

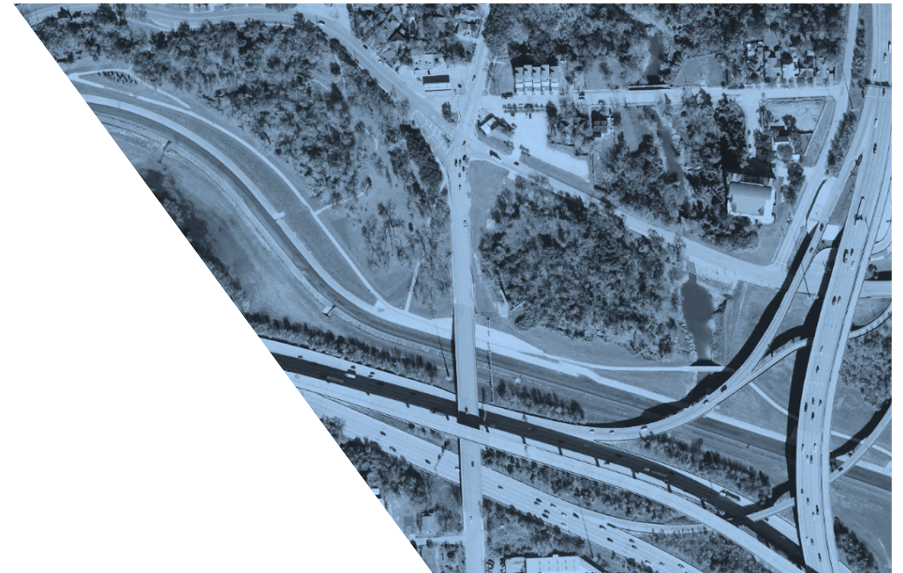
LOWER WHITE OAK BAYOU CHANNEL RESTORATION STUDY



Project Overview

2019 White Oak Bayou Association Annual Meeting

November 12, 2019



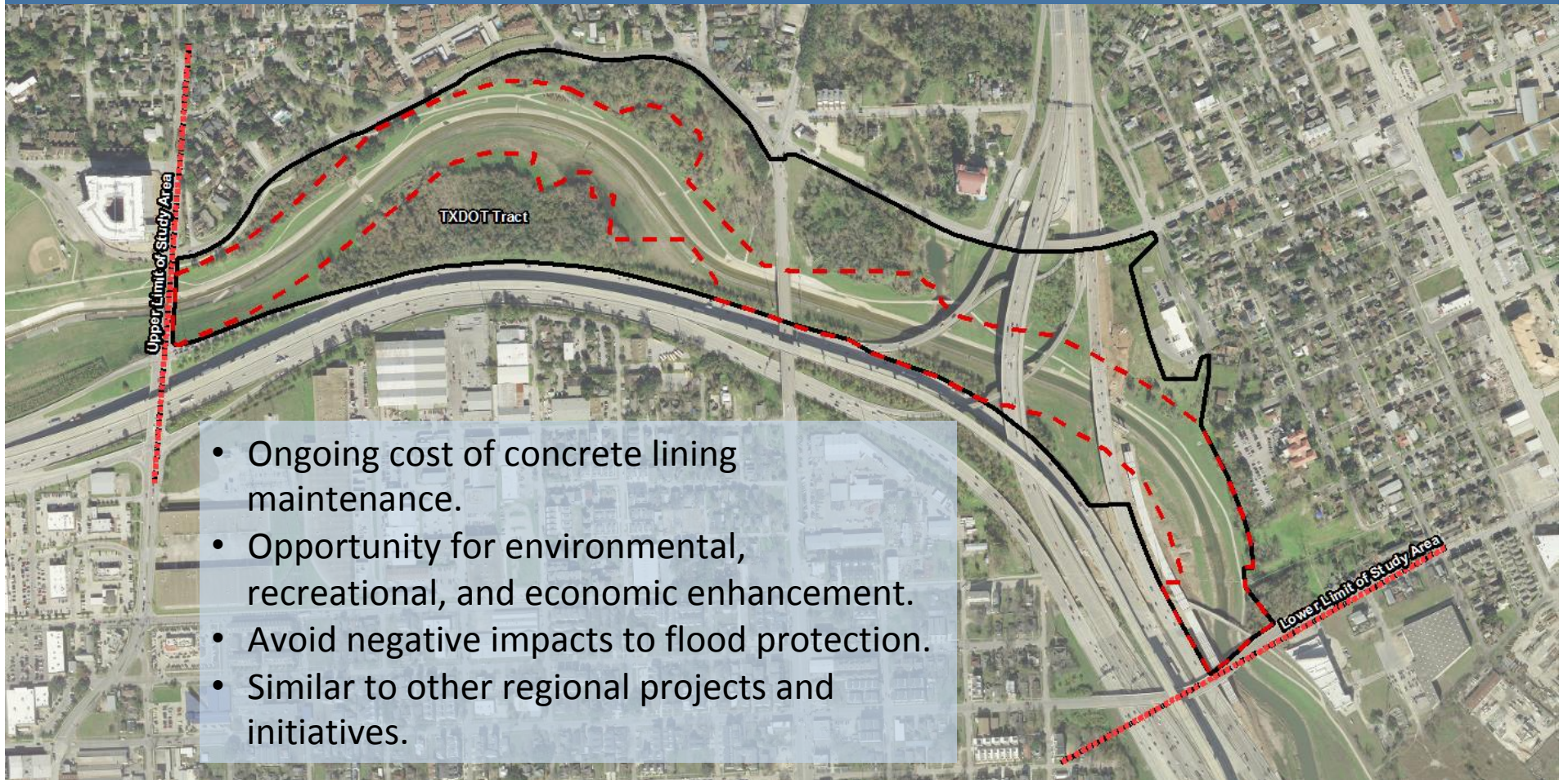
Lower White Oak Bayou (WOB) Channel Restoration Study, Title Slide Text

