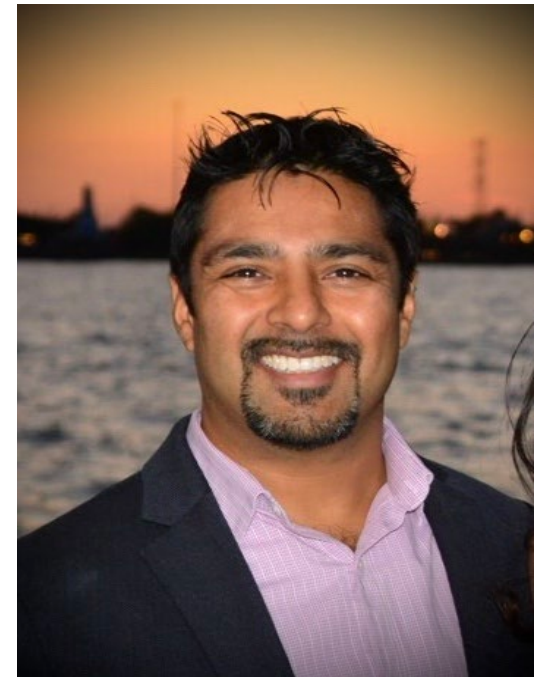




City of Houston Stormwater Master Plan

Paresh Lad

Division Manager
Transportation & Drainage Operations





STORMWATER MASTER PLAN AND MODEL

PARESH LAD, ENV SP

**TRANSPORTATION AND DRAINAGE
OPERATIONS PLANNING**





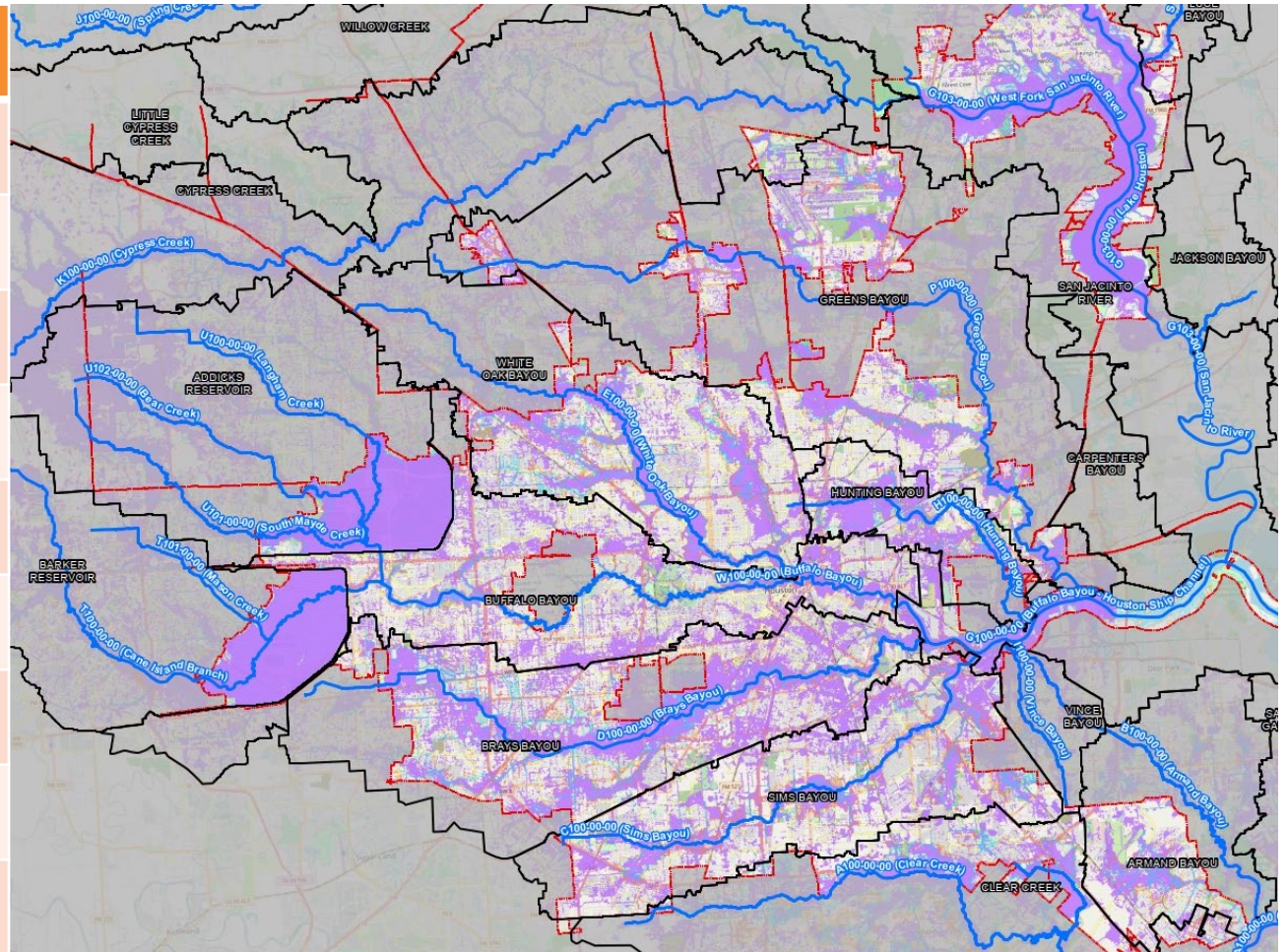
OUTLINE

- **Project Goal**
- **Purpose**
- **Prioritization**
- **Focus Area**

DRAINAGE INFRASTRUCTURE

City Infrastructure Statistics

Area	609 sq. miles
Manholes	47,000
Pipe > 24"	3,000 miles
Pipe > 36"	1,700 miles
Roadside Ditches	2,500 miles
Unstudied Channels	310 miles
Studied Channels	776 miles
Area in 500-year Floodplain	479 sq. miles
FEMA Flood Claims (since 2015)	55,000



