Virtual Public Meeting

June 16, 2022 from 6:30 to 7:30 p.m.

HARRIS COUNTY FLOOD CONTROL DISTRICT

Feasibility Study of Stormwater Conveyance Tunnels

Project ID: Z100-00-00-P019

Meeting Overview / How to Participate

Introduction	**6:30 to 6:35 p.m.**
Project Presentation, including: • Why Study Tunnel System Now? • What We Know So Far • Tunnel Investigation Continues	**6:35 to 7:15 p.m.**
Virtual Q&A Session	**7:15 to 7:30 p.m.**
Meeting Concludes	**7:30 p.m.**

Joining the Meeting

Presentation Date
6:30 to 7:30 p.m.

Join online at:
PublicInput.com/tunnels

Join by phone at **855-925-2801**
(Meeting Code: **9622**)

Scott Elmer, P.E., CFM

Asst. Director of Operations
Harris County Flood Control District

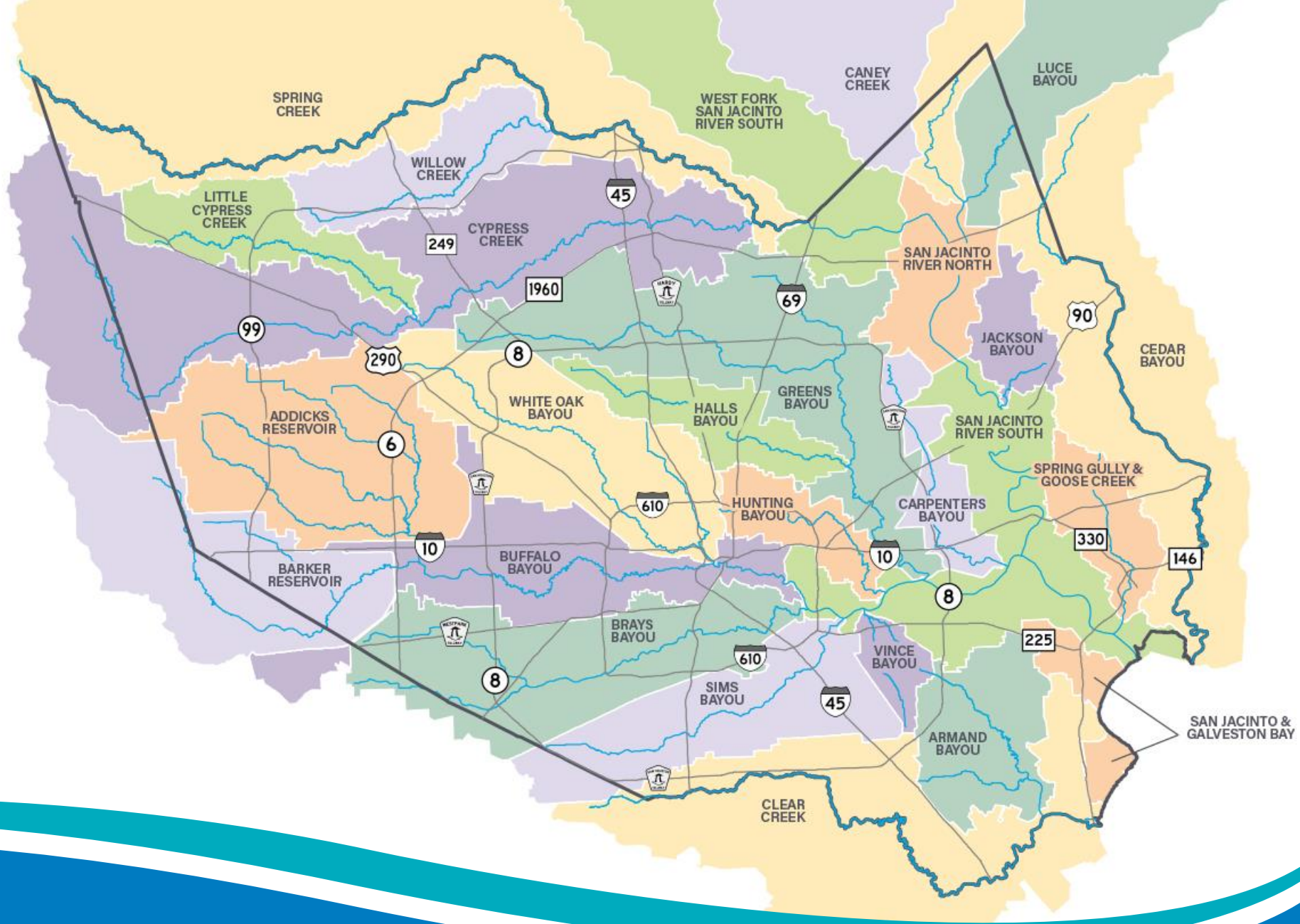
Harris County Flood Control District

- A special purpose district created in 1937 by the Texas Legislature
- In response to floods that devastated the Houston-area in 1929 and 1935
- Serves as a local partner to leverage federal dollars for flood damage reduction
- Harris County Commissioners Court serves as our board of directors or governing body

Our Mission

Provide flood damage reduction projects that work, with appropriate regard for community and natural values.

Harris County Watersheds



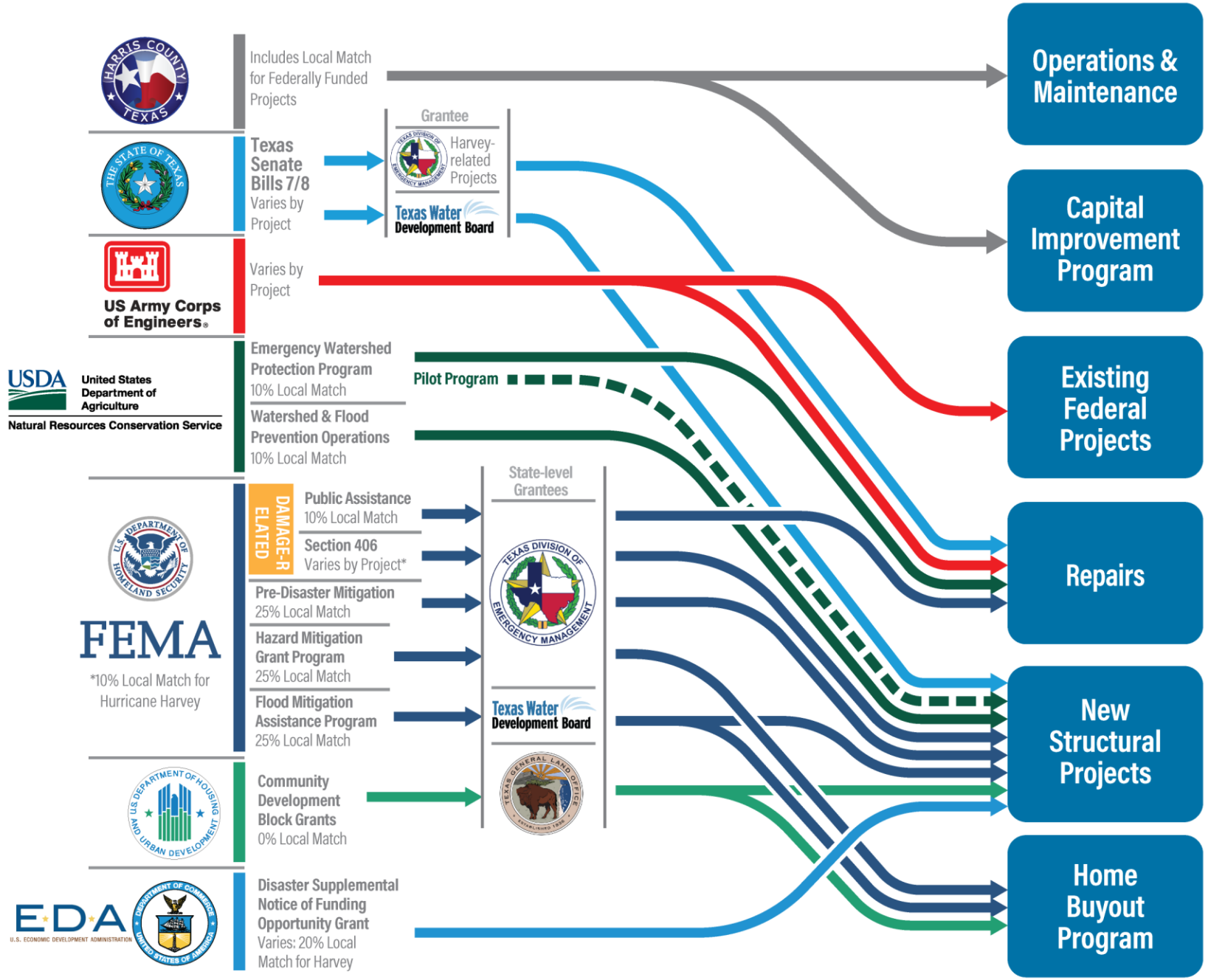
What is a watershed?

A geographical region of land or "drainage area" that drains to a common channel or outlet, mostly creeks and bayous in Harris County. Drainage of the land can occur directly into a bayou or creek, or through a series of systems that may include storm sewers, roadside ditches, and/or tributary channels.

Why is Harris County Flood Prone?

- Prone to extreme rainfall including tropical storms, and hurricanes
- Flat, slow-draining landscape
- Clay soils that do not soak up excess rainfall quickly

How is HARRIS COUNTY FLOOD CONTROL DISTRICT funded for disaster recovery & resiliency?



Investigation of a Large-Diameter Tunnel System

June 16, 2022

HARRIS COUNTY FLOOD CONTROL DISTRICT

Feasibility Study of Stormwater Conveyance Tunnels

Project ID: Z100-00-00-P019

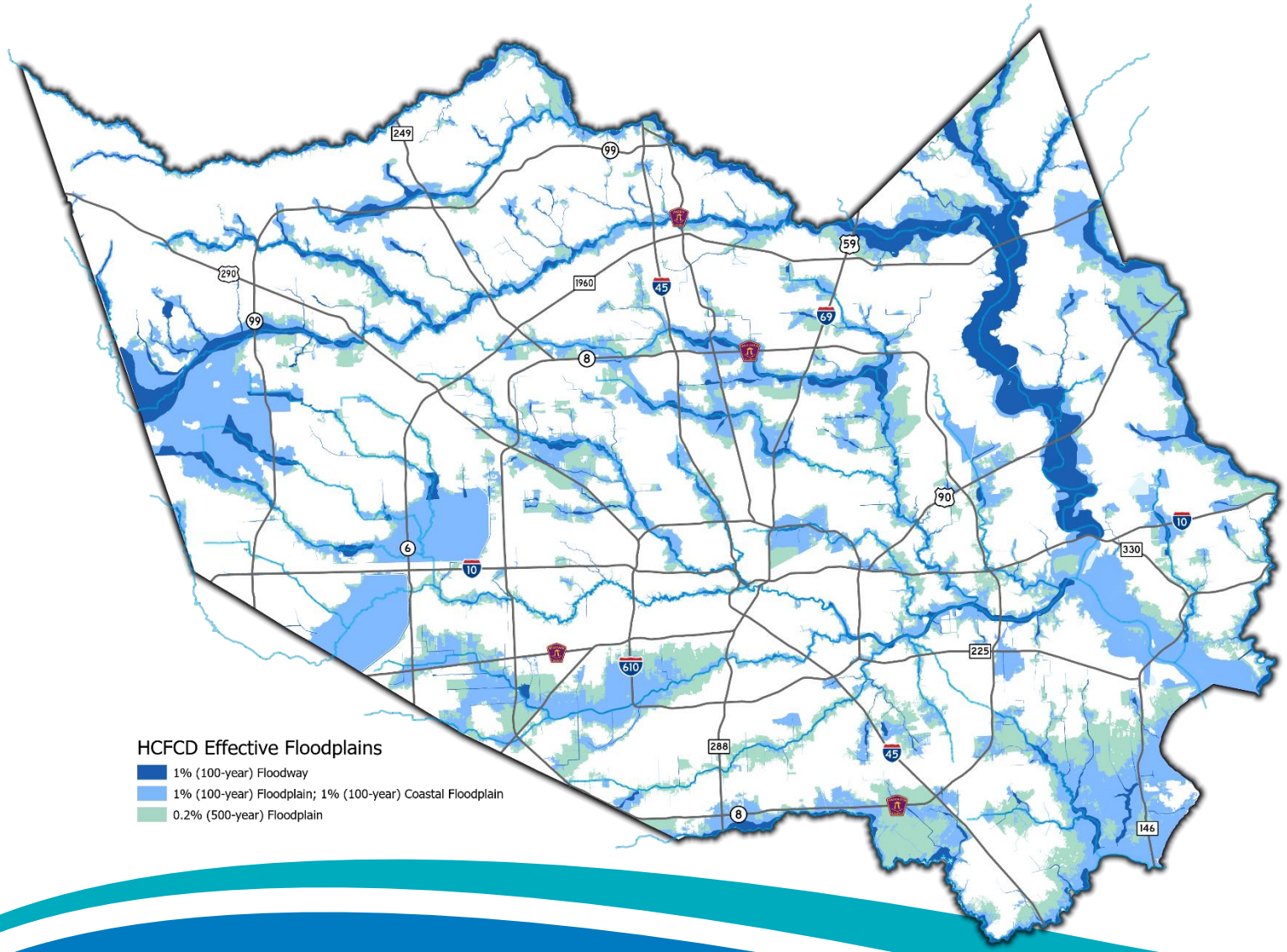
Tunnel Study Public Meeting

- Harris County – Overview of Flooding Challenges
- How a Tunnel Works, How a Tunnel is Constructed
- Phase 1 Study Results
- Phase 2 Study Results
- Work Ahead in Phase 3
- How to Provide Input