- This slideshow summarizing the *Lower White Oak Bayou Channel Restoration Study*, a high-level conceptual feasibility study, was presented to the White Oak Bayou Association's (WOBA) 2019 Annual Meeting, on November 12, by Cory Stull, P.E., CFM, a firm associate with Freese and Nichols Inc. (FNI).
- FNI performed study for the Harris County Flood Control District (HCFCD) with funding from Memorial Heights Redevelopment Authority (MHRA, aka TIRZ 5) and with participation by the City of Houston (CoH). Mr. Stull's role was to coordinate the project partners and to provide technical guidance and quality control to the FNI project team.
-
- The study was completed in mid-2017, and the report issued October 2017. The full report is available on the WOBA website: www.whiteoakbayou.org. Additional information can be found at www.HCFCD.org.
-
- A video recording made of the presentation was of poor quality; however, the audio portion was sufficient to prepare a transcript. The following text slides were prepared from the transcript to accompany the presentation slides. The transcript and text slides have both been reviewed and approved by Mr. Stull.

Lower WOB Channel Restoration Study, Introduction Slide Text

- In the 1960s, the U.S. Army Corps of Engineers “rectified” (i.e., channelized, straightened and widened) a large segment of White Oak Bayou as a flood reduction measure. This included an approximate 10-mile reach (from Hogan St., about a mile from the confluence with Buffalo Bayou, upstream to Cole Creek, between Pinemont Dr. and W. Tidwell Rd.), which was fitted with a concrete liner.
-
- The reason for a concrete-lined channel was that it is more efficient in moving downstream water faster than a natural channel. Following major rain events, urban watersheds, with more pavement and more efficient storm drainage systems move water to receiving streams, and flow levels peak, more rapidly. Concrete-lined channels reduce friction and move the water downstream faster than natural channels causing water levels to also fall rapidly. For this reason, watersheds like White Oak Bayou are often referred to as “flashy.”
-
- Such concrete liners typically have a design life of about 50 years, at which point concrete panels may begin to fail, requiring repair or replacement. HCFCD spends upwards of \$1-million/year on maintenance along White Oak Bayou alone, including replacement of concrete panels when needed. The impetus for this study was for HCFCD to assess the potential for cost savings associated with replacing the concrete-lined channel with a more natural channel design, instead of merely replacing the existing concrete panels with more concrete.