PAST EFFORTS

- Comprehensive Drainage Plan -1999
- GIS analysis of the City's storm sewer
- Pre-Atlas 14 rainfall
- Identification of adequate/inadequate systems
- Used to develop CIP's for the drainage infrastructure
- City surveyed the roadside ditch system in 2016
- Updated the CDP by combining the storm sewer system with the roadside ditch coverage
- Used current LiDAR to burn in the terrain which help create new outfall delineations
- Effort provided a view of the entire City and its infrastructure capacity

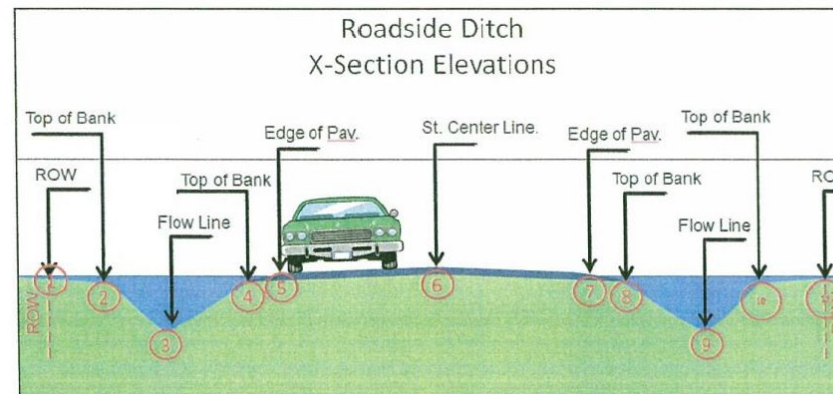
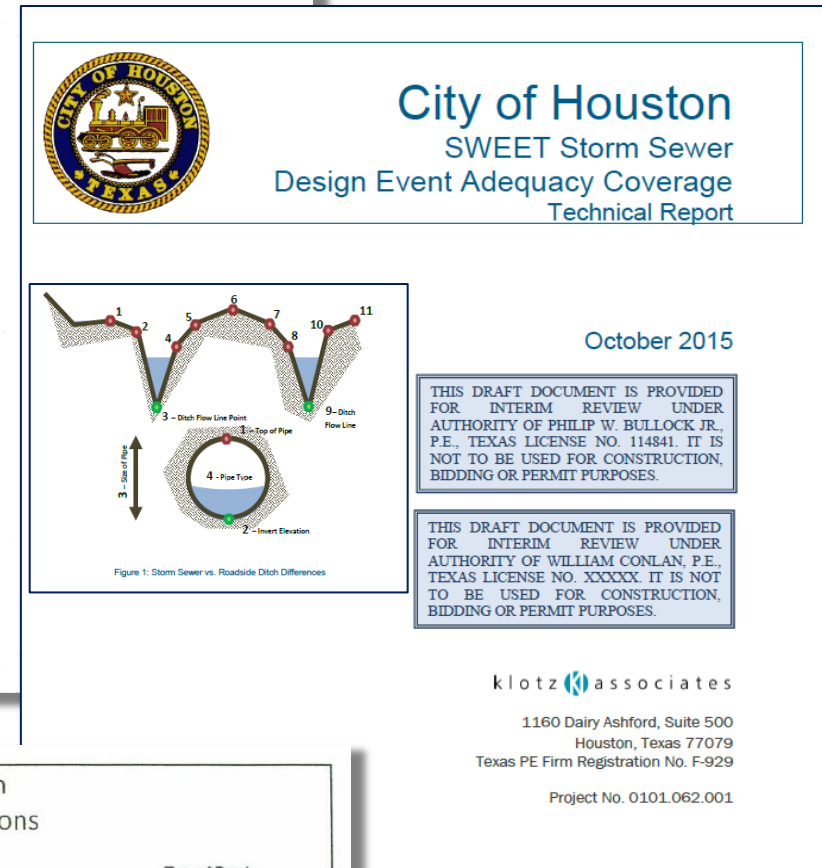
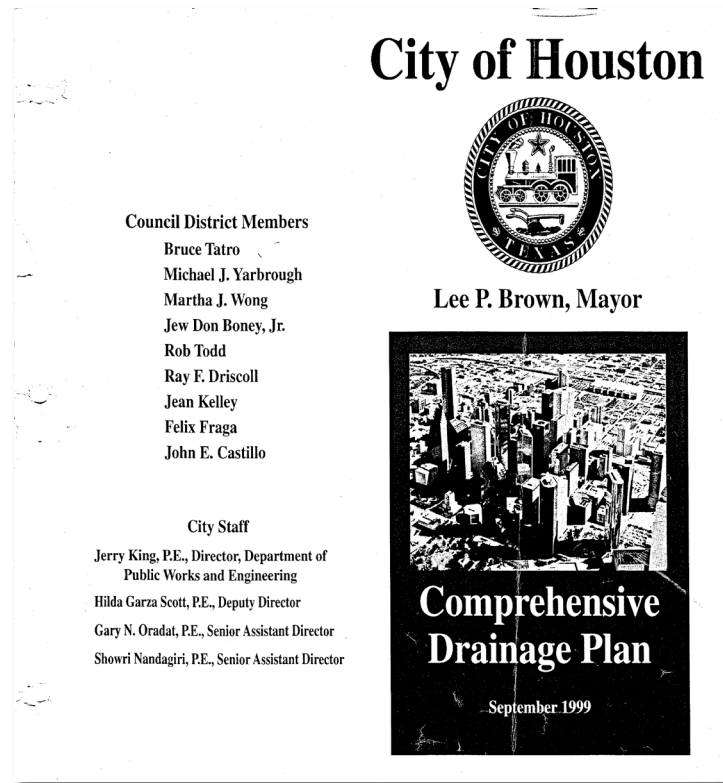
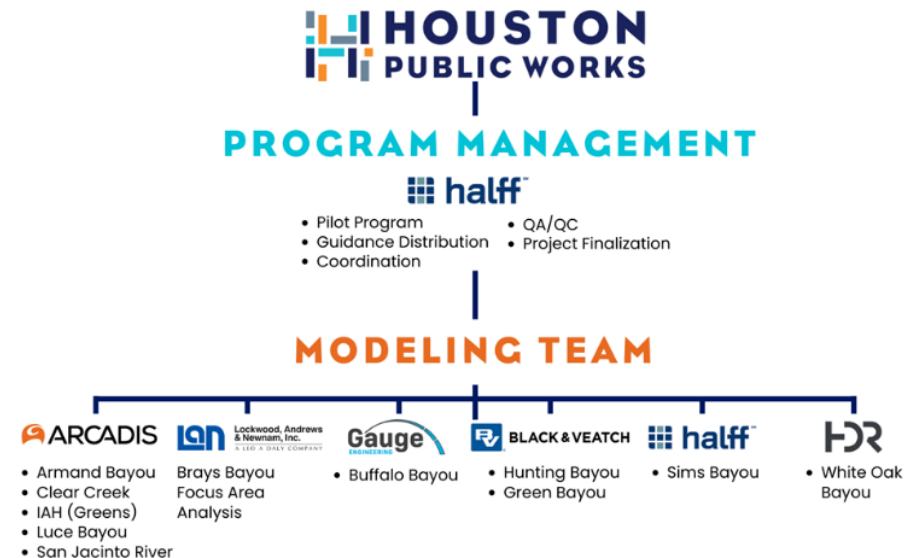