Mid-reach, Sims Bayou


Brays Bayou

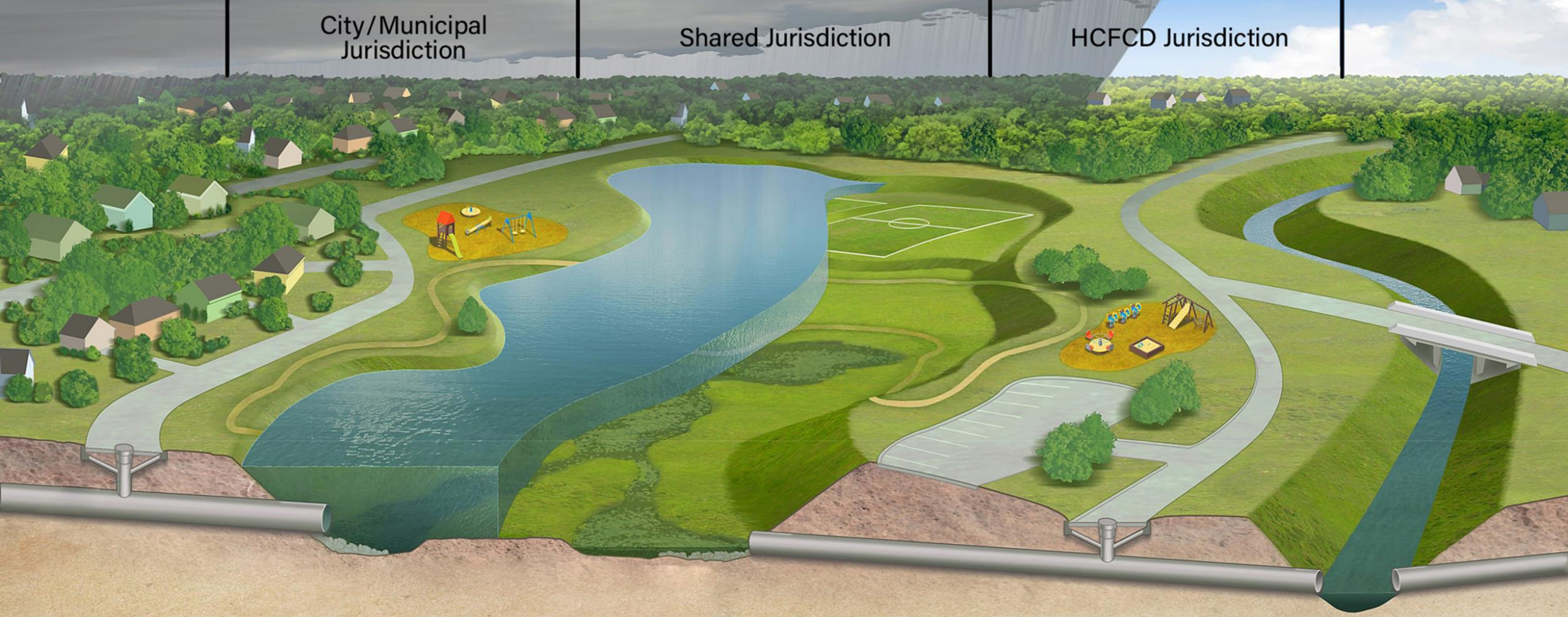
Flooding in Harris County

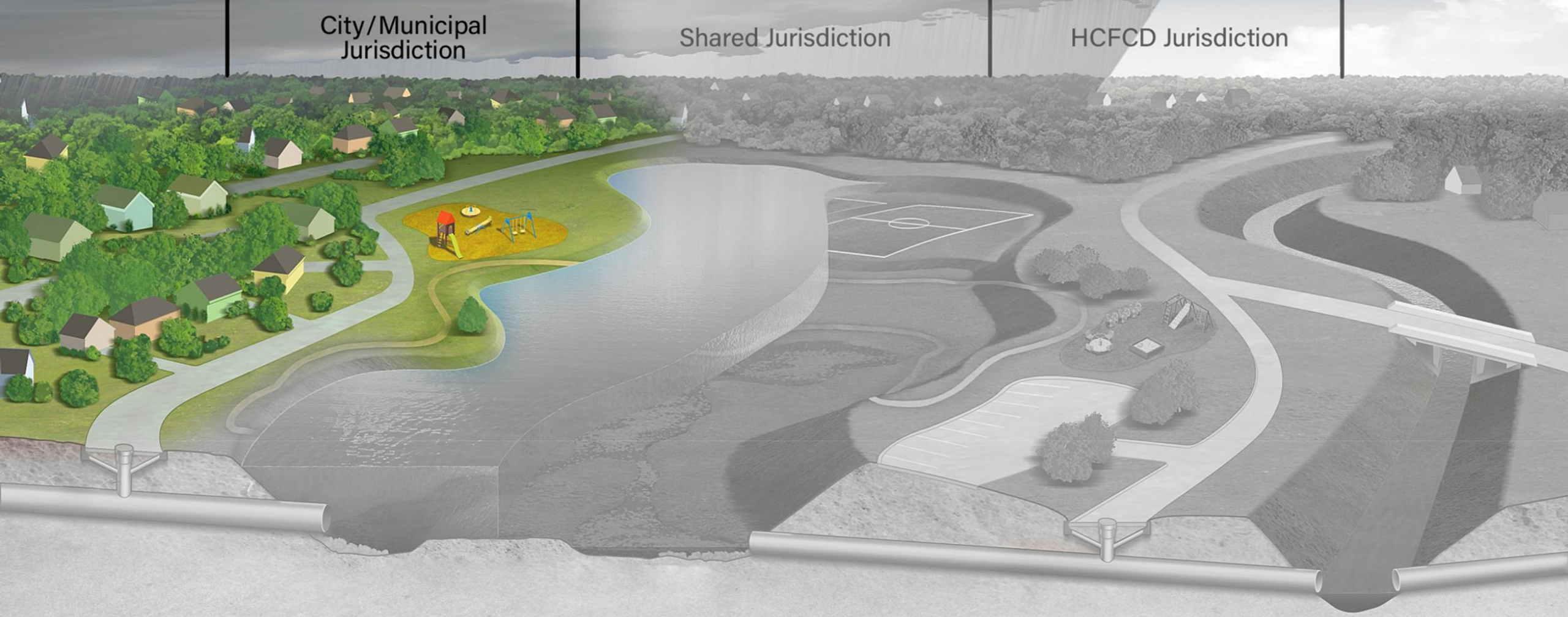


FEMA Effective Floodplains in Harris County

As of April 2022

Flooding in Harris County


City/Municipal Jurisdiction
Shared Jurisdiction
HCFCD Jurisdiction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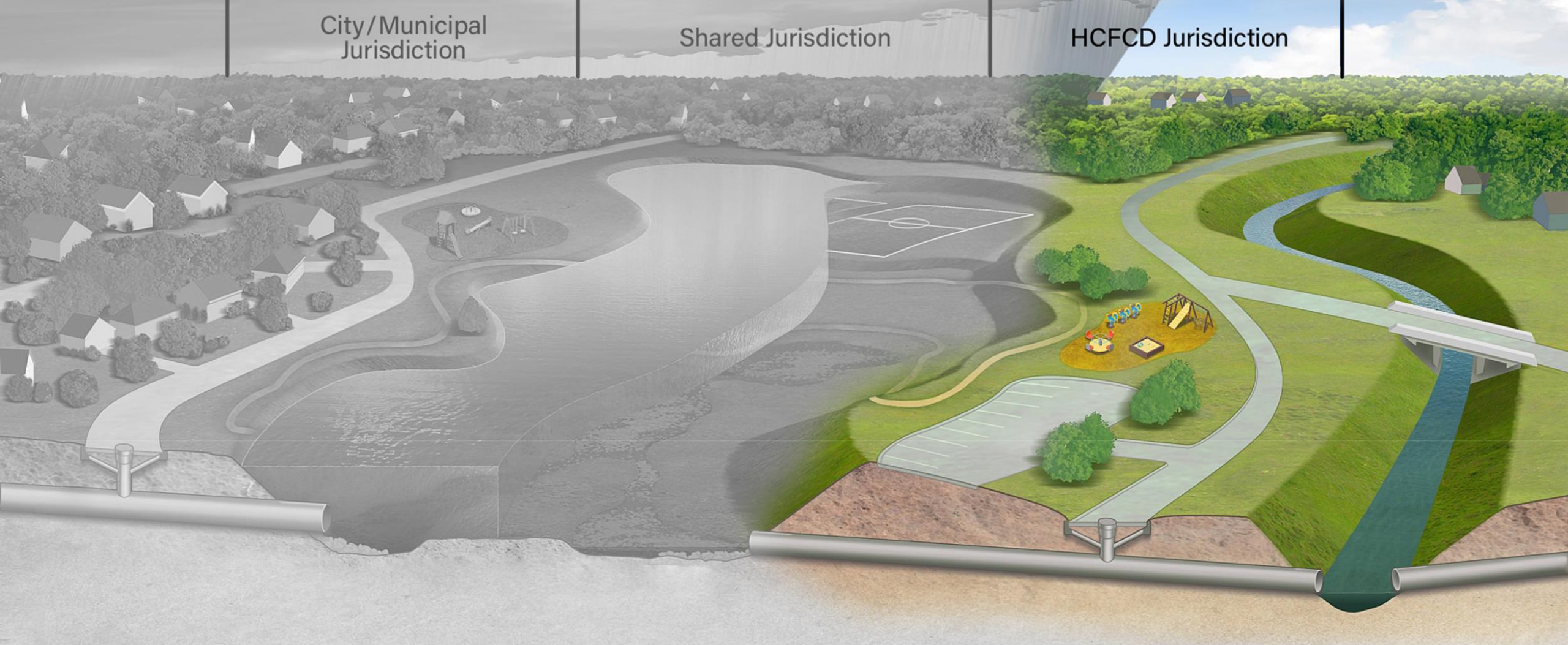
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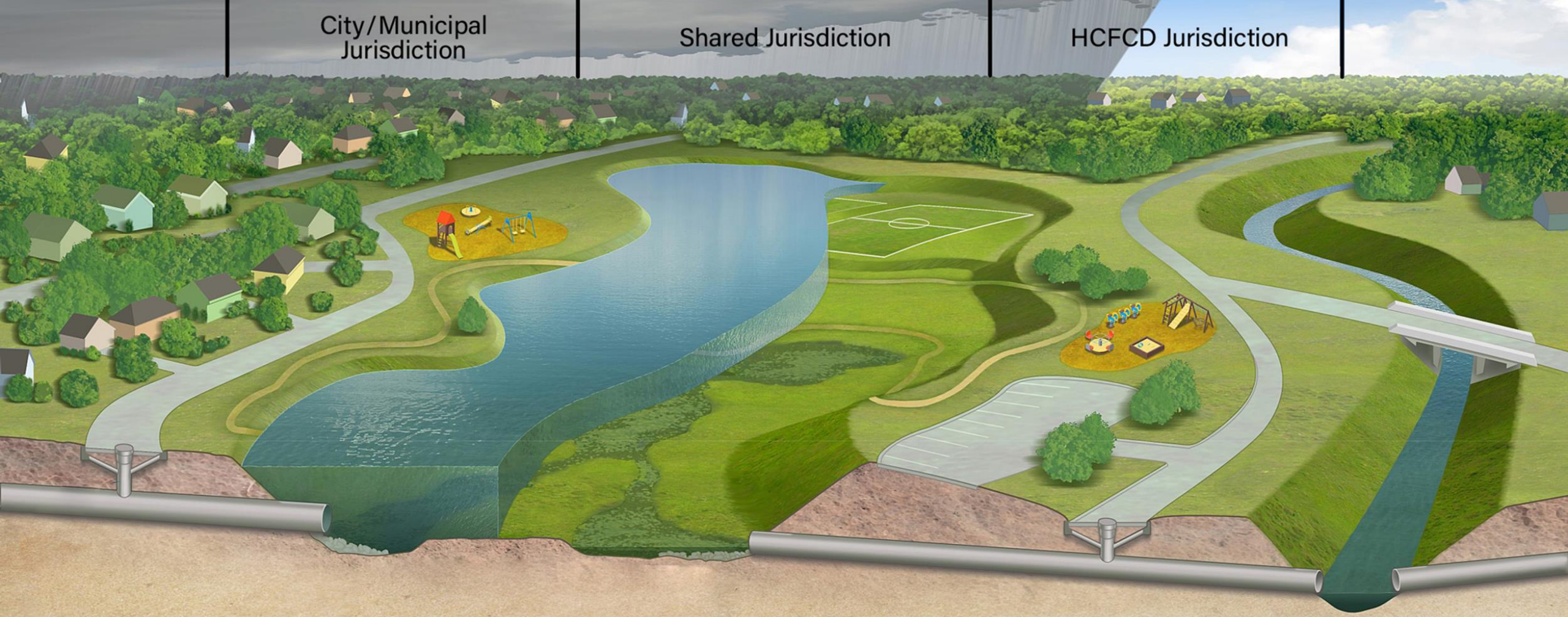
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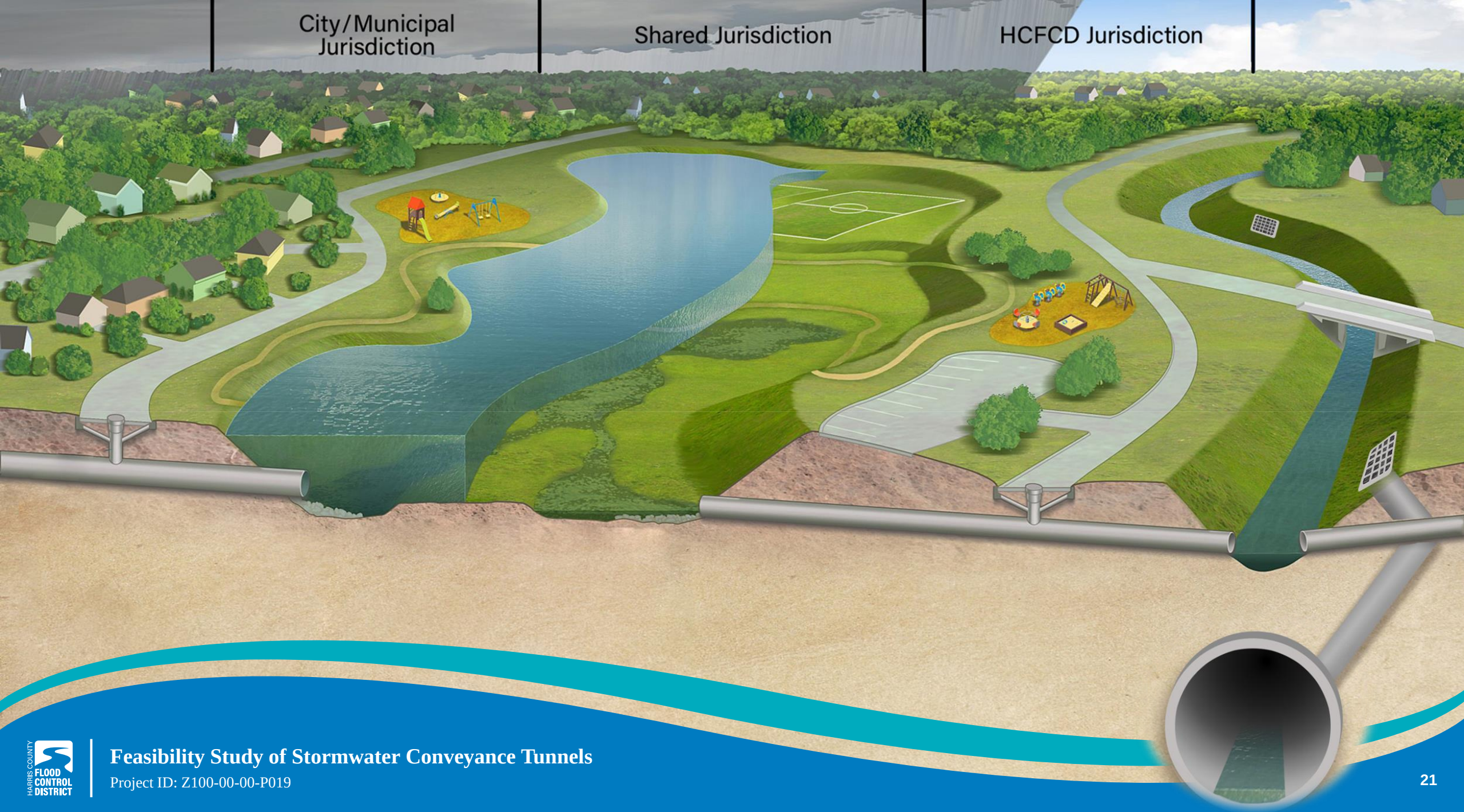
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Population Density