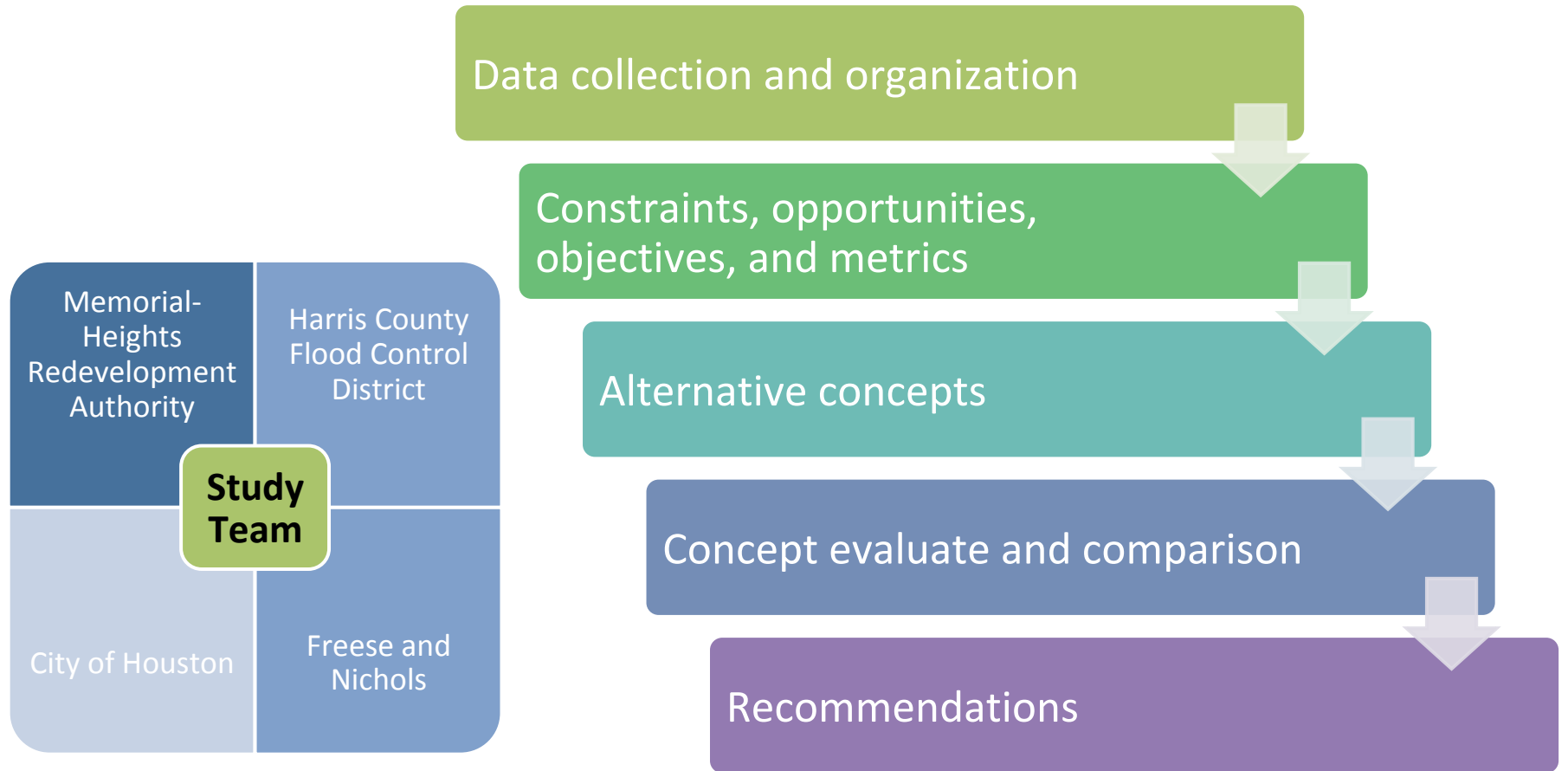
Introduction



Lower WOB Channel Restoration Study, Study Approach Slide Text

- This study is a very high-level feasibility planning study; any actual project would need considerable additional studies and evaluations. Consistent with HCFCD's mission to provide flood-damage reduction projects that work, in conjunction with community and natural values, any future project would need to ensure there would be, at a minimum, no adverse impact to flooding conditions. However, HCFCD's process does provide for evaluation of potential opportunities for environmental, recreational, community and urban design benefits.
-
- In this study, three conceptual design alternatives were developed and compared to the base case of on-going maintenance and replacement of the concrete channel liner panels. During this early stage of the process, objectives for what the project team was looking to accomplish were identified and metrics developed for measuring how well each conceptual alternative met those objectives. These were used as screening criteria to provide a basis for more guided recommendations in any future study.