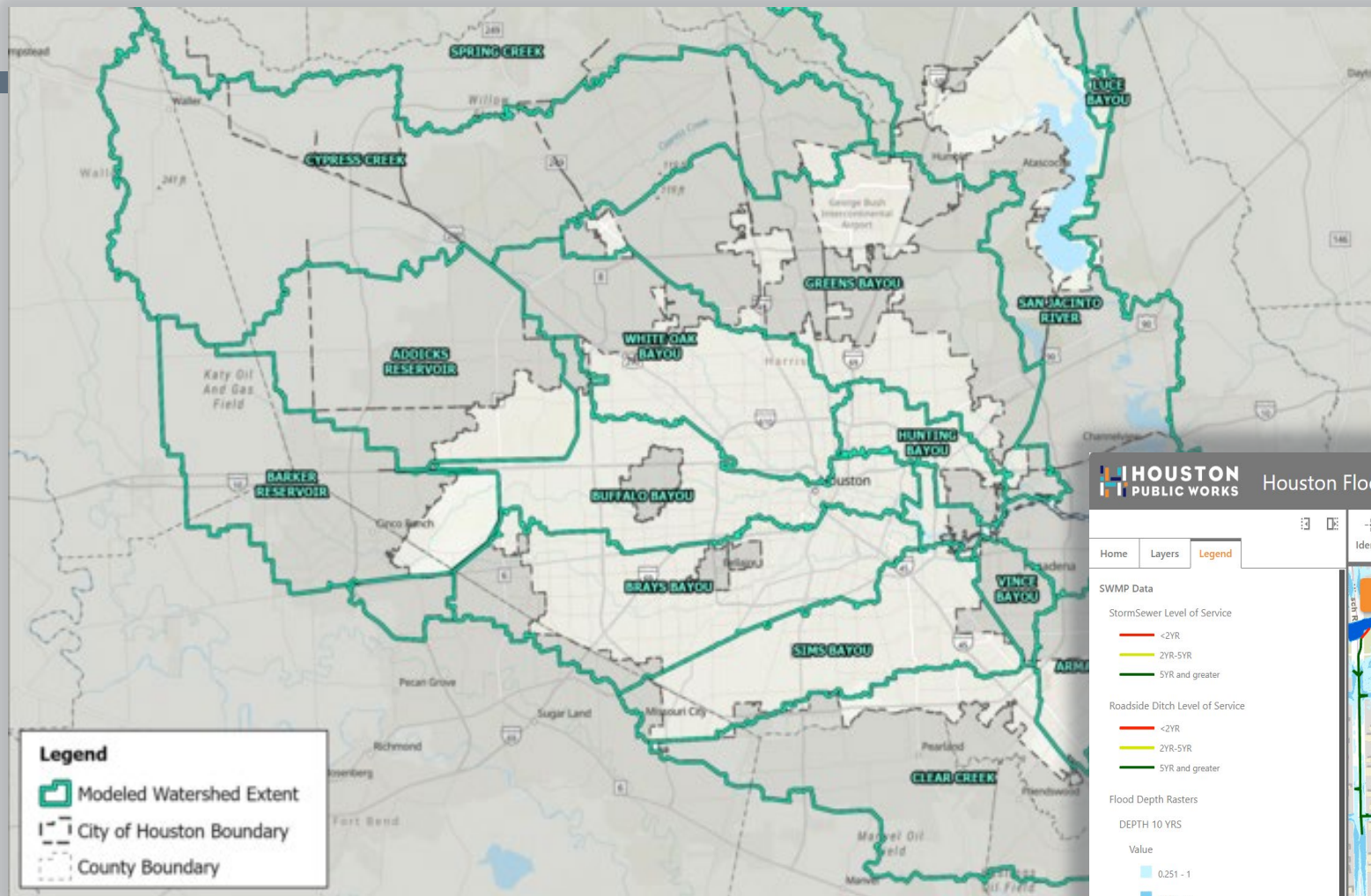
Figure 3: Cross Sectional Survey Data

STORMWATER MASTER PLAN STARTUP

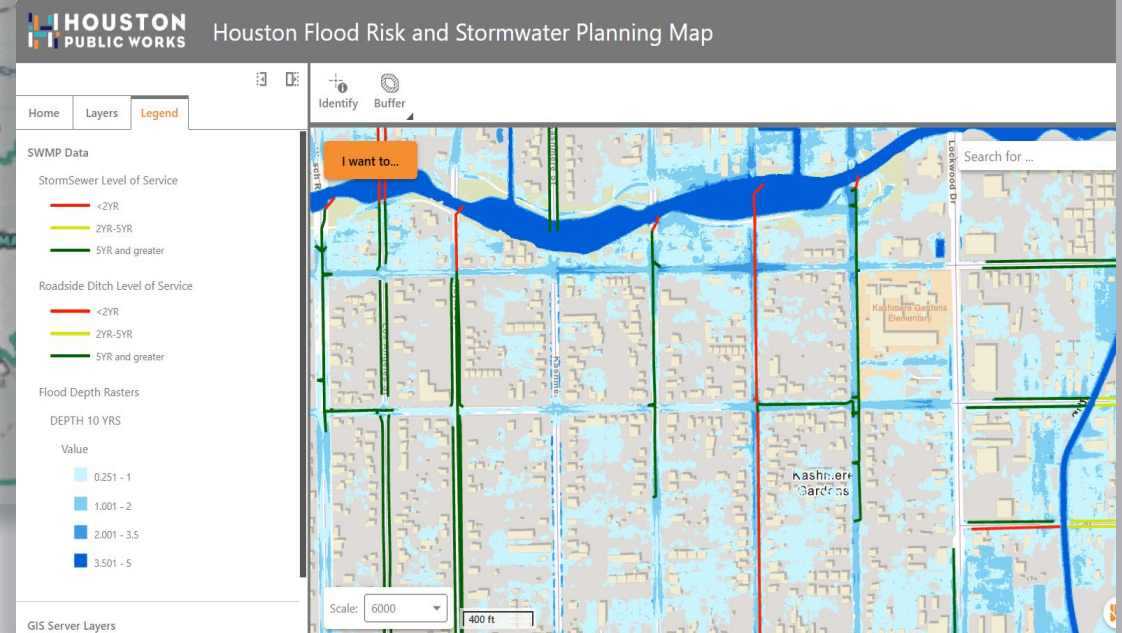
- 2018
 - Funding release from CDBG-DR 17 and application submitted by COH
- Funding:
 - CDBG-MIT 2017 – 5 Consultants, 11 Watersheds
 - TWDB – Sims Bayou Watershed (Pilot) and Project Technical Management
- Project Organization:
 - Reviewed infrastructure similarities and differences between watersheds, highlighted components of each to inform data collection and model development challenges.
 - Divided City into 6 watershed groups due to watershed characteristics and familiarity.



CITY WATERSHEDS



- Each Watershed Analyzed
- Model shows water movement and areas of flood risk



HOUSTON STORMWATER MASTER PLAN



Houston Stormwater Master Plan

The Houston Stormwater Master Plan (SWMP) initiative is poised to play a pivotal role in providing the City of Houston with a comprehensive stormwater and drainage infrastructure analysis. The information gathered and analyzed through this initiative will serve as a robust foundation for an equitable comparison of flood risk across the City, enabling informed decision-making on drainage projects and studies.



PROVIDE A COMPREHENSIVE DRAINAGE ANALYSIS OF THE CITY



UNDERSTAND EXISTING FLOOD RISK THROUGHOUT THE CITY



IDENTIFY FOCUS AREAS FOR FUTURE PLANNING FOR PROJECTS AND STUDIES

Study Goals

History and Overview

The City of Houston is prone to flooding due to its flat topography, dense development, and proximity to the coast. This flooding causes safety and economic ramifications that are felt throughout the region, the state and the nation. Since the 1990s, Houston has completed drainage planning efforts to understand the impacts of flood events better and develop plans to reduce the risk of flood for its residents. This study analyzes the influence of the City's local storm sewers and roadside ditches, alongside the drainage patterns created by channels, baysou and rivers that convey stormwater to the bay. With this approach, the Houston SWMP initiative provides the first comprehensive look at flooding and drainage in the City.

Previous Planning Efforts

1999

- Comprehensive Drainage Plan