Development makes it more challenging to construct traditional options like channels and basins

- 1930
- 1953
- 2021

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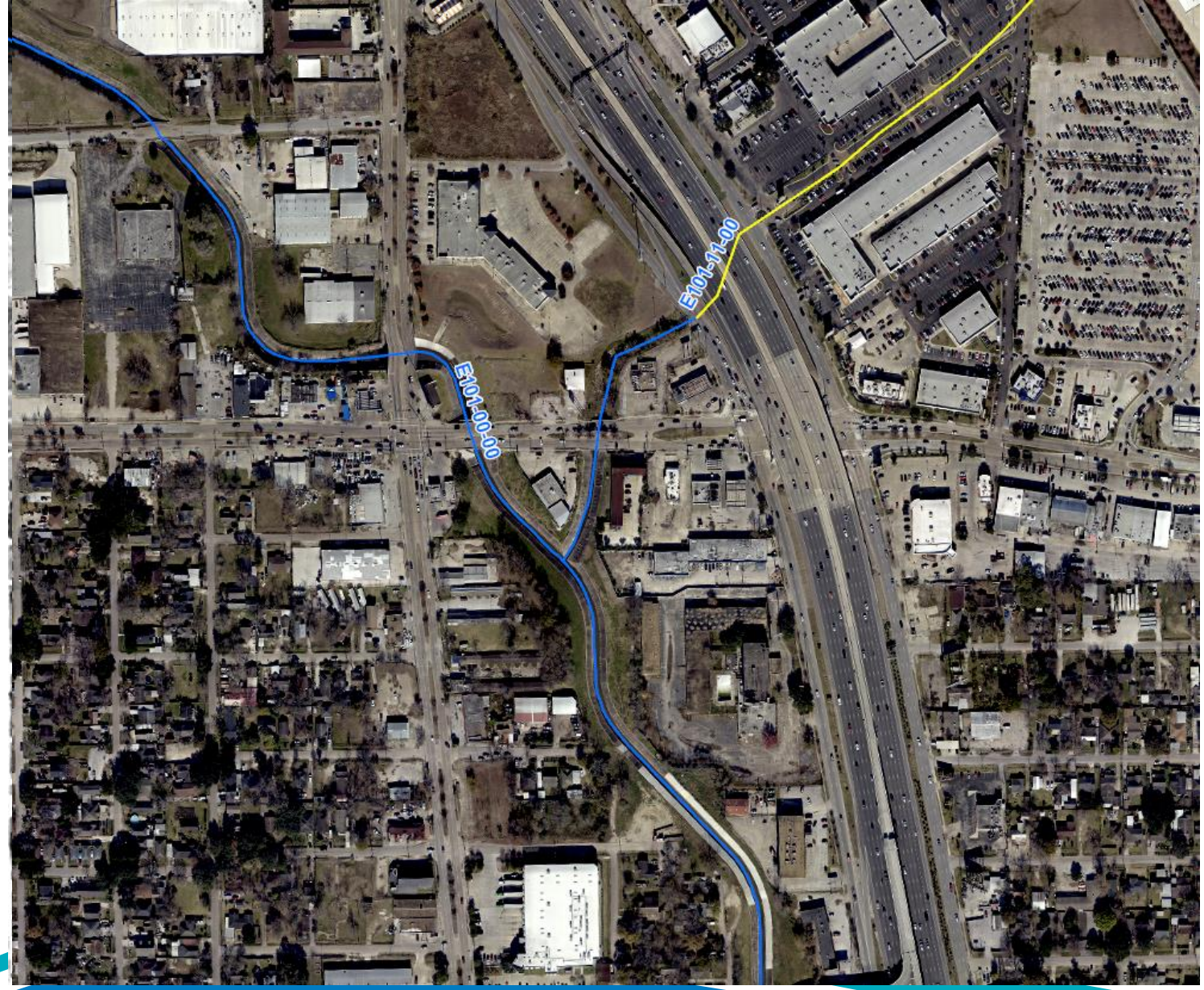

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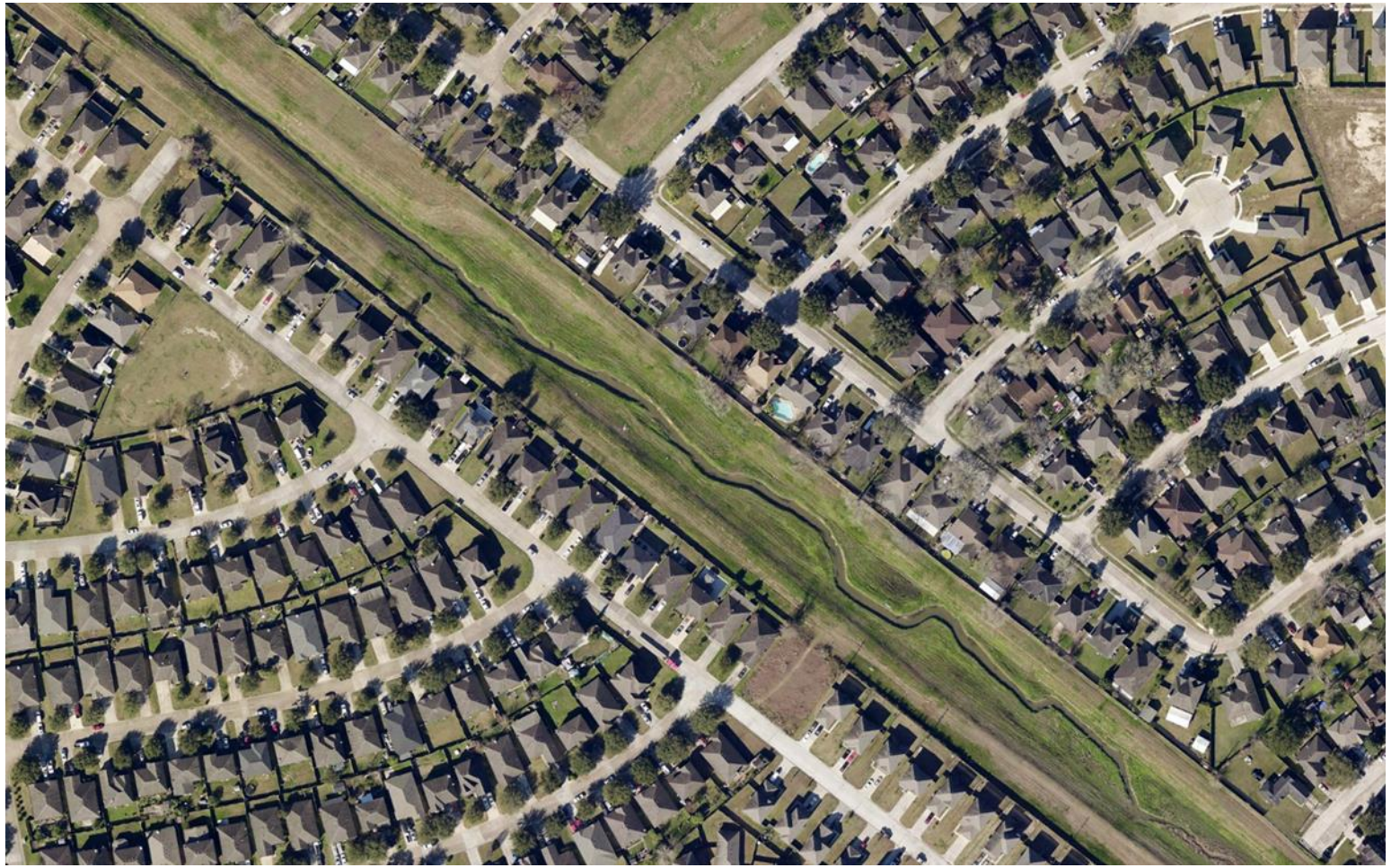

Channel Expansion Challenges

- Less available land in certain areas
- Residential property acquisition is required more and more often
- Environmental impacts
- Adverse impacts require additional land for mitigation