Overview of Study Approach



Lower WOB Channel Restoration Study, Existing Conditions Slide Text

- The next slide shows the existing condition of the bayou in the study reach, looking downstream from Taylor Street. A key point is that lower section of concrete has a very steep side slope and while the grass-lined portion above it is more gradual, it is still fairly steep. Restoration would necessitate decreasing the side slopes and thus widen the channel.
-
- This was in part also a right-of-way (ROW) exercise. The ROW along a lot of White Oak Bayou is a pretty limited. The study reach is more open than most, with open land along the I-10 corridor on the south bank and parkland on the north. For much of its length, however, the channel is closely paralleled by roadways (such as White Oak Drive paralleling the channel on the left in the photo, and hemmed in by residential and commercial development, with little adjacent, open real estate. A basic objective was to see if implementation of any of the conceptual alternatives would even be possible.

Existing Conditions



Lower WOB Channel Restoration Study, Objectives & Metrics Slide Text

- Each of the three design alternatives were evaluated based four categories : Natural Channel Design and Environment; H&H, or Hydrology and Hydraulics / Engineering (i.e., flood-risk aspects); Urban Design; and Economic Development.
-
- **Natural Channel Design and Environment** considered opportunities for design of a grass-lined channel that can handle the normal range of flow while using a natural floodplain for larger flooding events, while also minimizing erosion. In addition to efficient water conveyance, one benefit of a concrete liner is less susceptible to erosion, compared with natural channels. Buffalo Bayou is an example of a more natural, unlined channel where significant erosion does occur.
-
- **H&H and Engineering** objectives and metrics include ensuring, at a minimum, no adverse impact from a flood-risk standpoint and ideally decreasing flood risk, as well as increases in detention volume that could potentially be used by other entities to mitigate impacts from activities such as road-building and drainage improvements.
-
- **Urban Design and Economic Development** both relate to quality of life improvement in the surrounding area, potentially including connectivity of surrounding communities to greenspace, water quality, habitat or other environmental benefits, and improved property values.

Constraints, Opportunities, Objectives, Metrics

Natural Channel Design and Environment

- Provide stable channel configuration.
- Provide stormwater quality enhancement.
- Provide enhanced habitat features.

Engineering and H&H

- Reduce water surface elevations and increase floodplain storage.
- Protect infrastructure and access

Urban Design

- Enhance quality of life by integrating environmental sustainability and enhanced community character with flood damage reduction elements.

Economic Development

- Enhance economic development by integrating environmental and community features with flood damage reduction elements.

Lower WOB Channel Restoration Study, Alternative 1 Slide Text

- Among the three alternative scenarios, **Alternative 1** is the most limited and is specifically confined to the existing HCFCD ROW. Alternative 1 was intended to assess the possibility of concrete removal without having to extend the project footprint out of that existing ROW. Another Alternative 1 objective was to retain all existing trails.
-
- It was determined that within the existing HCFCD ROW, a natural or grass-lined channel could still convey the existing flood flows without causing any adverse impacts to flood risk in the area. Alternative 1 also added about 120 acre-feet of additional detention volume that could be used by local partners, such as the City of Houston, for road and drainage projects. Roadway construction often includes improving the drainage infrastructure, which moves water more efficiently to the receiving stream, which in turn requires additional detention to offset potential increased flood risk to surrounding communities. Alternative 1 provides a potential opportunity for partners to utilize the additional detention volume to off-set such impacts.

Alternative Channel Concept 1: Limited Scale



- Remove lining
- Remain within HCFCO ROW
- Retain existing level of trail features
- ~120 ac-ft capacity

Lower WOB Channel Restoration Study, Alternative 2 Slide Text

- In **Alternative 2**, the project footprint was expanded to encompass some of the additional greenspace on the north side of the project area. Expanding to the north enabled increasing the size of the natural channel and creation of a somewhat wider floodplain.
- This also enabled the addition of some water quality treatment features (wetlands) placed strategically at the outfalls of storm sewer outfalls potentially improving the quality of water flowing into the bayou. The detention volume is also increased to about 315 acre-feet compared to 120 acre-feet in Alternative 1.
-
- Another component of this concept was to replace all affected existing trails and increase the amount of trails added to the overall project footprint, as well as providing additional opportunities for habitat restoration or establishment.

