

White Paper to Identify Potential Pilot Projects Utilizing Tunnel Conveyance

Executive Summary

Introduction

The Harris County Flood Control District developed a white paper to explore the potential for underground tunnel conveyance systems as one of several long-term strategies to reduce flood risk across the region. This summary pulls from past research and studies and reflects a preliminary assessment of possible pilot projects that could help inform future decisions about the feasibility and implementation of such systems in Harris County.

Given that the Flood Control District has not previously undertaken underground infrastructure on this scale, a pilot tunnel project may offer a manageable opportunity to build internal knowledge and evaluate how this type of infrastructure could be developed. The pilot approach could also allow for testing of alternative project delivery methods, which may be beneficial for future complex undertakings. If successful, a pilot could demonstrate both functional and institutional readiness for potential future investment.

System Function and Conceptual Design

Tunnel conveyance systems are designed to move stormwater underground via gravity, functioning as inverted siphons. These systems typically include surface inlets (with weirs, gates, and drop shafts), a tunnel running 50 to 100 feet underground, and a controlled outfall structure.

Depending on tunnel length, diameter, and elevation drop, capacity can range from hundreds to over 13,000 cubic feet per second (cfs). These systems also require outfall systems, energy-dissipation, and sediment management features to ensure safe and effective operation.

While these concepts are well established in other contexts, their application in Harris County remains largely theoretical and would need to be verified through more detailed design and analysis.

Overview of Conceptual Alignments

To date, much of the Flood Control District's work has focused on large-diameter stormwater tunnels. Two large-scale tunnel systems were outlined in the 2022 Phase 2 Tunnel Study:

1. Greens Bayou / Halls Bayou / Hunting Bayou Tunnel
 - Approx. 18 miles, 35-ft diameter
 - Potential intakes at Greens, Halls, and Hunting Bayous
2. Buffalo Bayou Tunnel
 - Approx. 20 miles, 40-ft diameter
 - Proposed intakes at White Oak Bayou, IH-610, BW-8, and within Addicks/Barker reservoirs

Both alignments represent significant capital investments, each estimated to exceed \$5 billion. As such, full implementation is likely to be infeasible in the near term. However, smaller segments of these alignments could potentially be considered as pilot projects to test both concept and construction practices.

Preliminary Pilot Tunnel Concepts

In addition to the full tunnel alignments, this white paper identifies four potential smaller-scale pilot projects that could be pursued independently. These alignments were selected based on initial evaluations of flood risk, spatial constraints, and infrastructure needs:

- Brickhouse Gully (White Oak Bayou): ~3.5 miles; moderate diameter; limited right-of-way availability.
- Halls Bayou: ~3.5 miles; larger diameter; possible benefit to thousands of at-risk homes.

- Hunting Bayou: ~4 miles under Lockwood Drive; overlaps ultimate tunnel concept but could stand alone.
- Little Cypress Creek: ~3 miles; serves a constrained upstream area; not connected to the Phase 2 system.

Each of these pilot alignments is entirely conceptual and would require substantial additional engineering, environmental, and economic study to determine their viability. At this stage, they are only presented as examples of what could be explored—not as recommended projects. See the appendix for additional information on locations.

Feasibility and Implementation Timeline

Early estimates suggest that pilot projects could cost between tens and hundreds of millions of dollars, depending on their size and complexity. If one of these options were to be pursued, project delivery would likely follow this general sequence:

- Pre-Construction (4 to 6 years): Includes preliminary design, environmental permitting, stakeholder coordination, and ROW acquisition.
- Construction (2 to 4 years): Dependent on tunnel length and production rate of boring equipment.
- Total Duration: 6 to 10 years from initiation to completion.

This timeline is based on current expectations and experience from other recent tunnel projects in the greater Houston area. Adjustments may be needed depending on local conditions and project delivery model.

Permitting, ROW, and Environmental Considerations

A pilot tunnel project would likely require federal environmental permitting under the Clean Water Act, and possibly an Environmental Assessment or Environmental Impact Statement. If federal funding were involved, this could add time to the review process.

Right-of-way acquisition would include not only surface land for shafts and intakes, but also underground easements for the tunnel itself. Utility relocation may be required, particularly near intake and outfall locations.

Importantly, any proposed outfall would need to meet the Flood Control District's no adverse impact policy, and coordination with external stakeholders, such as the Port of Houston, would be required around outfalls.

Delivery Models and Funding Possibilities

Should a pilot project be pursued, there are multiple possible delivery models, each of which would need further exploration before moving forward. These include design-bid build, design-build, or public-private partnerships (P3).

Funding would likely need to come from a mix of sources, potentially including local funding, state and federal grants, and, for future full-scale systems, potential participation from the U.S. Army Corps of Engineers. Given the long timelines associated with federal funds, grant and P3 options may be more suitable for near-term pilot phases.

Next Steps and Considerations

Further investigation is needed to determine whether tunnel conveyance systems, and specifically pilot-scale implementations, represent a cost-effective and technically sound investment for Harris County and the Flood Control District. Detailed hydraulic modeling, cost-benefit analyses, and stakeholder engagement would be critical components of any future decision-making process.

While this white paper provides an initial roadmap, it is not intended to represent a finalized recommendation. Instead, it offers a foundation for future studies and policy discussions should tunnel conveyance continue to appear viable based on the data available.