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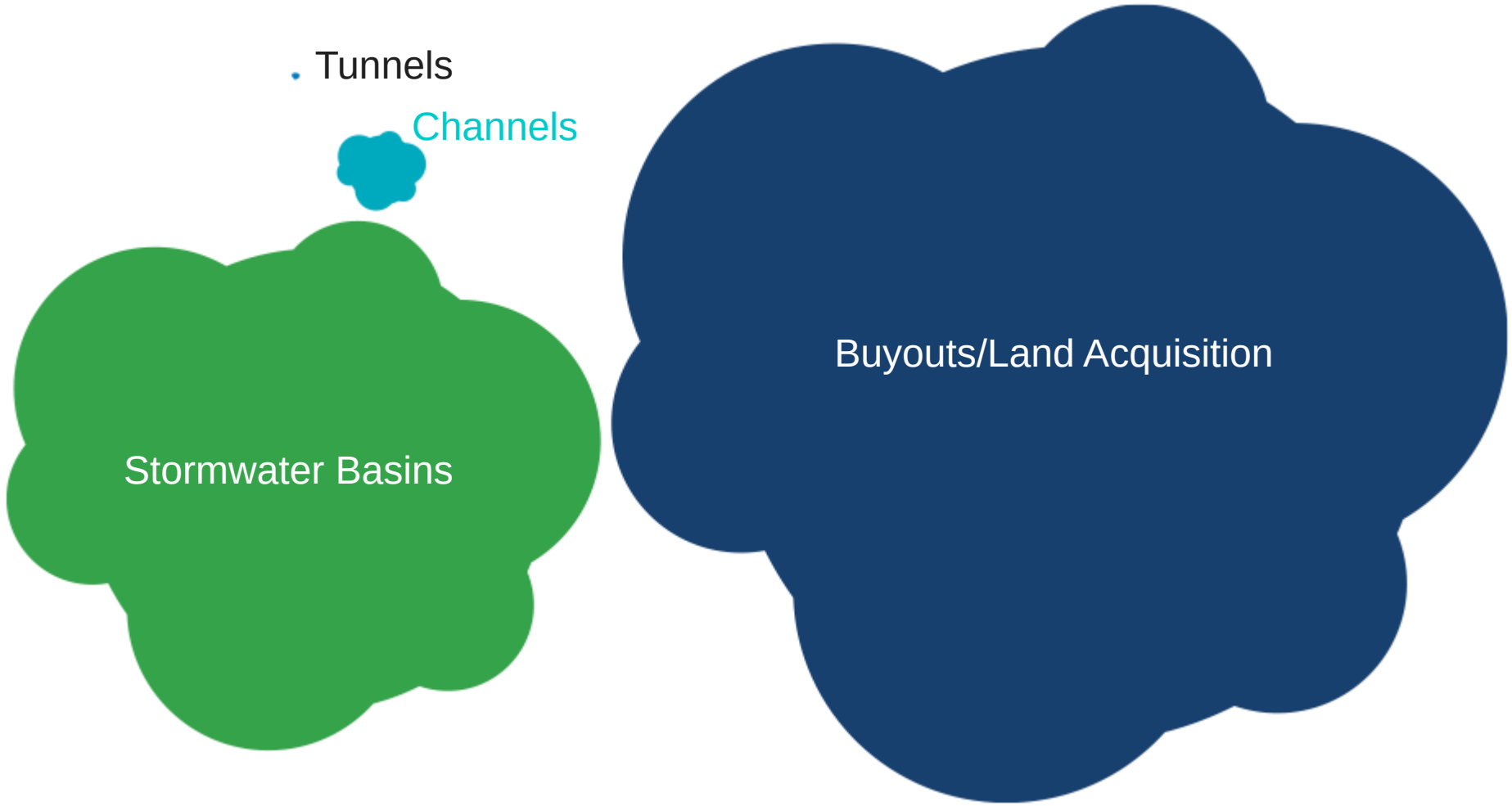
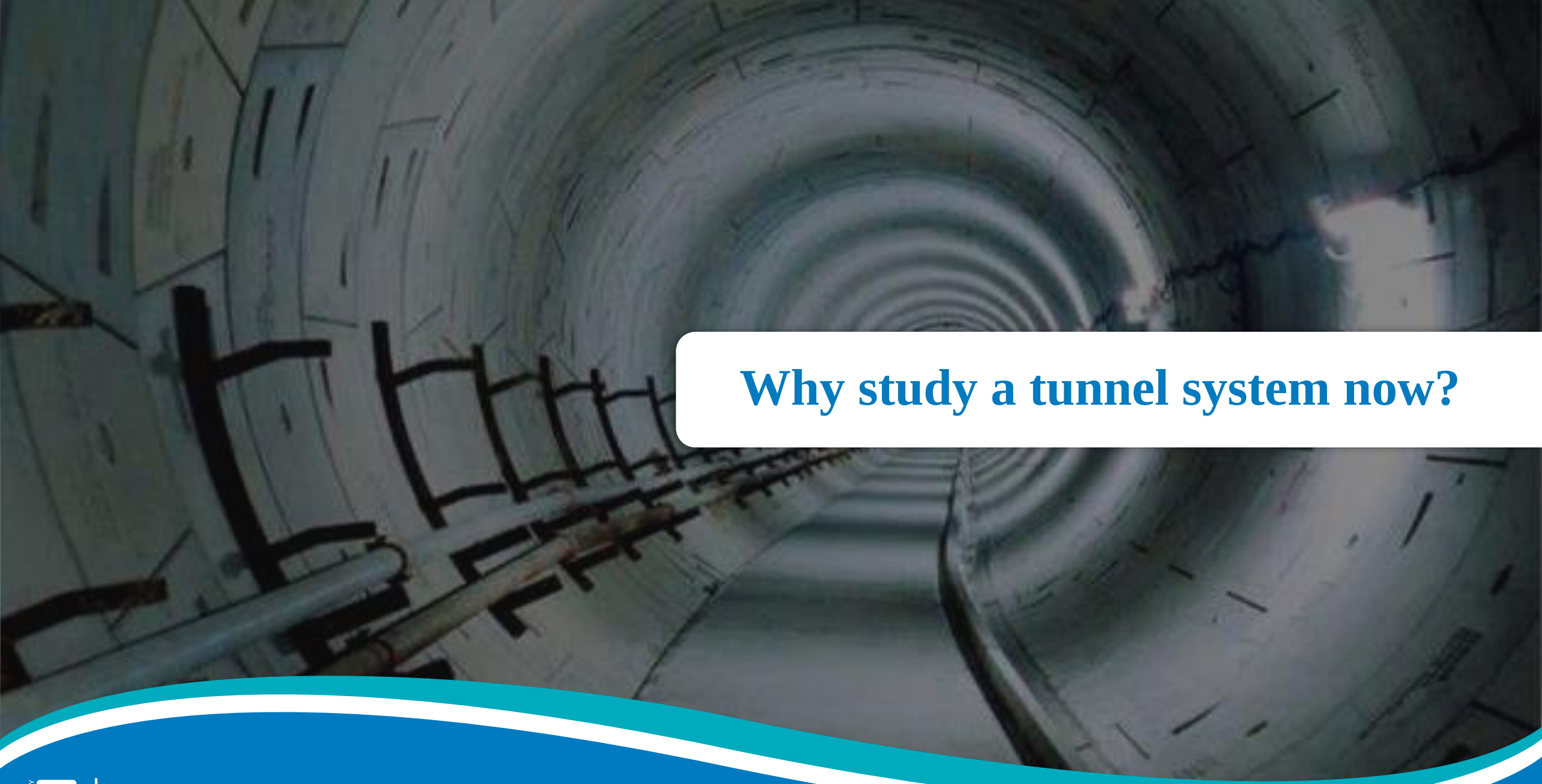


How much surface land is needed?

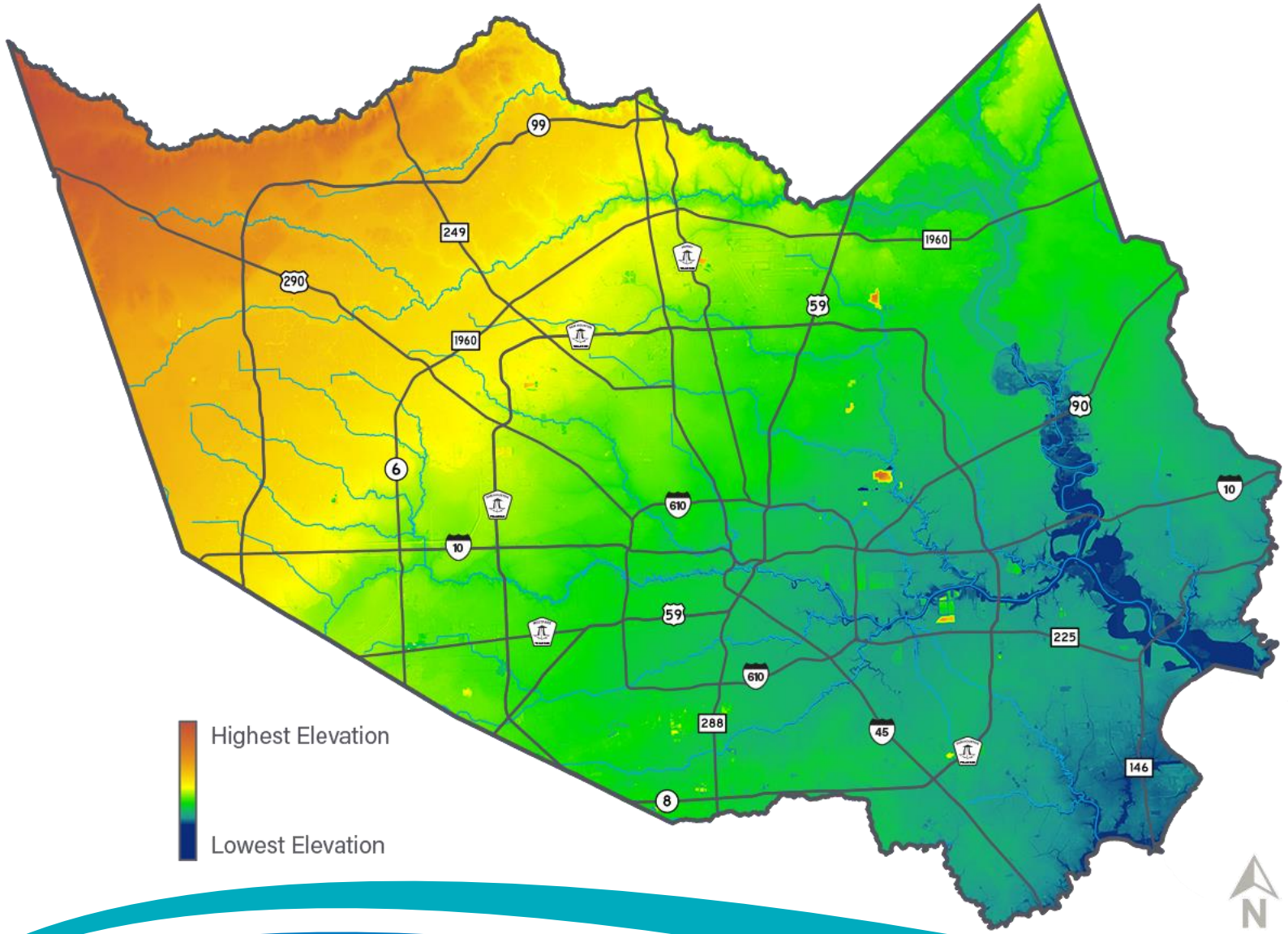
- 34 acres for Tunnels
- 377 acres for Channel Improvements*
- 1,882 acres for Stormwater Basins*
- 3,145 acres of Buyouts/Land Acquisition*

Shown for Representational Purposes Only

* A combination of these tools are typically required (versus the single tool)



Why study a tunnel system now?

