

**DRAFT**

**Prioritizing the Implementation of  
Harris County Flood Control District  
2018 Bond Projects**

**February 27, 2019**



## **Purpose**

This document provides the draft documentation for the Harris County Flood Control District (HCFCD) evaluation process of prioritizing 2018 HCFCD Bond projects. This report will outline the evaluation criteria and weighting process to prioritize each project relative to each other. The 2018 Bond election identified over 200 projects throughout Harris County. The projects will be prioritized in the coming years to deliver the maximum flood damage reduction benefits to Harris County citizens.

## **Flood Risk Reduction Benefits**

HCFCD strives to complete projects that help the most people first (worst first approach). 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 this time, HCFCD will estimate the benefits in terms of structures where flooding risks could be reduced.

## **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 HCFCD uses 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 HCFCD channels.
- Storm Repairs and Restore Channel Capacity - Projects that include fixing side slope failures and desilting channels to the restore the channel capacity to the original design.
- Flood Warning System – Improvements and advancements to the existing HCFCD Flood Warning System
- Floodplain Mapping Updates – Updates to the Federal Emergency Management Agency (FEMA) 1% floodplain maps and other mapping products.

## **Construction Ready Projects**

HCFCFCD was executing a phased Capital Improvement Program before the 2018 Bond election. Several projects that are in final design will have bid-ready construction plans in the near future and can quickly be executed by Bond funding. HCFCFCD will prioritize using 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 will continue these projects as designed. Three additional types of projects that were not evaluated were the buyout projects, subdivision drainage improvement projects, and county wide projects.

## **Project Prioritization**

Evaluation criteria were developed to rank each of the remaining 2018 Bond projects. The criteria allow for an opportunity to create objectivity in the prioritization process. Two methods were utilized to rank projects: Weighted Factors Analysis and a Pairwise Analysis, both of which are described in the sections below. For each method, the following criteria were used and are discussed below.

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

Each criterion described below has a scoring system ranging from 0 to 10. A score of “10” represents that a project where all criteria were met and a score of “0” shows the project met did not meet the criterion. A higher score will result in a higher final rank of the project in this prioritization algorithm.

### **Existing Conditions Drainage Level of Service**

The drainage level of service is a data set that was developed to determine the capacity of HCFCFCD channels. The capacity ranges from 1% Annual Exceedance Probability (AEP), or 100-year storm, to the 50% AEP storm, or 2-year storm. Table 1 defines the scoring associated with the level of service for the District channel in question.

**Table 1: Existing Conditions Drainage Level of Service Scoring Criteria**

| <b>Criteria</b>                                     | <b>Score</b> |
|---|--------------|
| 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           |

Lack of Service

HCFCFCD has not been able to implement capital improvement projects in all areas of Harris County, primarily due to funding constraints. The last time HCFCFCD completed a flood damage reduction project in the area provides the scoring for this criterion. The HCFCFCD projects considered are only capital improvement projects that have lowered flood risks in the project area not HCFCFCD maintenance projects. Table 2 provides the scoring ranges to account for equity.

**Table 2: Lack of Service Scoring Criteria**

| <b>Criteria</b>  | <b>Score</b> |
|--|--------------|
| HCFCFCD CIP project in area within the last 0-10 years | 2            |
| HCFCFCD CIP project in area within the last 10+ years  | 10           |

Flood Risk Reduction

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 HCFCFCD 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 (apartments) benefit by the proposed project. Providing flood risk reduction for multi-family structures can arguably benefit more people. Additionally, the percentages shown in the table below are calculated by evaluating the percent of structures removed from the effective 1% floodplain in all of Harris County by each proposed project. 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 3 defines the scoring associated with the 1% flood risk reduction of each Bond project.

**Table 3: Flood Risk (1% AEP) Reduction Scoring Criteria\***

| <b>Criteria</b>   | <b>Score</b> |
|---|--------------|
| 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           |

\* HCFCD 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. HCFCD will continue to work on this effort as we refine the methodology.

#### 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 4 defines the scoring associated with long term maintenance costs.

**Table 4: Long Term Maintenance Costs Scoring Criteria**

| <b>Criteria</b>   | <b>Score</b> |
|---|--------------|
| Project will require extensive or specialized maintenance                         | 2            |
| Project will require maintenance outside of HCFCD's regular maintenance practices | 6            |
| Project only requires regular, on-going maintenance                               | 10           |

#### Minimize Environmental Impacts

Table 5 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 5: Minimize Environmental Impacts Scoring Criteria**

| <b>Criteria</b>  | <b>Score</b> |
|--|--------------|
| 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 6 defines the scoring associated with the project’s potential for multiple benefits including, but not limited to recreational and environmental enhancements.

**Table 6: Potential for Multiple Benefits Scoring Criteria**

| <b>Criteria</b>   | <b>Score</b> |
|---|--------------|
| 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           |

Project Efficiency

Table 7 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 7: Project Efficiency Scoring**

| <b>Criteria</b>      | <b>Score</b> |
|----------------------|--------------|
| 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 8 provides scoring for projects that have a funding partner or not. Partnership projects are partially funded by another agency such as FEMA or a municipality. Since partnership projects leverage HCFCD 2018 Bond funds, they are given a score of 10.

