezoid channel has not been run.

Input from Subcommittee:

Effect of the Channel and Grass Terrace

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



Notes: The effect tapers toward zero from FM2351 to BAB which is at the end of the terracing. To get the full benefit in Friendswood the terracing must be extended further down stream. That will lower the dashed line. We want to move the end point to the left of I-45.

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-Snag	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
½ OF THE CREEK



Input from
Subcommittee:

HCFCD estimating
for excavation plus
30% for “soft costs”
that were identified
as “contingency”
on the previous
chart

From: Black, Alan (Flood Control) <Alan.Black@hcfcd.org>
Sent: Thursday, December 27, 2018 9:51 AM
To: Steven Simmons <ssimmons@ci.friendswood.tx.us>
Cc: Patrick G. Donart <pdonart@ci.friendswood.tx.us>; George Cherepes <gcherepes@ci.friendswood.tx.us>
Subject: [EXTERNAL]RE: High Level Forrest Bend (FM 528) Basin Estimate

\$10/CY is a very high level number. Excavation itself and off-site disposal by the contractor is traditional about \$8/CY. I add the \$2/CY for other items such as backslope swale interceptor, concrete for a weir as appropriate, maintenance access, etc. Then add another 30% for soft costs.

From: Steven Simmons [<mailto:ssimmons@ci.friendswood.tx.us>]
Sent: Thursday, December 27, 2018 9:48 AM
To: Black, Alan (Flood Control)
Cc: Patrick G. Donart; George Cherepes
Subject: RE: High Level Forrest Bend (FM 528) Basin Estimate

Mr. Black,

We met with our City Manager yesterday and our direction is to apply for the CDBG funds to go toward this project. Regarding the calculations below, can you confirm that the \$10 per cubic yard is a good figure and line out how that figure is achieved?

In speaking with the GCCDD and with our Public Works Department, the figure seemed to be low.

Respectfully,

Steven Simmons
City of Friendswood
Deputy Fire Marshal
Fire Marshal's Office / Office of Emergency Management
(281) 998-3335
ssimmons@ci.friendswood.tx.us

From: Black, Alan (Flood Control) <Alan.Black@hcfcd.org>
Sent: Friday, December 21, 2018 1:44 PM
To: Steven Simmons <ssimmons@ci.friendswood.tx.us>
Subject: [EXTERNAL]High Level Forrest Bend (FM 528) Basin Estimate