- City-wide analysis of storm sewer infrastructure
- Used GIS and regional method
- Determined storm sewer capacity
- Used for CIP identification

[Find out more](#)

2010

- Rebuild Houston
- Developed drainage impact fee to fund drainage project
- Created prioritization factor to conduct storm drainage planning studies
- Conducted various neighborhood planning studies

[Find out more](#)

2016

- Roadside Ditch Drainage Planning
- Updated 1999 CIP to combine storm sewer analysis with open ditches
- Created new outfall boundaries and later assessment of drainage infrastructure
- Incorporated into the prioritization framework for a comprehensive analysis

[Find out more](#)

2019 - Present

- HCFCD MAP/NECT
- Improving understanding of flood risk in Harris County to allow communities to make more informed decisions
- Developed new models for the baysou and channels throughout the county using the latest information and technology

[Find out more](#)

2024 - Present

- Stormwater Master Plan
- Created a comprehensive, citywide assessment of drainage throughout the City of Houston
- Provides understanding of flood risk based on storm sewers, open ditches, channels, and baysou
- Conducted focus area analysis to identify areas for projects and future studies

[Find out more](#)

Interactive Map

- Explore the watershed map with detailed planning results and watershed-specific insights
- Storm sewer and roadside ditches

[In progress](#)

City-Wide Information

The City of Houston drainage infrastructure consists of two components: primary drainage systems such as the major baysou, rivers, and channels which receive flows from both local runoff as well as contributing watersheds upstream of the City; and secondary drainage systems such as storm sewer and roadside ditch that collect and convey local runoff flows to the primary drainage systems. Both of these types of infrastructure were included within the Houston SWMP.

City Statistics

Size	670 sq mi	Storm Sewer*	1,900 mi
Population	2.3 million	Roadside Ditch*	2,800 mi
Structures*	550,200	Channels*	500 mi

*Representative of installed infrastructure



BRAYS BAYOU WATERSHED



What is a watershed?
A watershed is the area of land where rainfall flows to a specific point, such as a stream or lake.