**Table 8: Partnership Funding Scoring**

| <b>Criteria</b>                          | <b>Score</b> |
|--|--------------|
| No funding partner                       | 0            |
| Local, State, or Federal funding partner | 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.

- Flood Risk Reduction Weighting Factor 25%
  - Existing Conditions Drainage Level of Service Weighting Factor 20%
  - Lack of Service Weighting Factor 15%
  - Project Efficiency Weighting Factor 15%
  - Partnership Funding 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 a sample of nine projects. The metrics defined above were used to calculate a ranking for each HCFCD 2018 Bond Project. Each criterion score is multiplied by the criteria weight and added together for a total sum. The sum is the project rank.

**Table 9: Weighted Factor Ranking of Bond Projects**

| Project   | Flood Risk Reduction | Potential for Multiple Benefits | Long Term Maintenance Costs | Minimizes Environmental Impacts | Existing Conditions Drainage Level of Service | Project Efficiency | Lack of Service | Partnership Funding | Weighted Sum | Rank |
|---|----------------------|---------------------------------|-----------------------------|---------------------------------|---|--------------------|-----------------|---------------------|--------------|------|
| Criteria Weight   | 0.25                 | 0.05                            | 0.05                        | 0.05                            | 0.20  | 0.15               | 0.15            | 0.10                | 1.00         |      |
| C-02 - Aldine Westfield Detention Basin                                   | 8                    | 10                              | 10                          | 6                               | 7   | 10                 | 8               | 10                  | 8.4          | 2    |
| C-08 - Saltwater Ditch Conveyance Improvements                            | 5                    | 0                               | 6                           | 6                               | 10  | 10                 | 10              | 10                  | 7.9          | 3    |
| C-30 - Conveyance Improvements to Halls Bayou Trib P118-27-00             | 6                    | 7                               | 10                          | 2                               | 10  | 10                 | 10              | 10                  | 8.5          | 1    |
| CI-031 - Drainage Study for Improvements to Hunting Bayou Trib H103-00-00 | 4                    | 0                               | 10                          | 6                               | 10  | 10                 | 6               | 10                  | 7.2          | 5    |
| F-08 - Fondren Diverison Channel Conveyance Improvements                  | 6                    | 4                               | 10                          | 6                               | 2   | 2                  | 8               | 0                   | 4.4          | 6    |
| F-106 - Drainage Improvements in the Willow Creek Watershed               | 3                    | 10                              | 10                          | 0                               | 8   | 4                  | 3               | 0                   | 4.4          | 7    |
| F-14 - Drainage Improvements in the Kingwood Area                         | 3                    | 10                              | 10                          | 6                               | 3   | 4                  | 10              | 0                   | 4.8          | 8    |
| F-81 - Drainage Improvements to Buffalo Bayou Trib W153-00-00             | 3                    | 0                               | 2                           | 0                               | 1   | 4                  | 6               | 0                   | 2.6          | 9    |
| F-92 - Conveyance Improvements to Sims Bayou Trib C116-00-00              | 6                    | 0                               | 10                          | 6                               | 10  | 4                  | 10              | 0                   | 6.4          | 4    |
|   |                      |                                 |                             |                                 |   |                    |                 |                     |              |      |

**Pairwise Analysis**

A Pairwise Analysis determines the tradeoffs between evaluation criteria as a function of their relative importance. The same criteria were used as the Weighted Factor analysis, but the relative weightings differ because a Pairwise Analysis has more objectivity. Table 10 presents how the weighting of the criteria was calculated. The evaluation criteria are presented across the top row and left column. The solid blocks down the middle are where the selected criteria intersect. If the criteria on the top are more important than the criteria on the left, a value of 1 is populated. If they are equally important, a value of 2 is populated. If the criteria on the left are more important than the criteria on the top, a value of 3 is populated. The sum of all values for a given row then becomes the weighting factor of the respective evaluation criteria.

The process of determining a rank for each 2018 Bond project involves attributing a score to each of the criteria and then multiplying each score by the applicable criteria weight. The scores are then added together for a total sum. The alternative yielding the highest total sum is recognized as the most favorable (highest ranking). Using the Pairwise analysis typically provides a greater separation between each alternative than the Weighted Factor analysis.