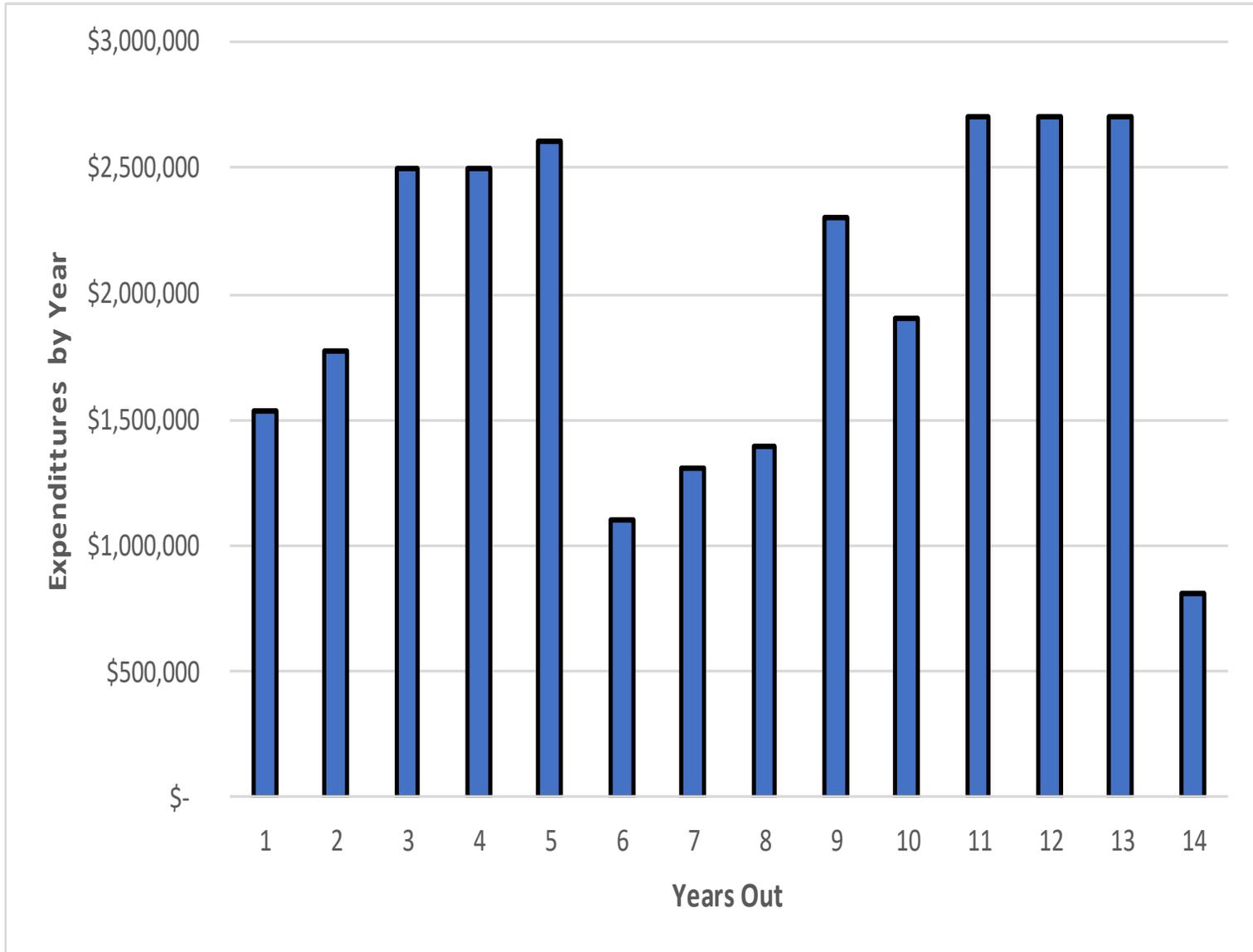
Good Afternoon Steven,

I assumed the site was 17 acres (see below).

Typically our basins lose about 25% of the top of bank footprint acreage to access, maintenance berms, etc. So call that 12.75 acres. I assumed the depth of the basin would be approximately 10 ft (total guess), and typically we'll lose about 20% of that volume to grading, side slopes, etc, so that yields 102 ac-ft of detention. Convert that to cubic yards (multiply x 43,560 and divide by 27) yields 164,560 CY. All in on a simple basin like this, including backslope swales, outfall pipes, etc, we use about

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

Input from
Subcommittee:



Citizen Advisory Team Evaluation

Technical Evaluation

- Technical maturity is low (high uncertainty).

Cost Evaluation

- The 25% cost share requirement was not met
- No cost basis or algorithm was provided for buyouts:
 - The \$30M figure depends on people allowing excavation on their private property.
- Cost estimates were only for drainage excavations
 - Considerations for use as a park were not part of the Subcommittee charter
- No accounting for inflation

Citizen Advisory Team

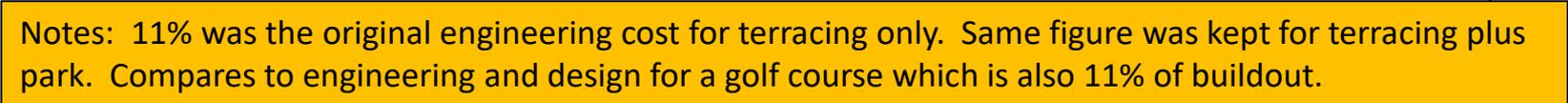
Line Item Change Recommendations

- **Delete de-snag** (Reduces total by \$3M and Cost Share by \$300K)
 - Rationale: Already being performed by GCCDD and HCFCD in places that need it. Terracing will obviate the need when it gets performed.
- **Delete bridge changes** (Reduces total by \$40M and Cost Share by \$4M)
 - Rationale: Benefits are either not apparent or very small in the simulation data. FM2351 is above flood level post-terracing. Bridge span and height requirements depend on the effects of the particular flood mitigation strategies implemented. Post-terracing downstream of the City will likely obviate the need to change FM528 bridge/road. Fund separately if later determined to be required.
- **Accept terracing cost as shown on the Subcommittee's summary chart**
 - Rationale: Includes 30% industry standard for uncertainty (source: HCFCD). This is expected to cover unknowns associated with the "as-simulated/as-costed" differences in excavation volume as well as other "soft costs". The Citizen Advisory Team acknowledges utilities relocation and erosion control (e.g. geo pavers) costs to be a risk.

