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Prioritization Framework for the Implementation of the Harris County Flood Control District 2018 Bond Projects

August 21, 2019

HARRIS COUNTY FLOOD CONTROL DISTRICT

Purpose

This document outlines the prioritization framework for the Harris County Flood Control District's (District) approach to the District's 2018 Bond Program projects. The District strives to complete projects that prevent the worst impacts on people first ("worst first" approach). This document evaluates a combination of several factors to develop a prioritization framework.

The 2018 Bond Program identified over 200 projects throughout Harris County. The prioritization framework summarized in this document includes evaluation criteria and a weighting process that will provide input to the master schedule of the 2018 Bond Projects throughout the remaining lifetime of the Bond.

Types of Bond Projects

The following are the major types of projects within the 2018 Bond election.

- Right-of-Way, Planning, Design and/or Construction Projects – Traditional infrastructure projects to reduce flooding potential.
- Floodplain Preservation and Right-of-Way Acquisition – Acquisition of property deep in the floodplain for preservation as well as acquisition of property for future projects.
- Subdivision Drainage Improvements – Projects typically in partnership with another agency that has primary jurisdiction to improve the internal subdivision drainage in conjunction with District channels.
- Storm Repairs and Restore Channel Capacity - Projects that include fixing side slope failures and desilting channels to restore the channel capacity to the original design.
- Flood Warning System – Improvements and advancements to the existing District's Flood Warning System
- Floodplain Mapping Updates – Updates to the Federal Emergency Management Agency (FEMA) 1% floodplain maps and other mapping products.

Projects Outside the Prioritization Framework

The District was executing a phased Capital Improvement Program before the 2018 Bond election. Several projects that are in final design or that have bid-ready construction plans can quickly be executed by Bond funding. The District has used Bond funding to pay for these construction-ready projects to deliver the projects quickly so that the flood risk reduction benefits can be realized by the community. Since these projects are already underway, our plan will be to re-engage the community to inform them of progress and timelines but to continue these projects as designed. Local entities have also expressed interest in co-funding several projects. Some of these projects were initiated once partnership funding became available.

Three additional types of projects that were not evaluated are buyout projects, subdivision drainage improvement projects, and countywide projects such as the flood warning system:

- Buyout projects are necessarily long-term projects that require close collaboration with local communities;
- All subdivision drainage improvement projects have been initiated due to the lower capital costs of these projects and the need for these projects to be in place to realize benefits from flood control infrastructure;
- Countywide projects do not fit easily within the framework developed here due to the challenges in estimating the flood risk reduction benefits from these projects.

Project Prioritization

Evaluation criteria were developed to determine the initiation schedule of each of the remaining 2018 Bond projects. The criteria allow for an opportunity to create objectivity in the prioritization process. The Weighted Factors Analysis used to evaluate the remaining projects is described below in detail with the following criteria:

- Flood Risk Reduction
- Existing Conditions Drainage Level of Service
- Social Vulnerability Index
- Project Efficiency
- Partnership Funding
- Long Term Maintenance Costs
- Minimize Environmental Impacts
- Potential for Multiple Benefits

Each project is assigned a score for each criterion below ranging from 0 to 10. A score of "10" represents that a project for which the criterion was fully met and a score of "0" indicates that the project met did not meet the criterion.

There may be cases were, for example, certain projects must start and finish prior to other projects because those projects are dependent upon each other. In these cases the prioritization of these projects will be modified in order to accommodate for those schedule dependencies.

Flood Risk Reduction

Flood risk reduction benefits can be calculated in terms of water surface elevation reductions, reductions in limits of the 1% floodplain (100-year floodplain), or the number of structures where flooding risks have been reduced. The preliminary engineering report phase for each Bond project will quantify these benefits. If a preliminary engineering report is not prepared at the time of estimation, the District will estimate the benefits in terms of structures where flooding risks could be reduced.

Flood risk reduction benefits are calculated in terms of the number of structures, as opposed to the value of structures, where flooding risks have been reduced. The District used the internal structural inventory database to determine the number of structures benefitting from the

proposed projects. The structural inventory database will ultimately take into account if multi-family structures, such as apartments, benefit from the proposed project. Providing flood risk reduction for multi-family structures can benefit more people. The District will incorporate this information into the framework once it is available from the structural inventory database.