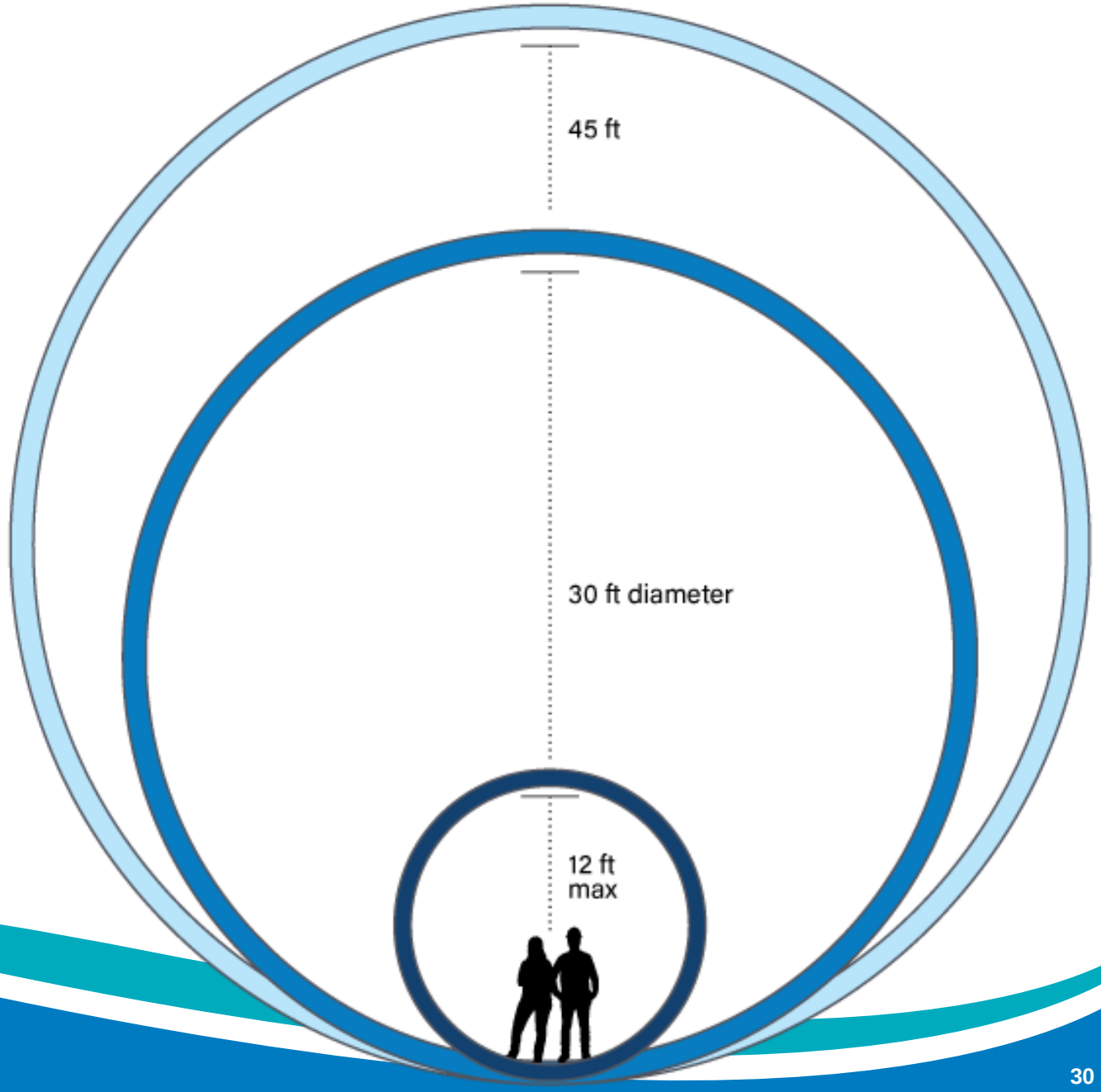


Tunnels Operate Using Gravity

There is a 244’ elevation change across Harris County.

How Different is a Stormwater Tunnel?

- 30 to 45 feet in diameter
- 9-25 miles in length
- Tunnel is 80 to 100 feet underground
- Tunnels carry exponentially more water than a storm sewer



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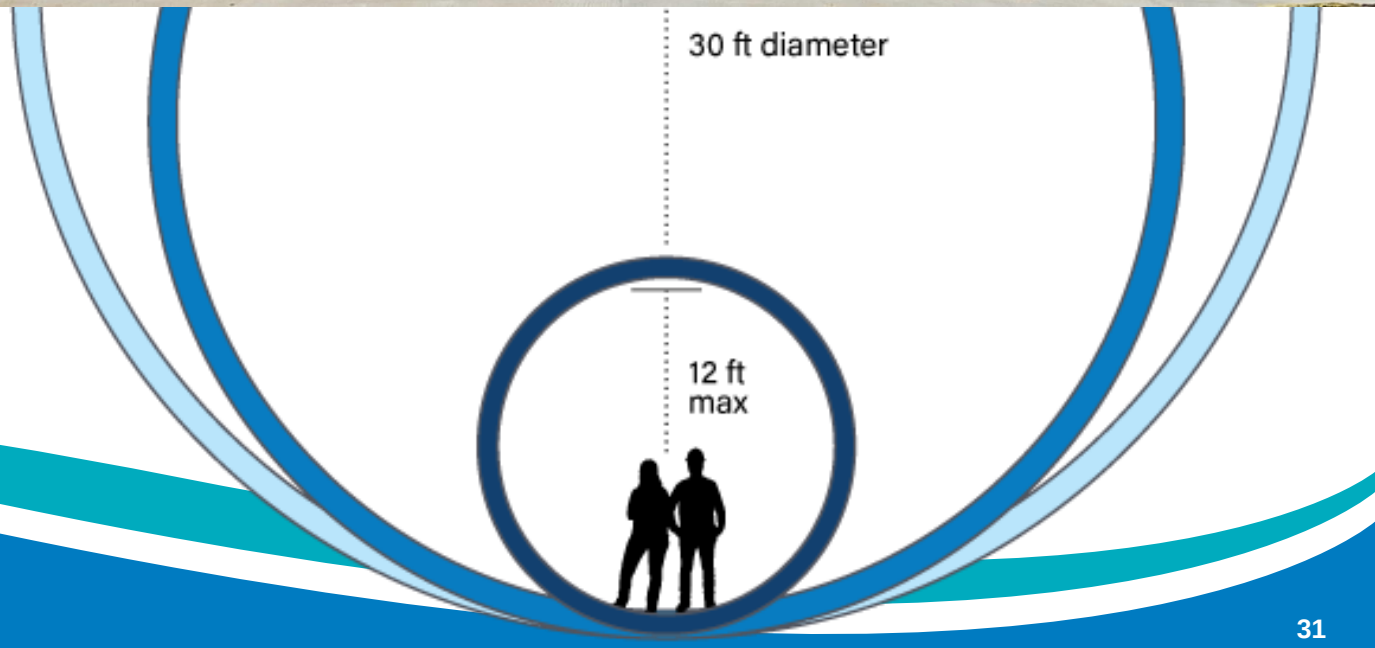

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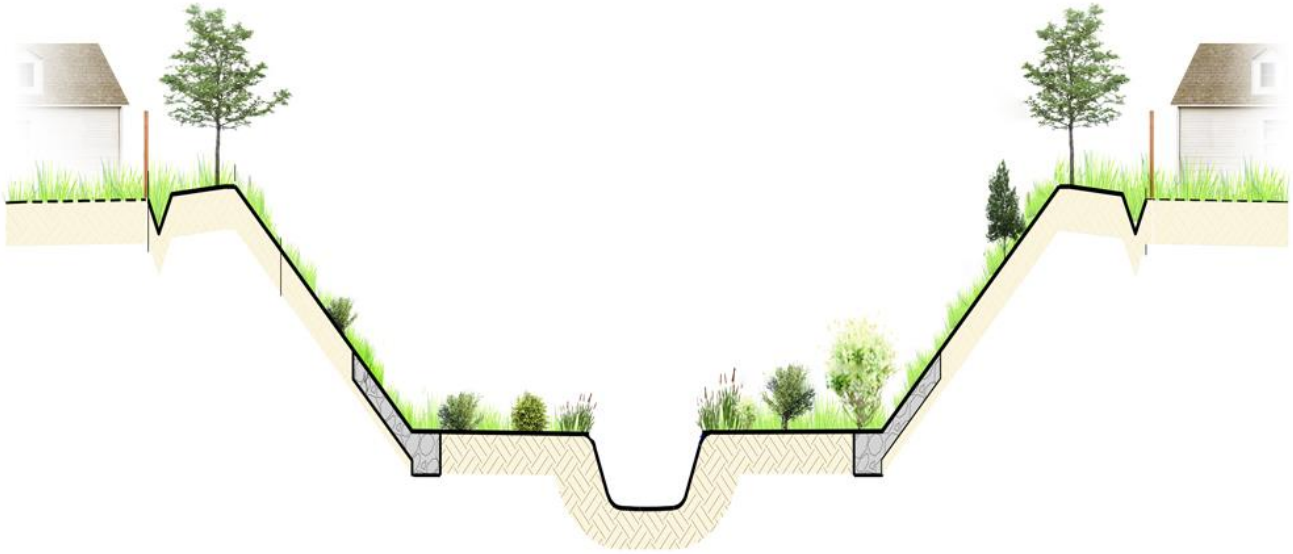

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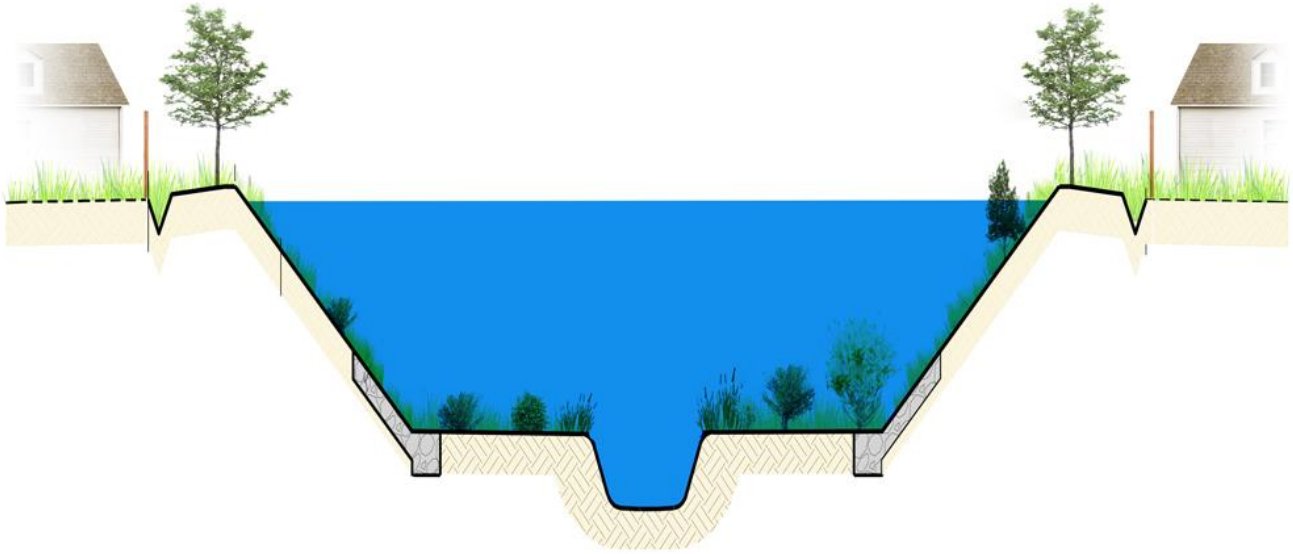

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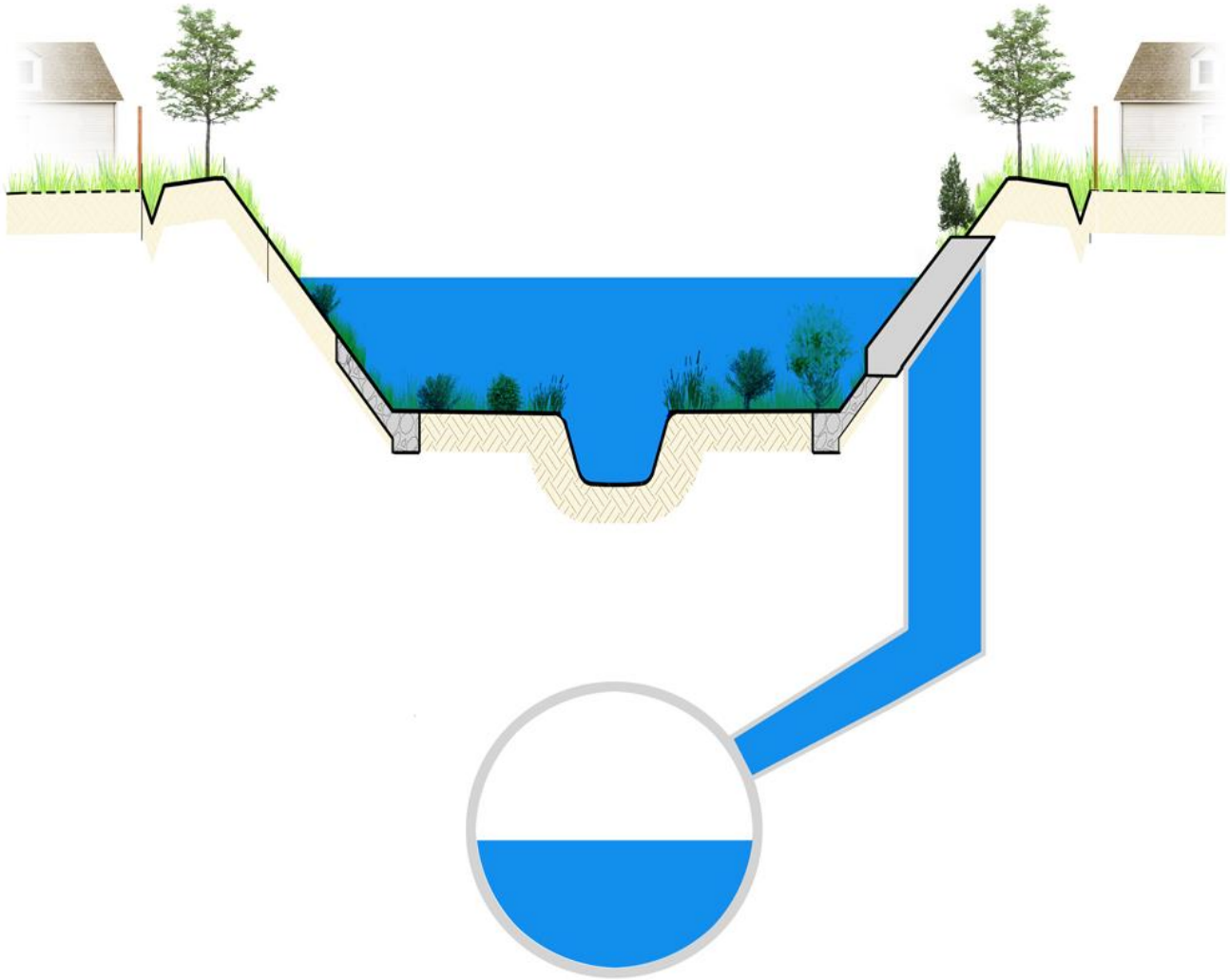