Size	127 sq mi
Area within City	90 sq mi
Developed Area within City	67 sq mi
Modeled Structures	140,130

The Brays Bayou watershed is located in the southwest portion of the City of Houston. Most of the watershed is located within City of Houston limits, with small portions falling in the cities of Seawall, The Woodlands, Houston City, Stafford, The Woodlands, Houston, and Sugar Land. It is bounded by Buffalo Bayou to the north and Santa Bayou to the south. Terrain in the watershed is generally flat with Brays Bayou draining to the east into the Buffalo Bayou - Houston Ship Channel. The watershed within City limits is mostly developed, consisting primarily of small-lot, single-family residences. There are areas of heavy commercial development near Highway 5 and I-69 as well as along I-610 where NRG Stadium and the Texas Medical Center are located.

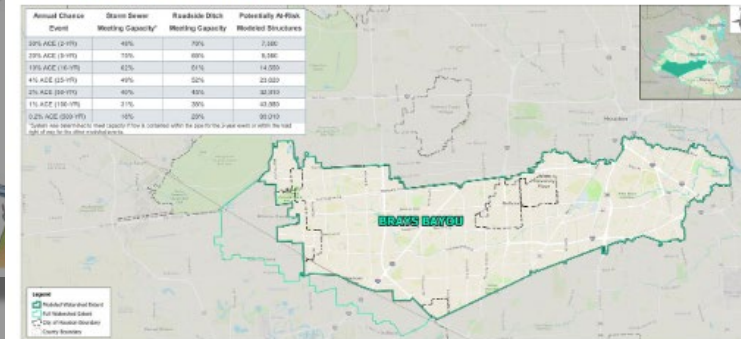
[View the Brays Bayou Watershed Report \(2024\)](#)

FEMA Floodplain Classification	Area within City (sq mi)	Structures within City (sq mi)
Within 1% ACE Floodplain (Zone AE)	29.3	34,250
Additional Within 0.2% ACE Floodplain	26.2	105,440
Outside 0.2% ACE Floodplain	72.8	74,320

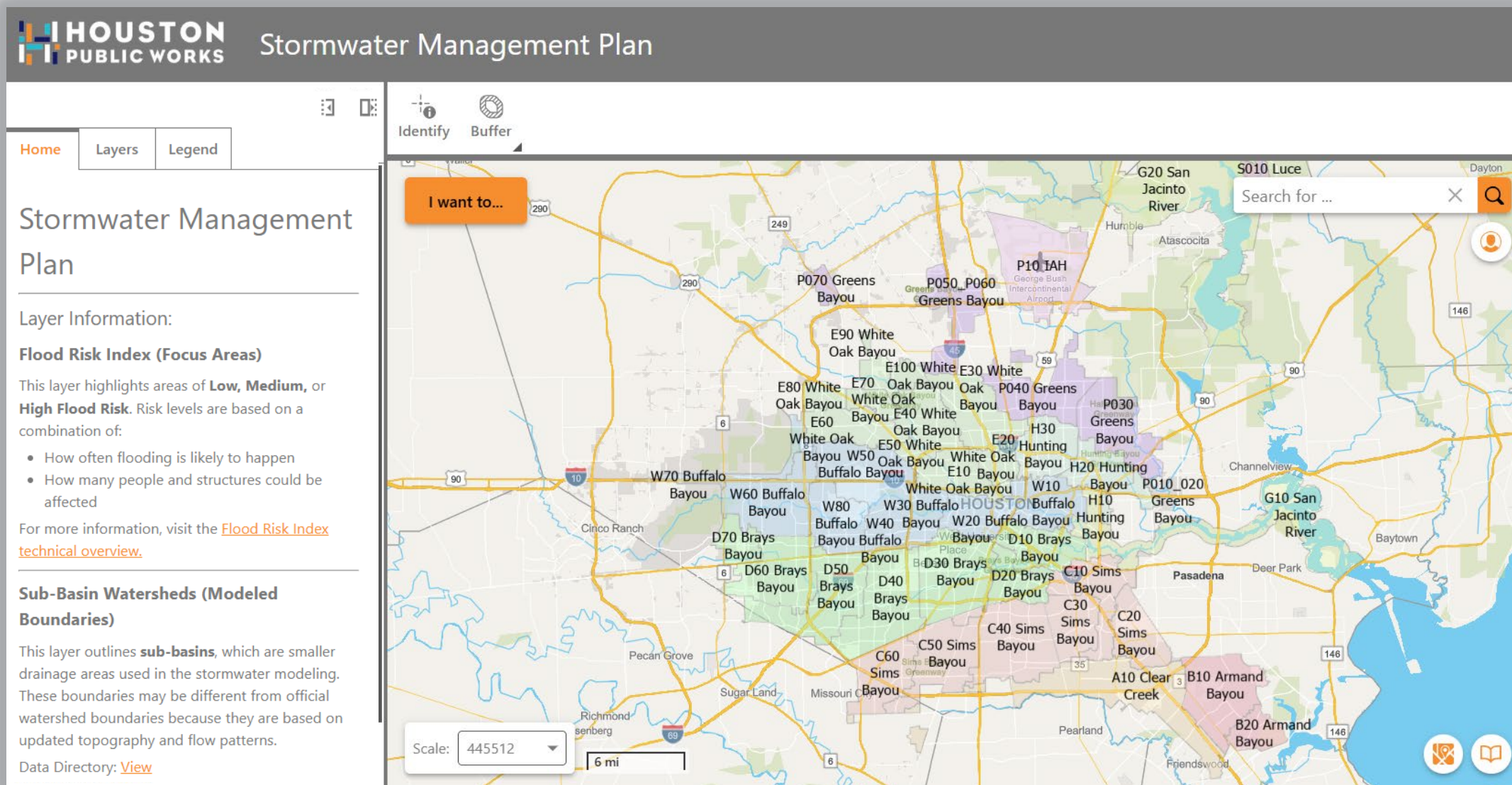
Conveyance Type	Length (mi)	Percent of Total
24" s Pipe Diameter < 36"	875	48%
36" s Pipe Diameter < 60"	459	25%
Pipe Diameter ≥ 60"	181	10%
Roadside Ditch	182	10%
Studied Channels	76	4%
Unstudied Channels	54	3%

Modeling results indicate that structural flooding in frequent events is largely contained to low-lying neighborhoods, including Alief and east Alameda Road. In more severe events, such as the 100- and 500-year events, widespread flooding can be seen along Brays Bayou as well as in nearby areas affected by the bayou watershed.