Flood risk reduction is scored by how much of the floodplain is reduced by each project then estimating the number of structures benefited by this reduction. Based on the Harris County Appraisal District's building footprint database, there are 183,833 structures that intersect with the limits of the Federal Emergency Management Agency (FEMA) mapped 1% AEP (100-year) effective floodplain. Table 1 defines the scoring associated with the 1% flood risk reduction of each Bond project.

Table 1: Flood Risk (1% AEP) Reduction Scoring Criteria*

Criteria	Score
Floodplain removed from 0 structures	0
Floodplain removed from < 10% of structures (~100 structures)	3
Floodplain removed from < 50% of structures (~200 structures)	6
Floodplain removed from < 75% of structures (~400 structures)	8
Floodplain removed from 100% of structures (~500 structures)	10

* The District is looking to determine the number of housing units and using that as a metric as opposed to structures. For example, an apartment building is one structure, but will contain multiple housing units. A flood damage reduction project could benefit multiple families and this benefit wouldn't be captured by only considering structures. The District will continue to work on this effort as we refine the methodology.

Existing Conditions Drainage Level of Service

The drainage level of service metric is a data set that was developed to determine the capacity of District channels. The capacity ranges from 1% Annual Exceedance Probability (AEP), or 100-year storm, to the 50% AEP storm, or 2-year storm. A channel with level of service greater than the 1% AEP is expected have less than 1% probability of flooding in a given year, while a channel with level of service less than 50% AEP is expected to have greater than 50% probability of flooding in a given year. Table 2 defines the scoring associated with the level of service for the District channel in question.

Table 2: Existing Conditions Drainage Level of Service Scoring Criteria

Criteria	Score
Level of service is > 1% AEP storm (100-year storm)	0
Level of service is < 1% AEP storm (100-year storm)	1
Level of service is < 2% AEP storm (50-year storm)	2
Level of service is < 4% AEP storm (25-year storm)	4
Level of service is < 10% AEP storm (10-year storm)	6

Level of service is < 20% AEP storm (5-year storm)	8
Level of service is < 50% AEP storm (2-year storm)	10

Social Vulnerability Index

Social vulnerability refers to the resilience of communities when confronted with disasters such as flooding. Communities that are more socially vulnerable are at greater risk for loss of life during a disaster and are slower to recover after a disaster. The Centers for Disease Control has created its Social Vulnerability Index (SVI) using 15 U.S. Census variables that influence a community's ability to prepare for, respond to, and recover from a disaster. These factors include the percentage of elderly residents, limited English proficiency, households without a vehicle, and other factors. The SVI score of the community served by a given bond project determines the scoring of this criterion. Table 3 provides the scoring ranges to account for social vulnerability.

Table 3: Social Vulnerability Scoring Criteria

Criteria	Score
SVI indicates low level of vulnerability	1
SVI indicates low to moderate level of vulnerability	4
SVI indicates moderate to high level of vulnerability	7
SVI indicates high level of vulnerability	10

Project Efficiency

Table 4 provides scoring for ranges of project efficiency. Project efficiency is defined as the total cost of the project divided by the number of structures within the mapped 1% AEP (100-year) effective floodplain that receive a flood damage reduction benefit.

$$Project\ Efficiency = \frac{Total\ Cost\ of\ Project\ (\$)}{\#\ of\ Structures\ Benefitted}$$

Table 4: Project Efficiency Scoring

Criteria	Score
Greater than 200,000	2
200,000 to 100,000	4
100,000 to 50,000	6
Less than 50,000	10

Partnership Funding

Table 5 provides scoring for projects based on the level of partnership funding. Partnership projects involve partial funding from another agency such as FEMA or a municipality.

Partnership projects are given a score based on the amount of leverage they provide to District 2018 Bond funds.

Table 5: Partnership Funding Scoring

Criteria	Score
No funding partner	0
Partnership funds cover less than 40% of project cost	4
Partnership funds cover 40-60% of project cost	8
Partnership funds cover greater than 60% of project cost	10

Long Term Maintenance Costs

Maintenance costs can be affected by the ability to access the channel, channel geometry and material, and maintenance berm width. Concrete-lined channels have different maintenance costs than grass-lined channels. Additionally, the size of the channel and/or stormwater detention basin will affect the maintenance costs. Table 6 defines the scoring associated with long term maintenance costs.

Table 6: Long Term Maintenance Costs Scoring Criteria

Criteria	Score
Project will require extensive or specialized maintenance	2
Project will require maintenance outside of District's regular maintenance practices	6
Project only requires regular, on-going maintenance	10

Minimize Environmental Impacts

Table 7 defines the scoring associated with project specific environmental mitigation. Environmental mitigation could include purchasing credits at a wetlands or streambank mitigation bank, completing environmental permits, and creating self-mitigating projects. Each of these items has an impact on project cost and schedule.