Alternative Channel Concept 2: Expansion North of Channel



- Incorporate green space
- Geomorphic channel and water quality features
- Add trail features
- ~315 ac-ft capacity

Lower WOB Channel Restoration Study, Alternative 3 Slide Text

- **Alternative 3** expanded upon Alternative 2 to encompass the southern TxDOT tract between the bayou and Interstate 10. The expanded footprint was used to further expand the trail network to the south side of the bayou.
- Generally, the natural channel and stormwater quality features stayed the same as in Alternative 2, but additional detention volume was added, for a total of almost 500 acre-feet of capacity, compared to about 315 in Alternative 2 and only about 120 acre-feet of in Alternative 1.

Alternative Channel Concept 3: Expansion North and South

- Incorporate TxDOT tract
- Geomorphic channel and water quality features
- Additional trail features
- ~495 ac-ft capacity



Lower WOB Channel Restoration Study, Evaluation & Comparison Slide Text

- To evaluate Alternatives 1, 2 and 3 in terms of the four objective categories, their benefits / performance in each category were rated on a scale of 1 (low) to 3 (high).
-
- For **Natural Channel Design / Environment** ratings were based on how well each alternative facilitated natural channel design, the volume of stormwater treatment added, how much habitat could potentially be added.
-
- **H&H / Engineering** benefits, were rated based on the amount of additional detention that could be provided, and any reductions to structural flooding or flooding of other critical facilities, including roadways, etc. It should be noted that H&H evaluations are based on pre-Atlas 14 statistical rainfall data and any future studies will necessarily be based on more recent data on the basis of which floodplain maps are being updated. Atlas 14 data for Harris County indicate an increase in rainfall for the 100-year storm from 12 inches to 17 inches in 24 hours).
-
- **Urban Design and Economic Development** metrics included potential for improving community access to greenspace and proximity to users, increasing trails, and area property values. This exercise drew upon recent research papers, some of which were also used for the Buffalo Bayou Park improvement, that have attempted to quantify the economic benefits that may be associated with these types of enhancement.

Evaluation and Comparison

Natural Channel Design and Environment

- Acreage of geomorphic floodplain provided.
- Acreage of stormwater quality features added.
- Acres of habitat added.

Engineering and H&H

- Acre-feet of linear detention added.
- Population with reduction to likelihood of flooding
- Number of structures with reduction to likelihood of flooding.
- Average reduction in one percent water surface elevation within each major reach.
- Approximate number of critical facilities and access routes benefited.

Urban Design

- Acres of concrete replaced with green space.
- Linear feet of connected trails added.
- Acres of additional green space made accessible.
- Increased population within proximity.

Economic Development

- Number of users within proximity contributing to recreational use value, user health and transportation benefit.
- Proximity benefits contributing to increased property values.
- Acreage contributing to increased environmental benefits.
- Increase in unit day value for recreation.

Lower WOB Channel Restoration Study, Recommendations Slide Text, Part 1

- Comparing the three alternative led to the general finding that benefits in all categories increased, generally because of the increased real estate (the wider the better), from Alternative 1 to 3, with corresponding increases in cost.
-
- Compared to Alternative 1, Alternatives 2 and 3 enabled superior enhancement of the Natural Channel Design / Environment component, including increased stormwater quality treatment capacity, beyond that allowed by the narrower existing HCFCD ROW. This resulted in a rating of 3 for both Alternatives 2 and 3, compared to 1 for Alternative 1.
-
- From an H&H / Engineering standpoint, the increased detention volume provided as an opportunity for local partners, increased the benefit from a rating of 1 for Alternative 1, to 2 for Alternative 2, and to 3 for Alt 3.
-
- Urban design and Economic Development, similarly, showed increased benefit from Alternative 1 to Alternatives 2 and 3. The added potential for new trail mileage and bringing new users into the park resulted in increased ratings from 1 for Alternative 1 to 2 for Alternative 2, and to 3 for Alternative 3. Because the south side / TxDOT tract abuts I-10 the number of additional users was not expected to increase significantly from Alternative 2 to Alternative 3, but more greenspace is added. In terms of Economic Development, Alternative 1 was rated 2 and Alternatives 2 and 3 were both rated 3.