During frequent events, flooding is primarily seen in the Alief neighborhood as well as in several areas west of Alameda Road. Flooding is due to undersized local infrastructure such as storm sewer and roadside ditch systems as well as low-lying terrain that prevents water from reaching outfall locations. Depths of 1 to 5 feet can be seen starting in the 2-year event with these neighborhoods. Elevated structures and road drainage mitigate some structural impacts; however, in more severe events, residents and businesses throughout Alief and areas west of Alameda Road experience widespread structural flooding.

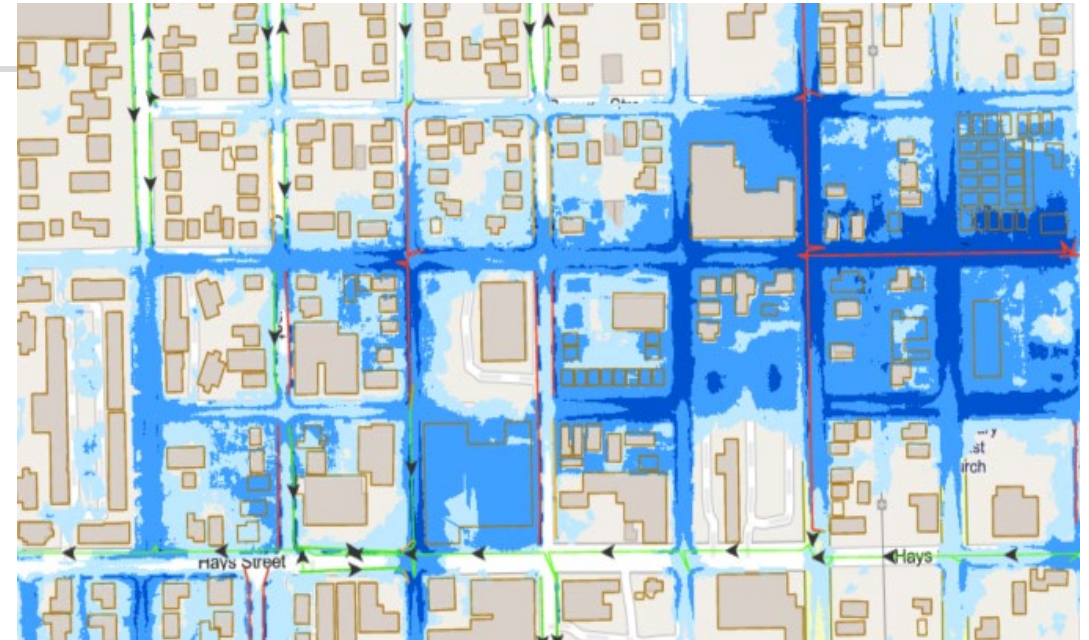


STORMWATER MASTER PLAN VIEWER



DATA AND PRIORITIZATION

- Raster for Various Flood Frequencies
- Population Associated to Structure
- Critical Facilities
- Mobility and Access