Table 7: Minimize Environmental Impacts Scoring Criteria

Criteria	Score
Project will have significant environmental impacts requiring a Corps of Engineers Individual Permit and mitigation bank credits	0
Project will have significant environmental impacts requiring mitigation bank credits	2
Project are able to significantly avoid environmental impacts	6
Project has minimal or no environmental impacts	10

Potential for Multiple Benefits

Table 8 defines the scoring associated with the project's potential for multiple benefits including recreational and environmental enhancements.

Table 8: Potential for Multiple Benefits Scoring Criteria

Criteria	Score
Project does not have multiple benefits	0
Project has recreational benefits	4
Project has environmental enhancement benefits	6
Project has recreational and environmental enhancement benefits	10

Weighted Factors Analysis

The Weighted Factors analysis allows criteria to be weighted based on percentages that sum to 100 percent. Each of the criteria was given a percentage weighting based on a holistic view of the District's priorities. The District's mission is to provide flood damage reduction projects that work, with appropriate regard for community and nature-driven values; therefore, flood risk reduction is the most heavily weighted factor, with the remaining factors weighted in decreasing order of priority: infrastructure and community equity, cost effectiveness, and other factors that influence the long-term value of the project.

• Flood Risk Reduction Weighting Factor	25%
• Existing Conditions Drainage Level of Service Weighting Factor	20%
• Social Vulnerability Index Weighting Factor	20%
• Project Efficiency Weighting Factor	10%
• Partnership Funding Weighting Factor	10%
• Long Term Maintenance Costs Weighting Factor	5%
• Minimizes Environmental Impacts Weighting Factor	5%
• Potential for Multiple Benefits Weighting Factor	5%
	100%

Using the criteria, scoring, and weights, Table 9 presents a ranking of the remaining Bond projects that have not started as of the date of this report. Each criterion score is multiplied by the criteria weight and added together for a total sum. The sum is the project rank. The projects were broken into four different groups. Each of these groups of projects (Quartiles) will be started by the District within a specific date range as shown on the master schedule. The first group of projects will start first, and then start the second group of projects and so on.