**Table 10: Calculation of Pairwise Weighting Factors for Evaluation Criteria**

| Criteria                                      | Flood Risk Reduction | Potential for Multiple Benefits | Long Term Maintenance Costs | Minimizes Environmental Impacts | Existing Conditions Drainage Level of Service | Project Efficiency | Lack of Service | Partnership Funding | Sum | Rank |
|---|----------------------|---------------------------------|-----------------------------|---------------------------------|---|--------------------|-----------------|---------------------|-----|------|
| Flood Risk Reduction                          |                      | 3                               | 3                           | 3                               | 3   | 3                  | 3               | 1                   | 19  | 1    |
| Potential for Multiple Benefits               | 1                    |                                 | 3                           | 1                               | 1   | 3                  | 1               | 3                   | 13  | 5    |
| Long Term Maintenance Costs                   | 1                    | 1                               |                             | 3                               | 1   | 1                  | 1               | 3                   | 11  | 7    |
| Minimizes Environmental Impacts               | 1                    | 3                               | 1                           |                                 | 1   | 3                  | 1               | 3                   | 13  | 5    |
| Existing Conditions Drainage Level of Service | 1                    | 3                               | 3                           | 3                               |   | 3                  | 3               | 1                   | 17  | 2    |
| Project Efficiency                            | 1                    | 1                               | 3                           | 1                               | 1   |                    | 1               | 1                   | 9   | 8    |
| Lack of Service                               | 1                    | 3                               | 3                           | 3                               | 1   | 3                  |                 | 1                   | 15  | 3    |
| Partnership Fundings                          | 1                    | 3                               | 3                           | 3                               | 1   | 1                  | 3               |                     | 15  | 3    |

Using the criteria, weights established in Table 9, and the metrics defined above, each of the alternatives was scored. Each score is multiplied by the criteria weight and added together for a total sum. Table 11 presents the results of the overall scores and ranking for each HCFCO 2018 Bond project evaluated.



**Table 11: Pairwise Ranking of HCFCD 2018 Bond Projects Evaluated**

| Project   | Flood Risk Reduction | Potential for Multiple Benefits | Long Term Maintenance Costs | Minimizes Environmental Impacts | Existing Conditions Drainage Level of Service | Project Efficiency | Lack of Service | Partnership Funding | Weighted Sum | Rank |
|---|----------------------|---------------------------------|-----------------------------|---------------------------------|---|--------------------|-----------------|---------------------|--------------|------|
| Criteria Weight   | 19                   | 13                              | 11                          | 13                              | 17  | 9                  | 15              | 15                  |              |      |
| C-02 - Aldine Westfield Detention Basin                                   | 8                    | 10                              | 10                          | 6                               | 7   | 10                 | 8               | 10                  | 949          | 1    |
| C-08 - Saltwater Ditch Conveyance Improvements                            | 5                    | 0                               | 6                           | 6                               | 10  | 10                 | 10              | 10                  | 799          | 3    |
| C-30 - Conveyance Improvements to Halls Bayou Trib P118-27-00             | 6                    | 7                               | 10                          | 2                               | 10  | 10                 | 10              | 10                  | 901          | 2    |
| CI-031 - Drainage Study for Improvements to Hunting Bayou Trib H103-00-00 | 4                    | 0                               | 10                          | 6                               | 10  | 10                 | 6               | 10                  | 764          | 4    |
| F-08 - Fondren Diverison Channel Conveyance Improvements                  | 6                    | 4                               | 10                          | 6                               | 2   | 2                  | 8               | 0                   | 526          | 6    |
| F-106 - Drainage Improvements in the Willow Creek Watershed               | 3                    | 10                              | 10                          | 0                               | 8   | 4                  | 3               | 0                   | 514          | 8    |
| F-14 - Drainage Improvements in the Kingwood Area                         | 3                    | 10                              | 10                          | 6                               | 3   | 4                  | 4               | 0                   | 522          | 7    |
| F-81 - Drainage Improvements to Buffalo Bayou Trib W153-00-00             | 3                    | 0                               | 2                           | 0                               | 1   | 4                  | 6               | 0                   | 222          | 9    |
| F-92 - Conveyance Improvements to Sims Bayou Trib C116-00-00              | 6                    | 0                               | 10                          | 6                               | 10  | 4                  | 10              | 0                   | 658          | 5    |

Table 12 shows the results of the ranking between the two methodologies.

**Table 12: Comparison of Priority Projects (Weighted Factor and Pairwise Rankings)**

| Project   | Weighted Factor Ranking | Pairwise Ranking |
|---|-------------------------|------------------|
| C-02 - Aldine Westfield Detention Basin                                   | 2                       | 1                |
| C-08 - Saltwater Ditch Conveyance Improvements                            | 3                       | 3                |
| C-30 - Conveyance Improvements to Halls Bayou Trib P118-27-00             | 1                       | 2                |
| CI-031 - Drainage Study for Improvements to Hunting Bayou Trib H103-00-00 | 5                       | 4                |
| F-08 - Fondren Diverison Channel Conveyance Improvements                  | 6                       | 6                |
| F-106 - Drainage Improvements in the Willow Creek Watershed               | 7                       | 8                |
| F-14 - Drainage Improvements in the Kingwood Area                         | 8                       | 7                |
| F-81 - Drainage Improvements to Buffalo Bayou Trib W153-00-00             | 9                       | 9                |
| F-92 - Conveyance Improvements to Sims Bayou Trib C116-00-00              | 4                       | 5                |