Lower WOB Channel Restoration Study, Recommendations Slide Text, Part 2

- Along with the benefits, projected costs increase from Alternatives 1 through 3, from \$30-million to \$60-million for the one-mile pilot project . This can be compared to the baseline case of simply replacing the aging concrete with new lining. At present day costs, hypothetically removing and replacing all he concrete liner in a single project would cost on the order of \$15 to \$20-million, which is comparable to spending several hundred thousand dollars per year on maintenance on an annualized basis over a 50-year period.
-
- These very preliminary estimates of cost are significant and will be a major driving factor and important component in the feasibility of any future project. They were considered to be conservative at the time of the study, but may be less so when updated rainfall data and floodplain maps are used in future evaluations.
- Conservative assumptions included the need to haul excavated material a considerable distance unless it can be utilized for a contemporaneous nearby project, and the need for soft-armoring the restored channel. Geotechnical testing and slope stability studies would be needed to resolve this assumption. It should also be noted that removing the concrete may reduce, but does not eliminate, annual maintenance costs, under any of the alternatives.

Recommendations

Focus Area	Baseline Replacement	Alternative		
		1 (Limited Scale)	2 (North)	3 (North/South)
Natural Channel Design and Environment	-	●	●●●	●●●
Engineering and H&H	-	●	●●	●●●
Urban Design	-	●	●●	●●●
Economic Development	-	●●	●●●	●●●
Project Cost and Development	\$17.6-million 2-3 years	\$29.5-million 5-6 years	\$42.8-million 6-7 years	\$60.3-million 7-8 years

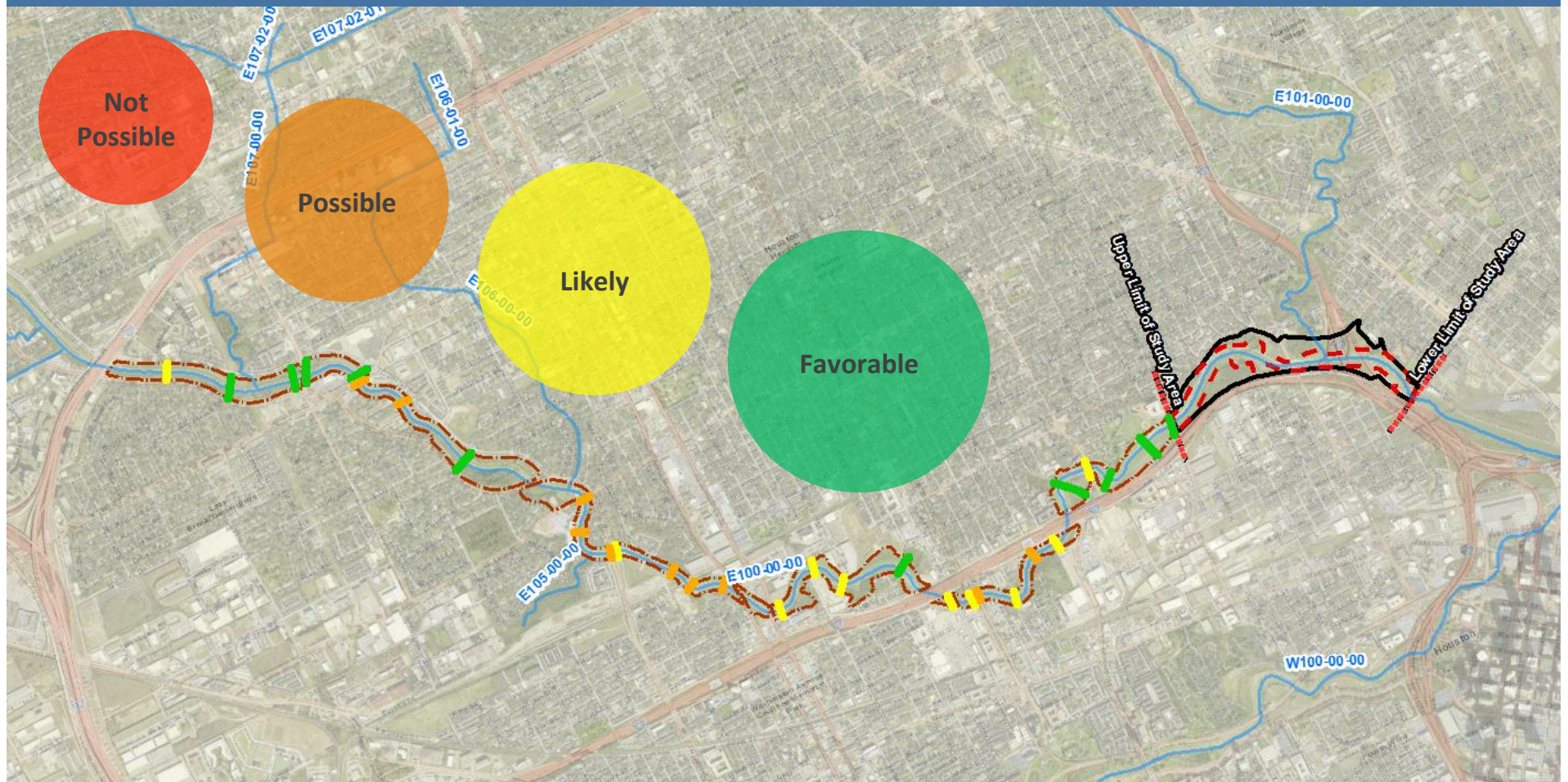
● – Identified benefits from restoration