Table 9 – Summary of Bond Project Scores – DRAFT 8/21/2019

MAP ID	Watershed	Title	August 2019 - Score (Version 5)	August 2019 - Rank (Version 5)	August 2019 - Quartile Rank (Version 5)
C-23	Greens Bayou	Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-08-00	8.35	1	1
C-24	Greens Bayou	Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-09-00	8.25	2	1
C-43	Greens Bayou	Potential CDBG-DR (2017) - Planning, Right-of-Way Acquisition, Design and Construction of Channel Conveyance Improvements along P138-01-01	8.1	3	1
C-30	Greens Bayou	Right-Of-Way, Design, and Construction of Channel Conveyance Improvements on P118-27-00	8.05	4	1
C-15	White Oak Bayou	Design and Construction of Arbor Oaks Stormwater Detention Basin	8	5	1
C-08	Sims Bayou	Right-Of-Way Acquisition, Design, and Construction of Stormwater Detention Basin and Channel Conveyance Improvements along Salt Water Ditch	7.85	6	1
F-95	Sims Bayou	Planning, Right-Of-Way Acquisition, Design and Construction Along C144-00-00	7.3	7	1
C-10	Sims Bayou	Design and Construction of C506-01-00-E003	7.2	8	1
F-41	Cedar Bayou	Right-of-Way Acquisition, Design and Construction of Channel Conveyance Improvements along Clawson Ditch and Q124-00-00	7.2	8	1
C-47	Addicks Reservoir	Design and Construction of a Bridge Replacement for Greenhouse Road at South Mayde Creek	6.9	10	1
CI-006	Greens Bayou	Design and Construction of a Stormwater Detention Basin in Brock Park	6.9	10	1
F-47	Cedar Bayou	Right-Of-Way Acquisition, Design and Construction of Stormwater Detention Basins near Coastal Water Authority canals and IH 10	6.9	10	1
F-92	Sims Bayou	Planning, Right-Of-Way Acquisition, Design and Construction Along C116-00-00	6.7	13	1
C-13	Brays Bayou	Right-Of-Way, Design and Construction of Conveyance Improvements along Bintliff Ditch	6.6	14	1
F-07	Brays Bayou	Planning, Right-Of-Way Acquisition, Design, and Construction of Channel Conveyance Improvements on Keegans Bayou	6.5	15	1
F-46	Cedar Bayou	Design and Construction of the Q500-01 Stormwater Detention Basin	6.5	15	1
C-48	Addicks Reservoir	Right-Of-Way Acquisition, Design and Construction of a Stormwater Detention Basin on South Mayde Creek near the Grand Parkway	6.35	17	1
F-88	Cypress Creek	Design and Construction of Stormwater Detention Basins in Large Buyout Areas	6.3	18	1
F-89	Little Cypress Creek	Design and Construction of Additional Volume in Little Cypress Creek Stormwater Detention Basins	6.3	18	1
C-39	White Oak Bayou	Right-of-Way Acquisition, Design and Construction of the North Canal	6.2	20	2
F-19	Spring Creek	Spring Creek Right-of-Way Acquisition and Floodplain Preservation	6.2	20	2
F-36	Willow Creek	Willow Creek Right-of-Way Acquisition and Floodplain Preservation	6.2	20	2
C-57	Galveston Bay	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements Along F216-00-00	6.05	23	2
C-07	Armand Bayou	Design and Construction of the B509-04-00 Stormwater Detention Basin	6	24	2
F-43	Cedar Bayou	Right-of-Way Acquisition, Design and Construction of Channel Conveyance Improvements along Adlong Ditch	6	24	2
CI-60	San Jacinto River	Planning, Right-Of-Way, Design and Construction of Conveyance Improvements along Panther Creek	5.9	26	2
F-08	Brays Bayou	Right-Of-Way Acquisition, Design, and Construction of Channel Conveyance Improvements on Fondren Diversion Channel	5.9	26	2
F-125	Carpenters Bayou	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements in Carpenters Bayou watershed	5.9	26	2
F-17	Hunting Bayou	Right-Of-Way Acquisition, Design and Construction of Wallisville Outfall	5.85	29	2
C-44	Armand Bayou	Armand Bayou Right-of-Way Acquisition and Floodplain Preservation	5.8	30	2
F-20	Cypress Creek	Cypress Creek Right-of-Way Acquisition and Floodplain Preservation	5.8	30	2
CI-022	Greens Bayou	ROW, Design, and Construction of Stormwater Detention Basin Near P130-05	5.65	32	2
F-104	Vince Bayou	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements in Vince Bayou Watershed	5.65	32	2
F-94	Sims Bayou	Planning, Right-Of-Way Acquisition, Design and Construction Along C143-00-00	5.65	32	2
CI-031	Hunting Bayou	HCFCD Cost Share of Study with the City of Houston on Wallisville Outfall	5.55	35	2
C-06	Armand Bayou	Right-Of-Way Acquisition, Design and Construction of B112-00-00 and Tributaries Conveyance Improvements	5.4	36	2
F-106	Willow Creek	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements in Willow Creek Watershed	5.3	37	2
F-120	Goose Creek	Right-Of-Way Acquisition, Design, and Construction of General Drainage Improvements in Goose Creek watershed	5.3	37	2
F-51	Luce Bayou	Luce Bayou Right-of-Way Acquisition and Floodplain Preservation	5.3	37	2
F-01	Clear Creek	Right-Of-Way Acquisition, Design, and Construction of Channel Conveyance Improvements on A135-00-00	5.1	40	3