- **550,000**

- Structures Modeled

- **500**

- Miles of Channel Modeled

- **1,900**

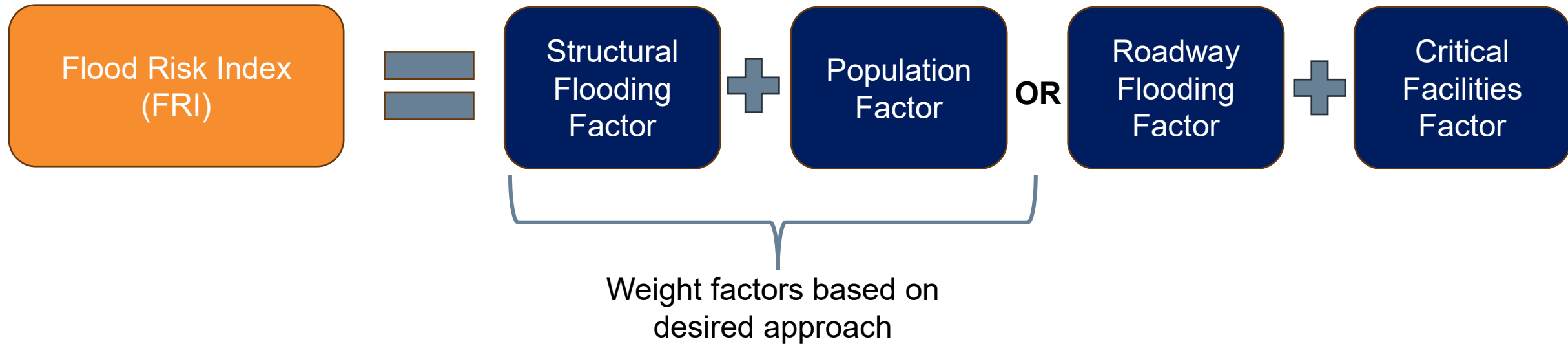
- Miles of Storm Sewer Modeled

- **2,800**

- Miles of Roadside Ditch Modeled

INSTANCE FACTOR AND FLOOD RISK INDEX

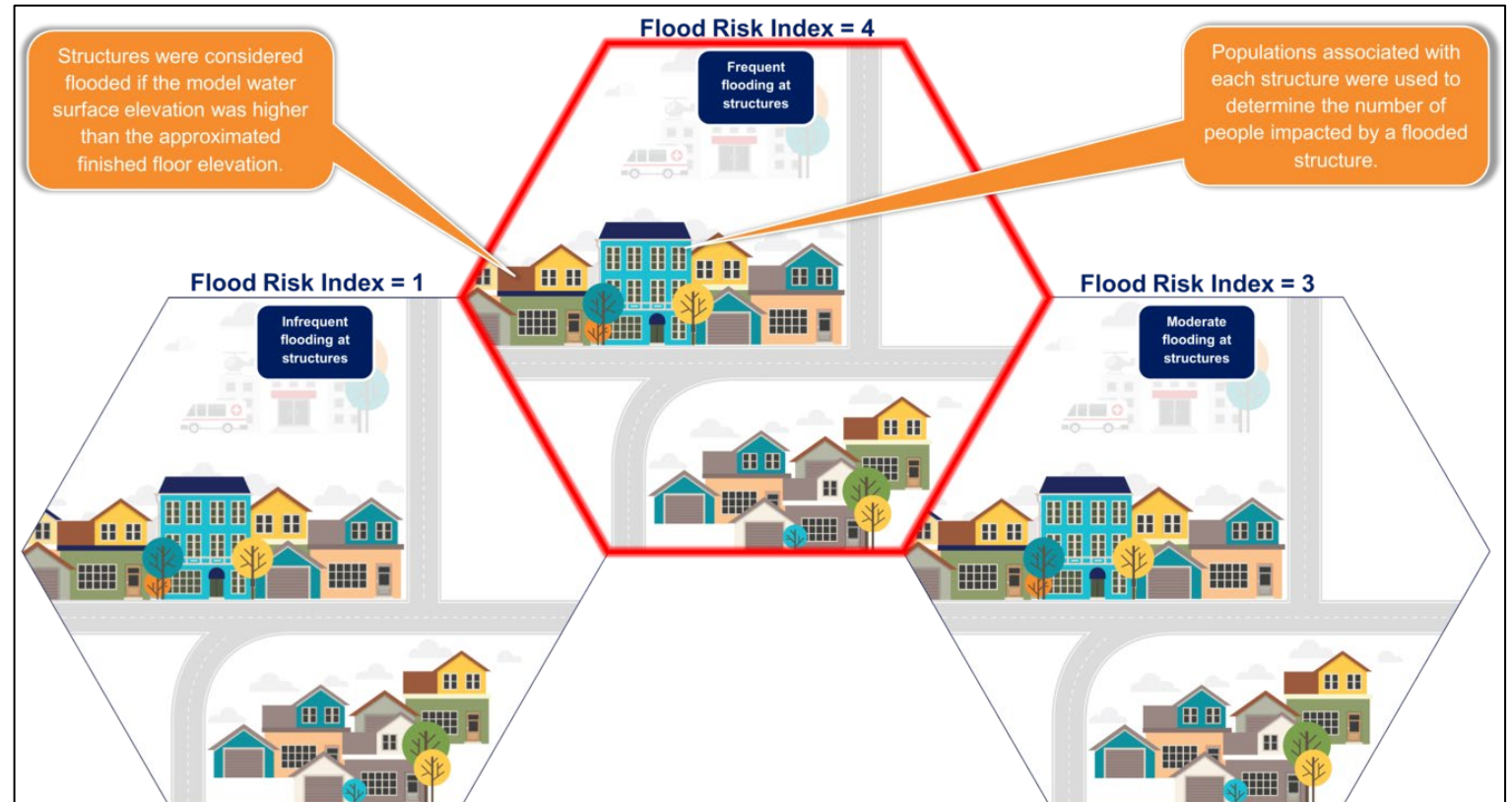
- Compares impacts of flooding across the City
- Provides one general number for each hexagon
- Factors can vary based on agency recommendations