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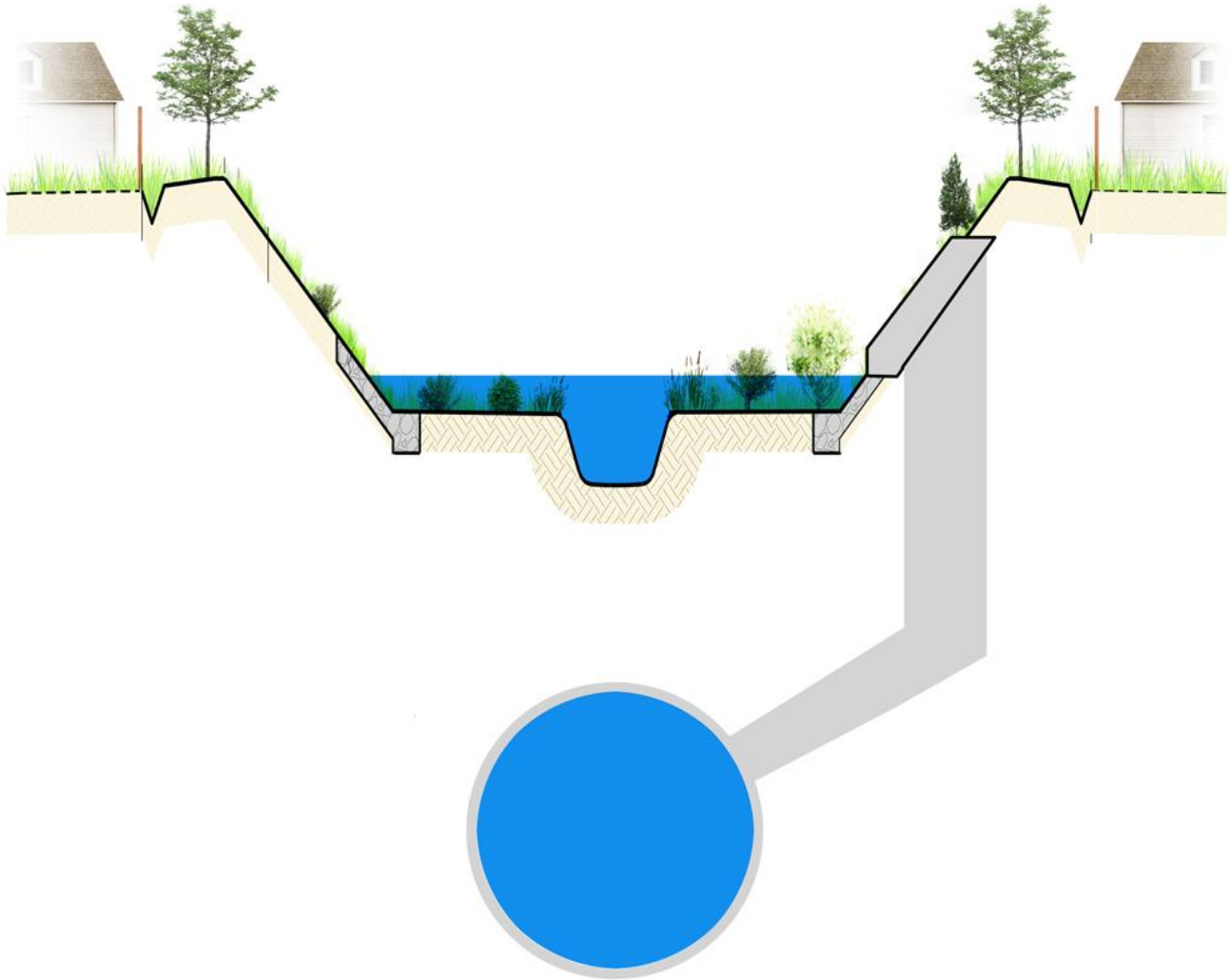
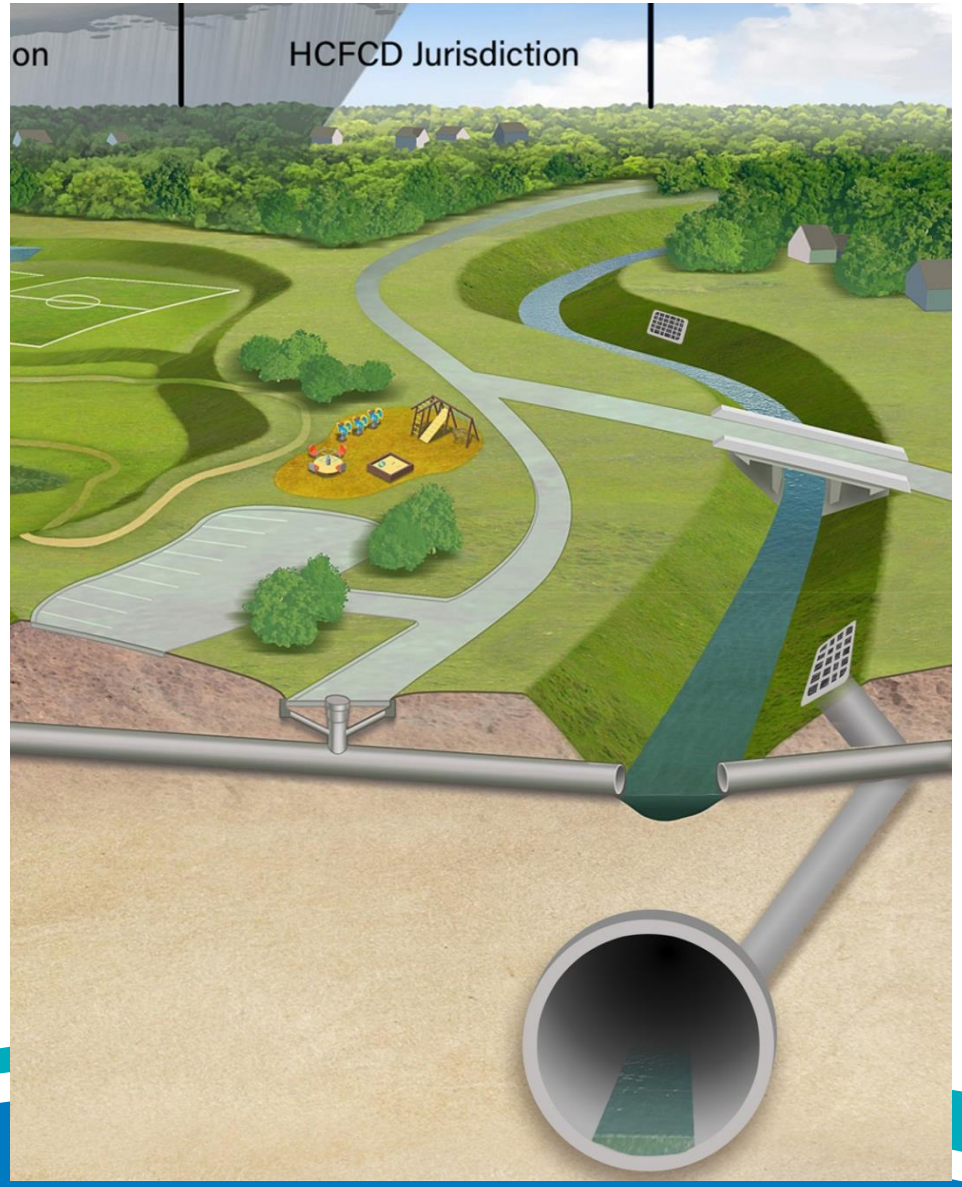


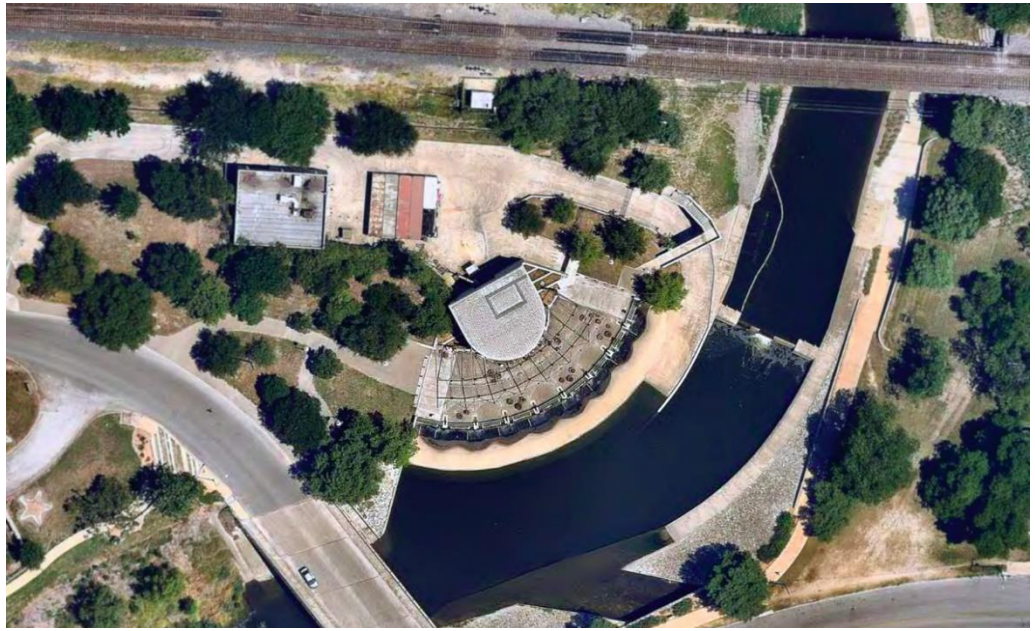


Tunnels and channels work together

- In heavy rain as a channel fills, water drains into the tunnel inlets
- Several inlets to each tunnel
- Water moves downstream to a strategically placed outlet

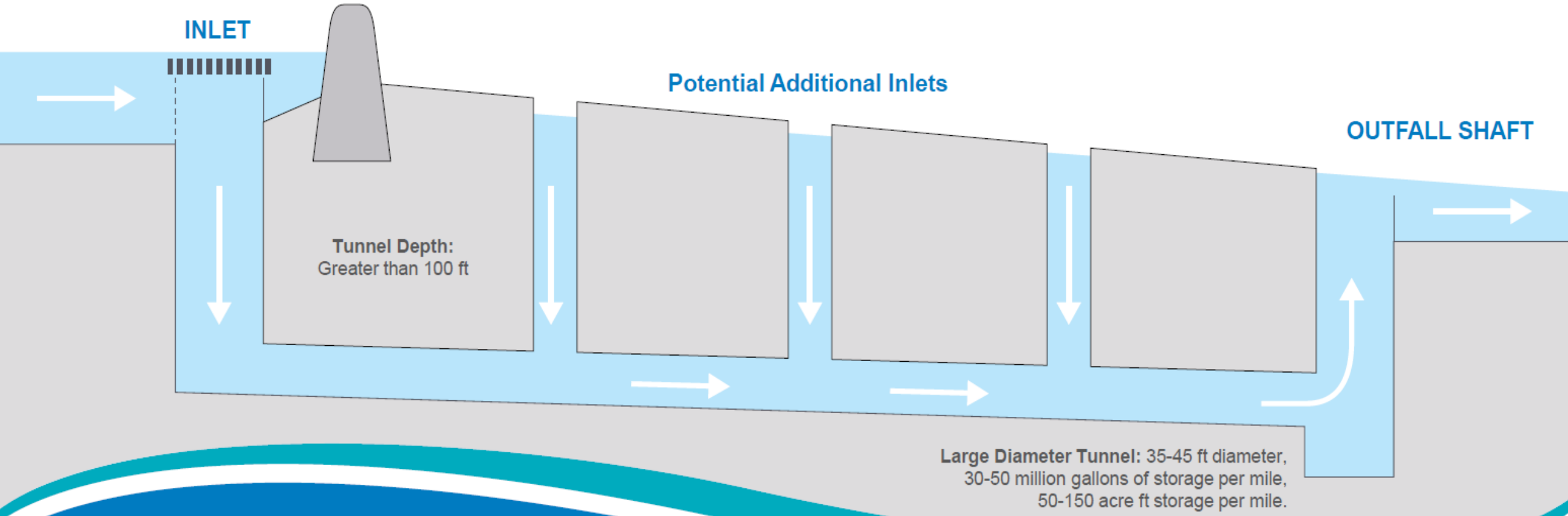
Tunnel Outfall System

What it Looks Like: San Antonio Flood Control Tunnel Outfall



How Does a Stormwater Tunnel Work?