F-109	Goose Creek	Right-Of-Way Acquisition, Design, and Construction of General Drainage Improvements on Spring Gully	5.1	40	3
F-93	Sims Bayou	Planning, Right-Of-Way Acquisition, Design and Construction Along C124-00-00	5.1	40	3
CI-010	White Oak Bayou	Partnership Project with Jersey Village on Right-of-Way Acquisition, Design, and Construction of General Drainage Improvements along E127-00-00	5	43	3
C-118	Spring Creek	Planning, Right-of-Way Acquisition, Design and Construction of a Reservoir along Spring Creek	4.95	44	3
CI-032	White Oak Bayou	Investigation of Additional Stormwater Detention Basins in the White Oak Bayou Watershed	4.95	44	3
C-52	Addicks Reservoir	Rehabilitation of Channels Inside of Addicks Reservoir to Restore Channel Conveyance Capacity	4.9	46	3
CI-030	White Oak Bayou	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements along Turkey Gully	4.9	46	3
F-69	Cedar Bayou	Right-Of-Way Acquisition, Design and Construction of channel conveyance improvements on Q136-00-00 - Part of the Upstream Cedar Bayou Project	4.9	46	3
C-50	San Jacinto River	Future Partnership Projects Based on Results of Study for ROW Acquisition, Design, and Construction of General Drainage Improvements in San Jacinto River Watershed Study	4.8	49	3
CI-019	San Jacinto River	Investigations of Potential Detention Sites Around Glendale Dredge Site in Partnership with the City of Houston	4.75	50	3
CI-028	San Jacinto River	Design and Construction of Additional Gates on Lake Houston in Partnership with the City of Houston	4.75	50	3
F-119	Spring Creek	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements along Spring Creek	4.75	50	3
F-70	Cedar Bayou	Upstream Cedar Bayou Project - Right-Of-Way Acquisition, Design and Construction of Channel Conveyance Improvements and Stormwater Detention Basin Upstream of FM 1960	4.7	53	3
CI-034	Brays Bayou	Investigation of Channel Improvements Upstream of Fondren Road on Brays Bayou	4.6	54	3
F-111	San Jacinto River	Planning , Right-Of-Way Acquisition, design and Construction of General Drainage Improvements East of Lake Houston	4.6	54	3
CI-029	Sims Bayou	Restore Channel Conveyance Capacity Along C102-00-00	4.5	56	3
F-108	Luce Bayou	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements in Luce Bayou Watershed	4.5	56	3
CI-009	Buffalo Bayou	Partnership Project with Fort Bend County on Right-of-Way Acquisition, Design, and Construction of General Drainage Improvements along Clodine Ditch	4.45	58	3
F-98	Galveston Bay	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements in Galveston Bay Watershed	4.45	58	3
F-99	Armand Bayou	Right-Of-Way, Design and Construction of Conveyance Improvements along Armand Bayou	4.4	60	4
CI-59	Hunting Bayou	Planning, Right-Of-Way, Design and Construction of a Diversion Channel from H102-00-00 to H100-00-00 through Galena Park	4.2	61	4
CI-025	Brays Bayou	Investigation of Additional Stormwater Detention Basins in the Brays Bayou Watershed	4.15	62	4
F-84	Addicks Reservoir	Design and Construction of Secondary Outfall for John Pauls Landing for the Upper Langham Creek Program	4.15	62	4
F-42	Cedar Bayou	Right-of-Way Acquisition, Design and Construction of Channel Conveyance Improvements along Magee Gully	4	64	4
CI-003	Clear Creek	Rehabilitation of the A214-00-00 channel to Restore Channel Conveyance Capacity	3.9	65	4
CI-037	Sims Bayou	Restore Channel Conveyance Capacity Along C146-00-00	3.9	65	4
CI-038	Brays Bayou	Restore Channel Conveyance Capacity Along D115-00-00	3.9	65	4
CI-61	San Jacinto River	East Fork, West Fork and Lake Houston Dredging	3.8	68	4
F-107	Jackson Bayou	Right-of-Way Acquisition, Design and Construction of General Drainage Improvements in Jackson Bayou Watershed	3.8	68	4
C-53	Barker Reservoir	Rehabilitation of Channels Inside of Barker Reservoir to Restore Channel Conveyance Capacity	3.7	70	4
C-12	Brays Bayou	Right-Of-Way, Design and Construction of Conveyance Improvements along Poor Farm Ditch	3.55	71	4
CI-024	Buffalo Bayou	Investigation of Effectiveness of Micro-Detention in the Buffalo Bayou Watershed	3.35	72	4
F-55	Addicks Reservoir	Planning, Right-Of-Way Acquisition, Design, and Construction for Ultimate Conveyance on Bear Creek	3.3	73	4
F-80	Buffalo Bayou	Planning, Right-Of-Way Acquisition, Design and Construction Along Soldiers Creek	3	74	4
F-79	Buffalo Bayou	Planning, Right-Of-Way Acquisition, Design and Construction Along W157-00-00	2.95	75	4
F-15	San Jacinto River	Planning , Right-Of-Way Acquisition, design and Construction of General Drainage Improvements Near Atascocita	2.85	76	4
CI-001	Clear Creek	Rehabilitation of the Clear Creek channel to Restore Channel Conveyance Capacity	2.8	77	4
CI-017	Buffalo Bayou	Design & Construction of Replacement Bridges Along Buffalo Bayou	2.35	78	4
CI-018	Buffalo Bayou	Rehabilitation of W140-00-00 to Restore Channel Conveyance Capacity	1.7	79	4