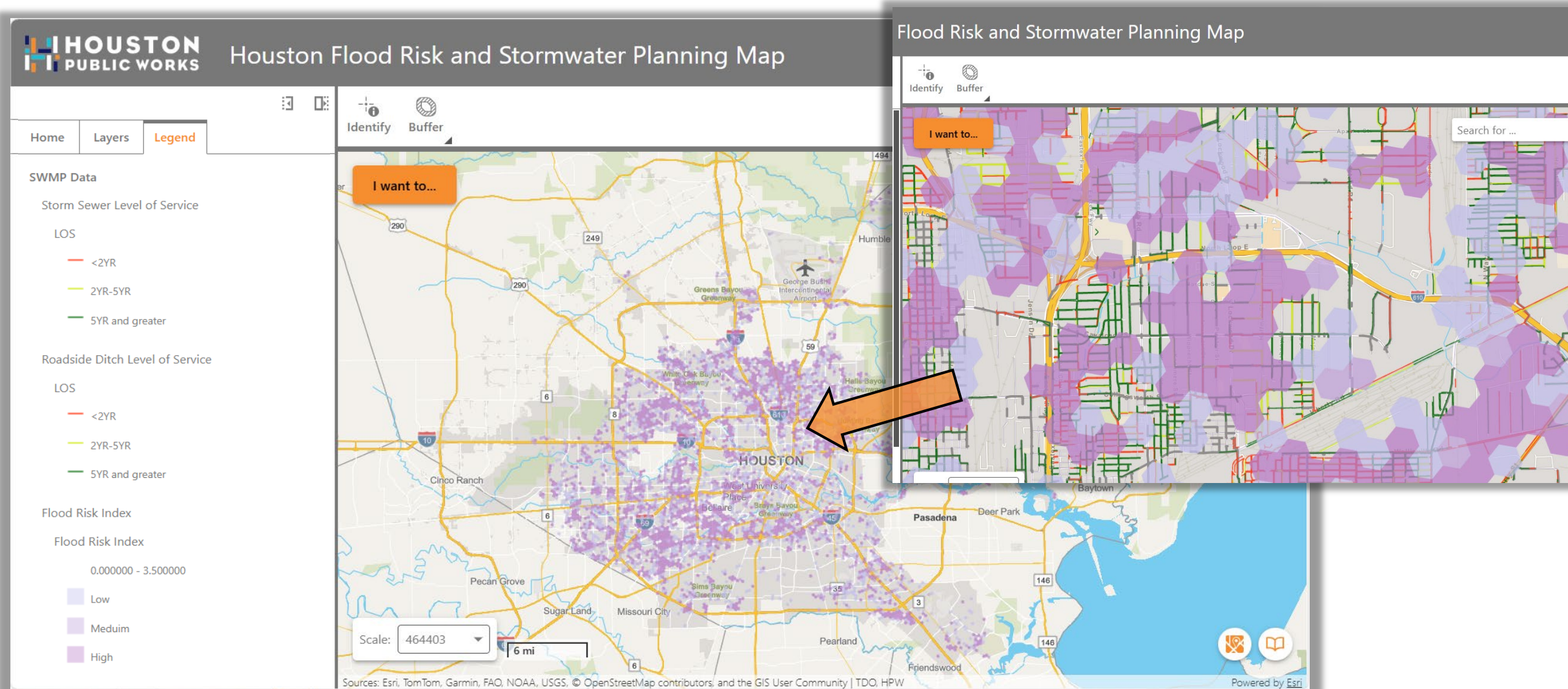
INSTANCE FACTOR AND FLOOD RISK INDEX

Available Data

- Structural Instances
 - FFE
 - Population
 - Critical Facilities
- Roadway Instances
 - Centerline Elevations
 - $\geq 6''$ of Ponding



FLOOD RISK INDEX

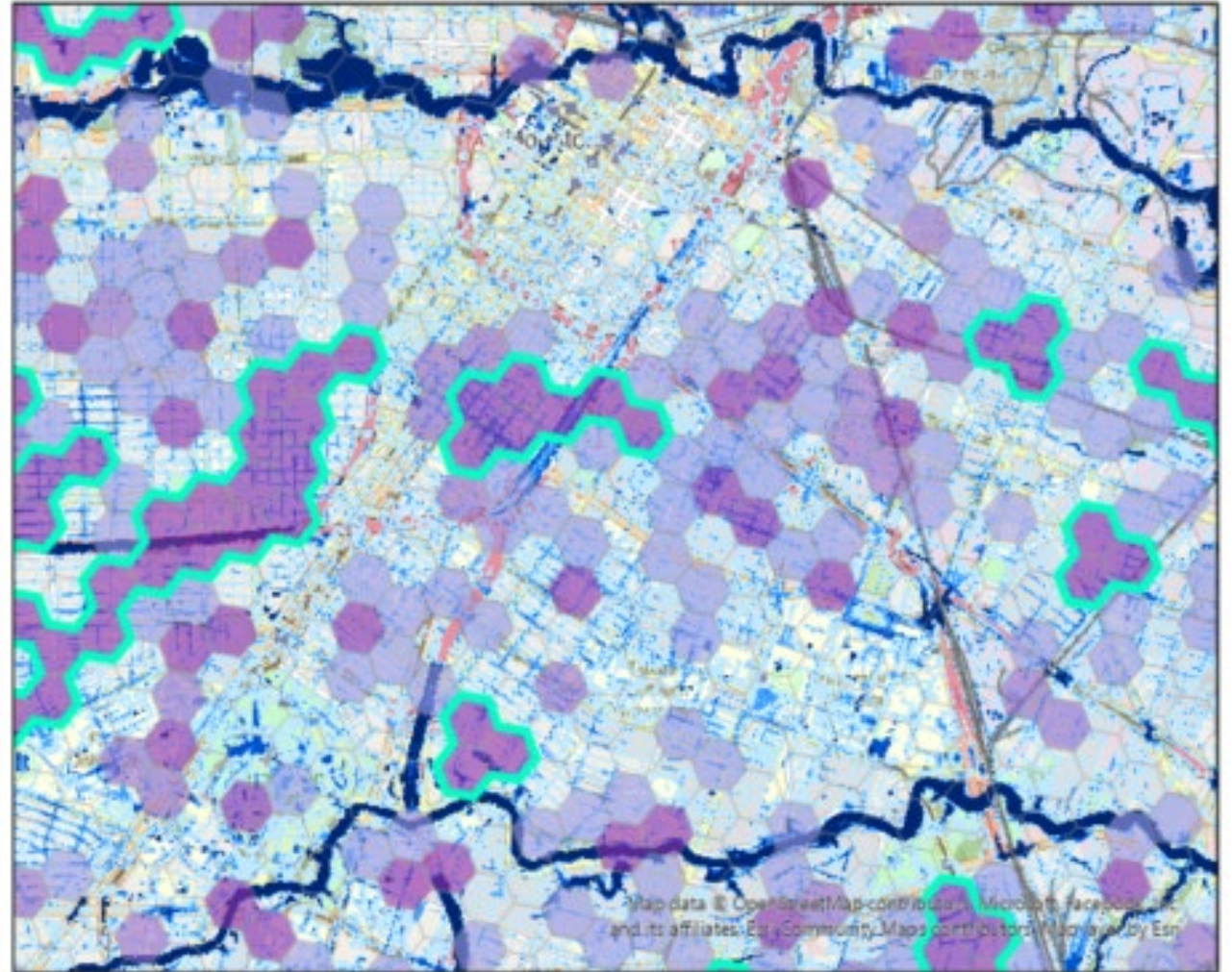




WHAT'S NEXT

Prioritization

- Fous Areas
 - Cluster FRI based on set threshold
- Additional Factors:
 - Socioeconomic Variables (SVI, LMI, etc.)
 - Review Public Works Critical Facilities
 - Open Channel Floodplain Influence



PROJECT TEAM



PROGRAM MANAGEMENT



- Pilot Program
- Guidance Distribution
- Coordination
- QA/QC
- Project Finalization

MODELING TEAM



- Armand Bayou
- Clear Creek
- IAH (Greens)
- Luce Bayou
- San Jacinto River



Lockwood, Andrews
& Newnam, Inc.
A LEO A DALY COMPANY

Brays Bayou
Focus Area
Analysis



- Buffalo Bayou



- Hunting Bayou
- Green Bayou



- Sims Bayou



- White Oak Bayou

THANK YOU

www.houstonpublicworks.org/houston-stormwater-master-plan