Gravity Moves the Water



HARRIS COUNTY
FLOOD CONTROL DISTRICT

Video courtesy of Herrenknecht

So, what do we know so far?

Tunnel Study Phase 1: Feasibility

Go/No-Go

Critical Factors

- Can we build tunnels in our geological conditions?
- Can tunnels move enough water to make a difference?

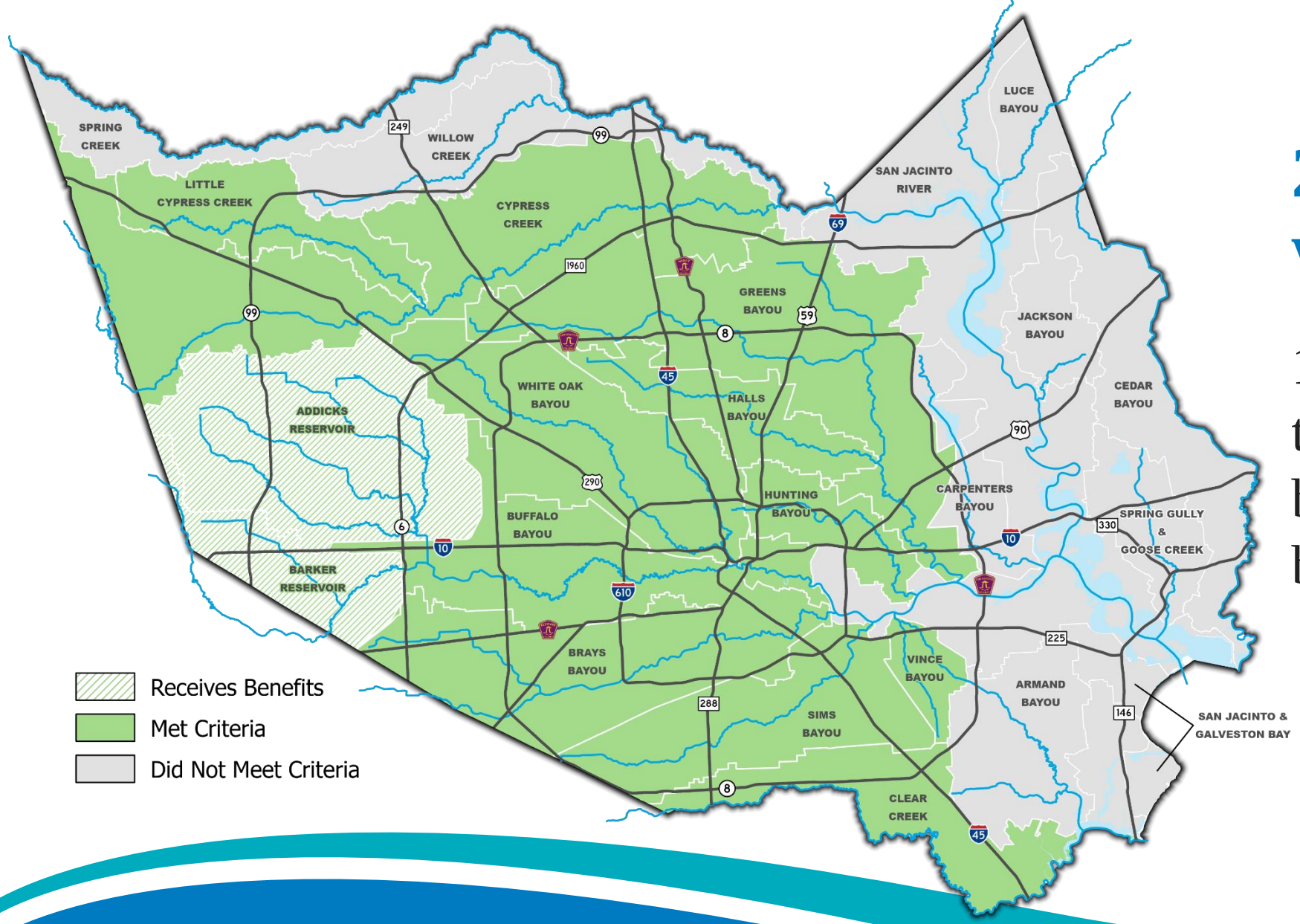
For information on Phase 1 please visit: **https://www.hcfcd.org/Z-08**

Tunnel Study Phase 2: Feasibility

Identifying Tunnel System Alignments

A complex analysis

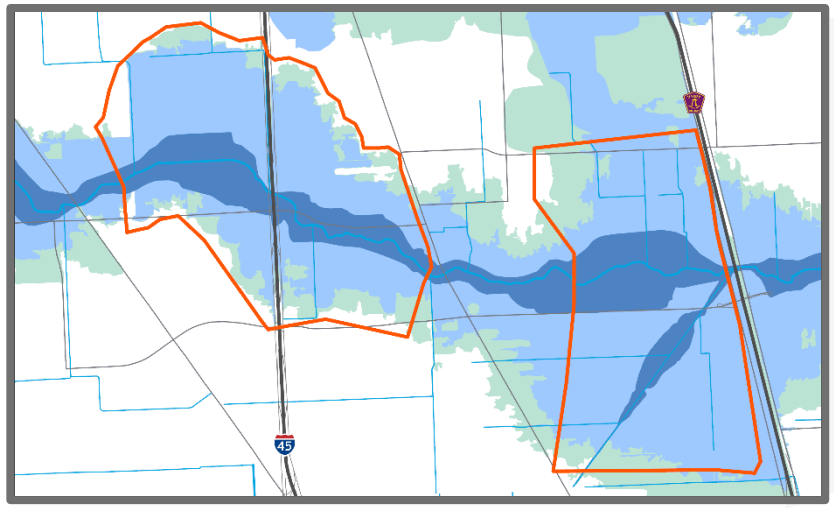
- Identify the criteria for a tunnel and the watersheds that met the criteria
- Identify flood damage centers that presented the highest risk and will benefit from tunnels
- Consider life safety
- Identify strategic locations for intakes and outfalls
- Identify opportunities to integrate tunnels with existing and proposed flood damage reduction systems
- Avoid geologic and man-made hazards



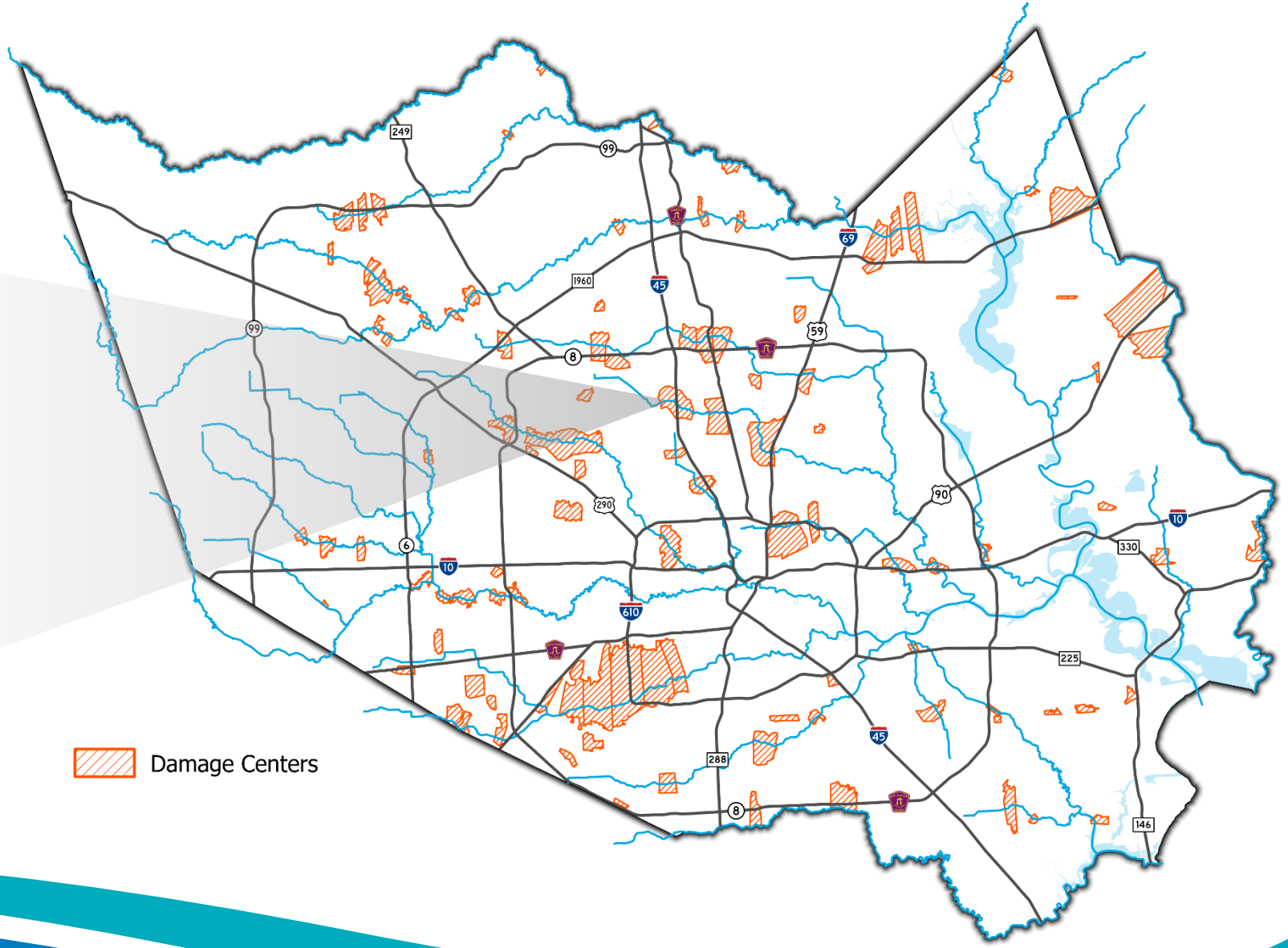
23 Watersheds were Evaluated

11 Watersheds where tunnels would likely be most effective and beneficial

Damage Centers



A concentrated area that has and will continue to flood repeatedly, with water in homes and businesses.