Citizen Advisory Team

Line Item Change Recommendations

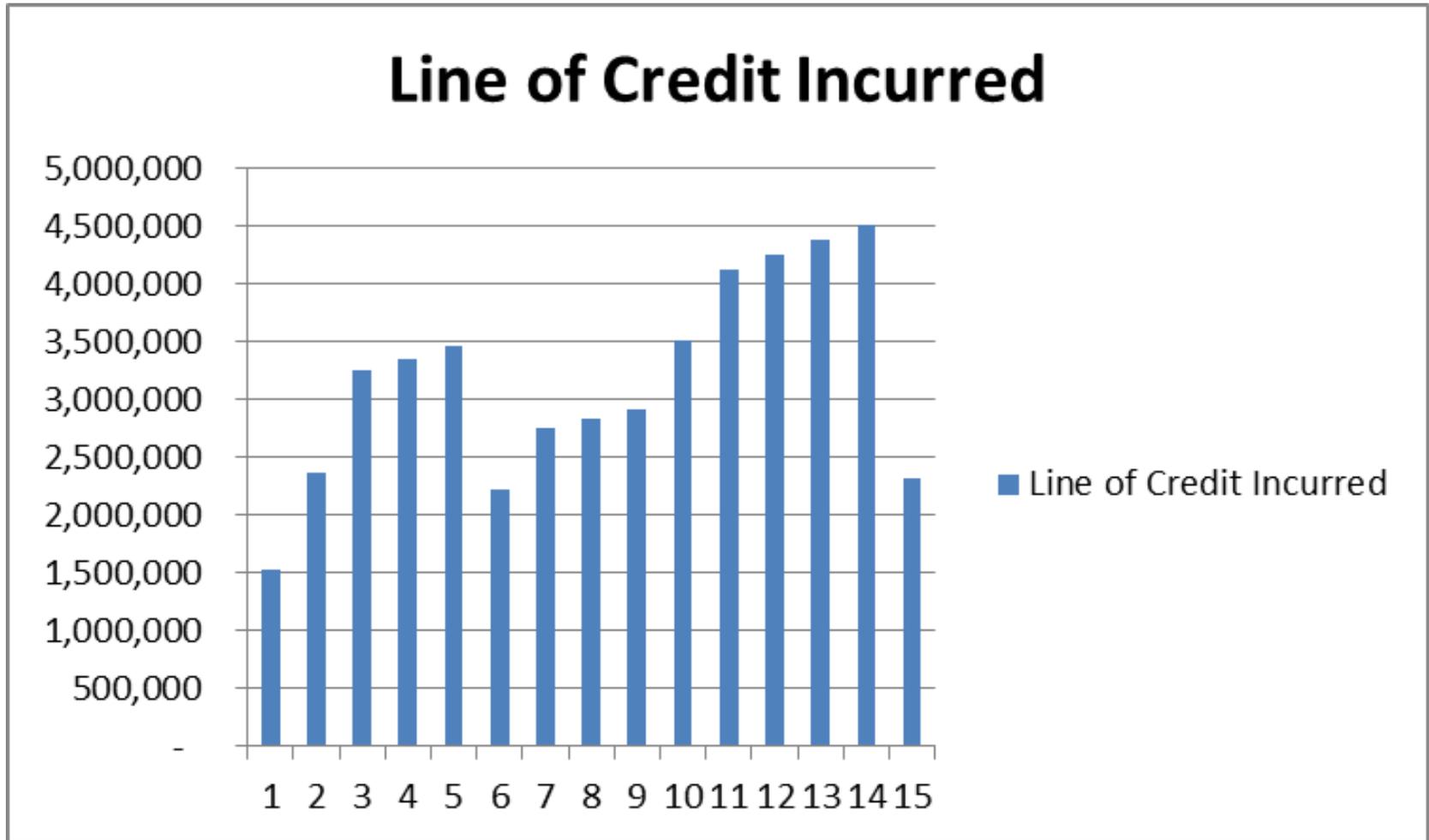
- **Increase terracing cost share from 20% to 25% to meet the cost share requirement for drainage projects** (Cost Share changes from \$18M to \$22.5M)
 - Rationale: Meet the requirement. We need the 25% required cost share to compete for State and Federal funds. HCFCF used 25% (see back up).
- **Increase Buyouts from \$30M to \$48M** (Cost Share changes from \$7.5M to \$12M)
 - Rationale: This is the result of the algorithm (provided in Back-up). The original figure depended on excavating on private land.
- **Increase Engineering from \$10M to \$14.5M to include Park Design** (Cost Share changes from \$2M to \$3M)
 - Rationale: Ensure that Friendswood gets a beautiful park with drainage and not just a drainage channel. Cost basis provided in back-up materials based on 11% of buildout cost.
- **Account for 3% per year inflation**
 - Rationale: Standard practice. This is a 15 year+ project.



Notes: 11% was the original engineering cost for terracing only. Same figure was kept for terracing plus park. Compares to engineering and design for a golf course which is also 11% of buildout.

Cost Share Expenditure by Year

(Provided by the Citizen Advisory Team)



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%

Citizen Advisory Team Recommendation

- \$47.5M over 15 years.
 - Meets the 25% cost share requirement
 - Does not require excavation on private properties
 - Provides for the design of a park with drainage*
(not just a drainage feature that later has to be corrected)
 - Accounts for inflation

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

Payoff from the Citizen Advisory Team Recommendation

- Purchase of approximately 75 homes saves about 1000 homes in Friendswood after improvements in Friendswood (13 to 1 payoff).
- With downstream improvements the purchase of approximately 75 homes can save >2,000 homes in Friendswood (>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 for outdoor activities like 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 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?**
 - 100%. Improves Clear Creek capacity to handle the drainage from all residents 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 Federal, State and County 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 \$1.75 per month in property taxes at the end of 5 years. It will equate to an estimated increase of \$5.26 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				