Lower WOB Channel Restoration Study, Upstream Potential Slide Text

-
- As a final step in this study, the high-level feasibility assessment was extended upstream toward I-610 to assess whether this concept is possible for reaches beyond the pilot area. In the analysis presented on the next slide, the colors demonstrate the feasibility for applying a natural channel or concrete removal in a succession of upstream reaches, based on current land-use. It was determined to be, at a minimum, possible to remove concrete liner and restore the channel along its full length up to I-610. This very preliminary assessment is based on simplified channel cross-sections and applying rainfall assumptions valid at the time of the study. While possible, it would require a good amount of additional study based on more current information.
-
- The concept of concrete removal and restoring White Oak Bayou to a more natural channel goes back decades including work by Kevin Shanley and others. There have been and continue to be a range of different opinions as to whether or not the benefits of such a project justify the cost. Indisputably, there are trade-offs between having concrete that is very efficient at moving water and reducing erosion versus a more natural channel. These trade-offs are some of what will need to be studied further.

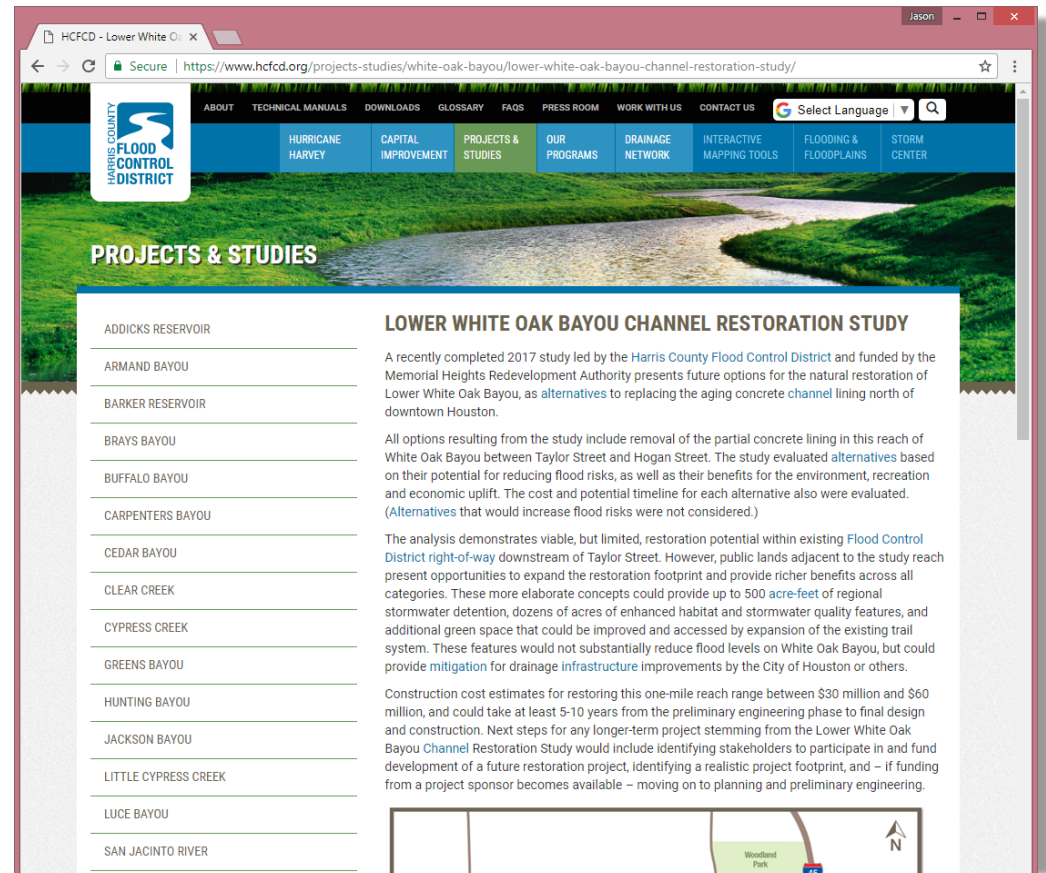
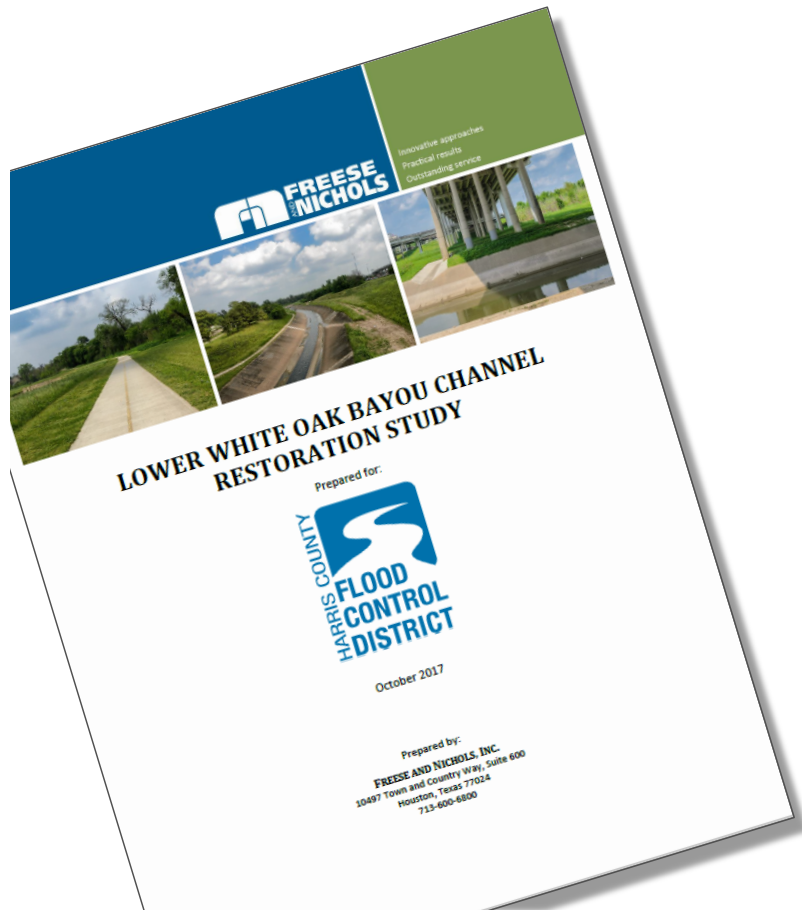
Upstream Restoration Potential



Lower WOB Channel Restoration Study, Reports Available Slide Text

- Further information on this particular project as well as other projects on White Oak Bayou can be found at <www.hcfcd.org>. The full report documenting this study is available at <www.whiteoakbayou.org>.

Report Available



LOWER WHITE OAK BAYOU CHANNEL RESTORATION STUDY



Project Overview

2019 White Oak Bayou Association Annual Meeting

November 12, 2019