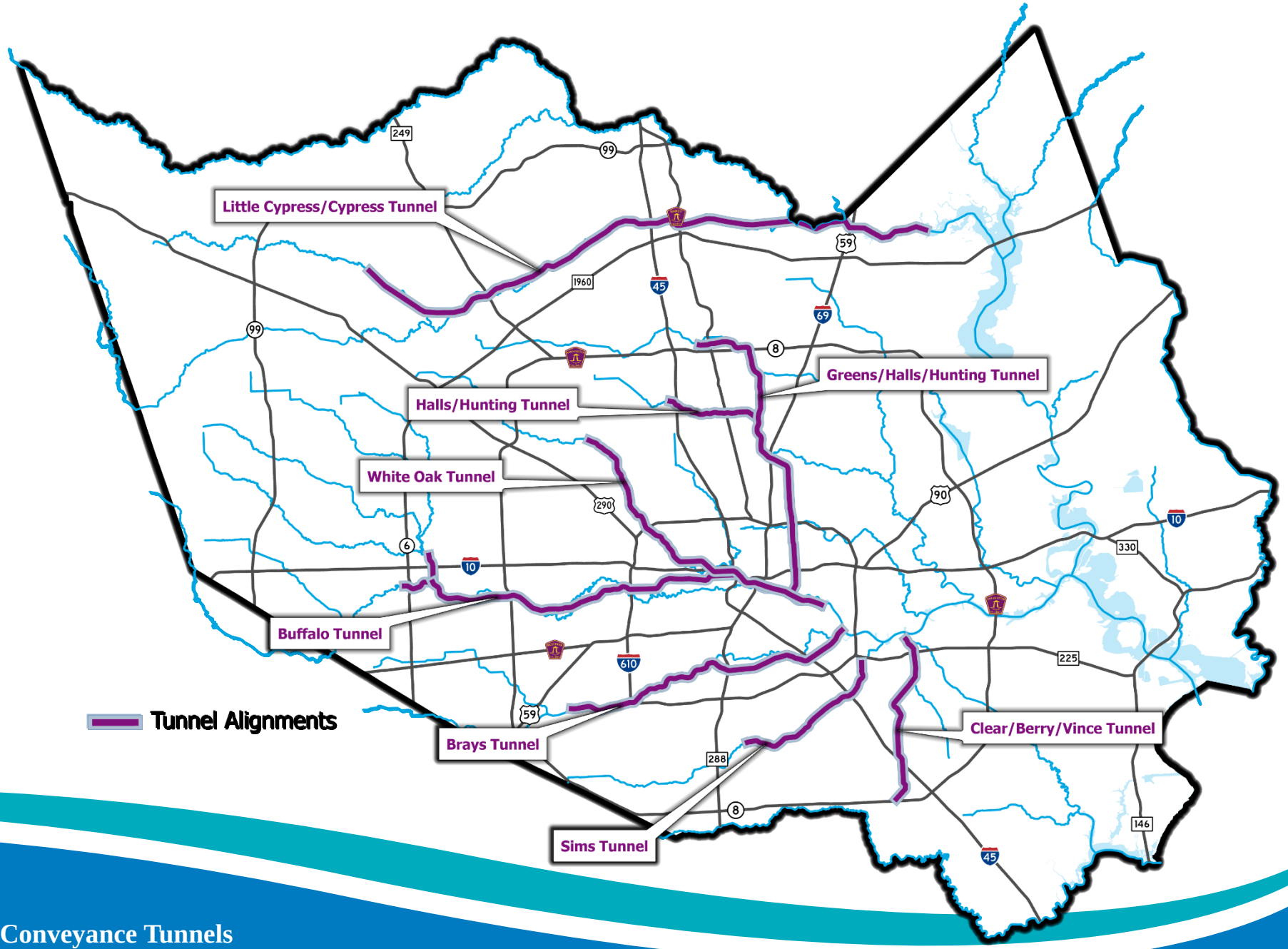
Potential Tunnel System

Located where Tunnels would likely be most effective and beneficial

80,000-120,000 future instances of flooding avoided

Est. Cost $30 Billion

All alignments are preliminary and will be refined in Phase 3



Potential Tunnel System Summary

	Length (miles)	Diameter (feet)	Inlets and Outlet	Estimated Conveyance (cfs)	Range in Ground Cover (feet)
Brays Bayou	16	35	3	8,310	45-120
Buffalo Bayou	25	30-40	7	12,020	60-140
Clear Creek, Berry and Vince Bayous	9	35	3	7,310	46-87
Greens, Halls and Hunting Bayou	18	35	4	9,740	55-125
Halls and Hunting Bayou	16	35	4	10,370	58-125
Little Cypress Creek, Cypress Creek	24	35	4	10,210	39-97
Sims Bayou	8	35	2	7,260	52-153
White Oak Bayou	16	35	3	10,300	54-104

* Estimated using Atlas 14, 100-year storm event over 100-year service life

Potential Advantages of Tunnel System

- Expands options for flood damage reduction
- Makes our stormwater network more robust
- Reduces community disruption and increases resiliency
- Reduces environmental impact

Tunnel System Benefits

MOVES SIGNIFICANT AMOUNT OF ADDITIONAL WATER

MINIMIZES LAND ACQUISITIONS

CONSTRUCTED FASTER THAN MULTIPLE TRADITIONAL PROJECTS OF EQUIVALENT COMBINED BENEFIT

Tunnel System Considerations

- Criteria for federal funding continues to evolve
- Preliminary Cost Estimate for Tunnel System: $30 Billion

Points to Remember

- New technology often involves learning as you implement
- A tunnel system would be an addition to our existing stormwater management network
- Weather will always be unpredictable
- Flooding will always be a possibility in Harris County
- Everyone should purchase flood insurance!

Investigation of Tunnels Continues

Where we are headed

Phase 3 Investigation

- Understanding the Need and Working with the Community
- Advancing the Design
- Quantifying the Benefits
- Investigating Funding Sources

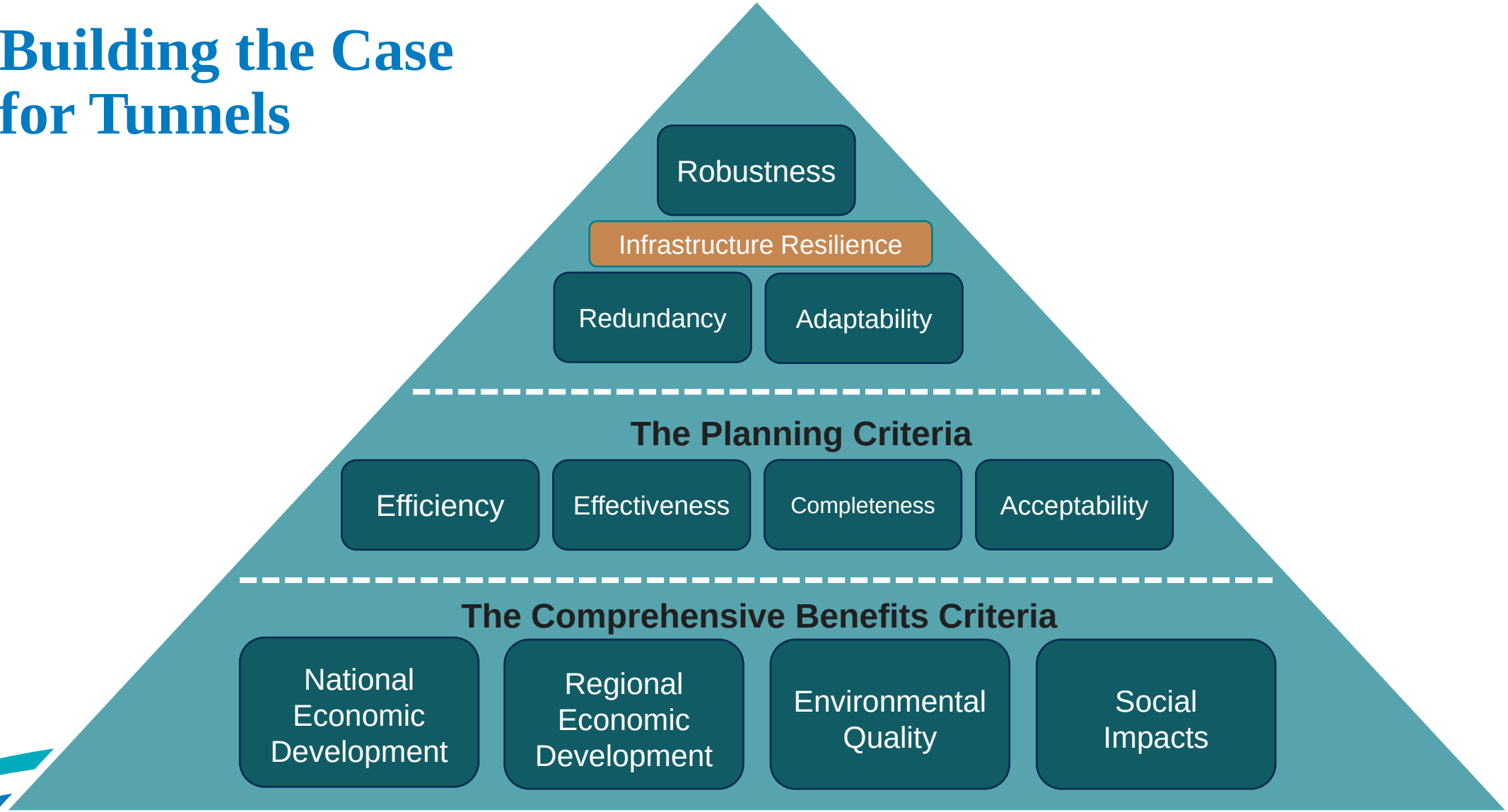
Working with the Community

- Educate the public on how a tunnel system can benefit our neighborhoods
- Develop clarity on where improvements are needed most, and which flood damage reduction tool makes sense in varying locations
- Capture input that will inform the project team as they continue to evaluate
- Measure public support for adding a tunnel system to our flood risk reduction strategy and tools
- ***You have an important role to play in this decision.***

Advancing the Design:
Analyzing Approximately 130 miles of a Potential Tunnel System

- Determine how tunnels will most effectively integrate with our existing network and planned improvements to the network
- Identify ways to mitigate downstream impacts
- Finalize a tunnel system that provides the greatest flood damage reduction benefits, while considering cost and potential funding
- Quantify flood damage reduction benefits through drainage modeling, engineering and design, cost estimating, and other means

Building the Case for Tunnels



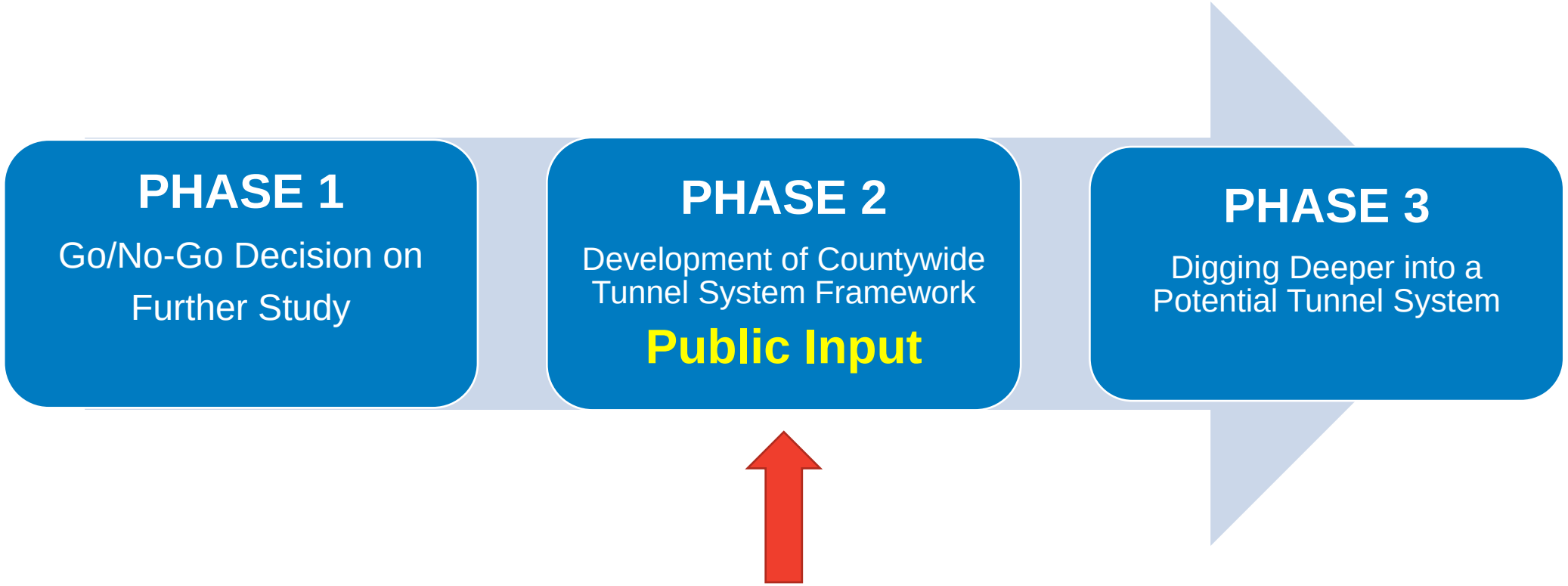
Securing Funding

- Complete the necessary work to position a tunnel system for State and Federal Funding.
- Due to the scale of the potential system, minimizing the burden on Harris County taxpayers is an important objective

Phase 3 Investigation, Recap

- Understanding the Need and Working with the Community
- Advancing the Design
- Quantifying the Benefits
- Investigating Funding Sources

Where we are today



We want to hear from you.

Please visit **hcfcd.org/tunnels** to learn more
about the **Feasibility Study of Stormwater Conveyance Tunnels**,
ask questions and sign up for our mailing list.

Virtual Public Meeting Instructions

There are three ways to leave a comment about this project during tonight's session or during the comment period from June 16, 2022, through September 30, 2022:

- Submit a comment at **PublicInput.com/tunnels**
- On the Flood Control District's website at **hcfcd.org/tunnels**, or
- Via phone at **855-925-2801** with Meeting Code: **9622**

Any questions not addressed during tonight's Q&A will receive a response from the Flood Control District after the event. Meeting information and video will be available on:

- **hcfcd.org/tunnels**
- The Flood Control District's YouTube channel

☑ GET FLOOD INSURANCE

EVERYONE NEEDS IT

Flooding conditions can occur year-round, and you do not have to live in the 100-year floodplain to be at risk.

Flood loss claims as a result of Hurricane Harvey

- Approximately 68% were outside of the FEMA mapped 100-year floodplain.

Hurricane Season: June-Nov

Flood Season: Year-round