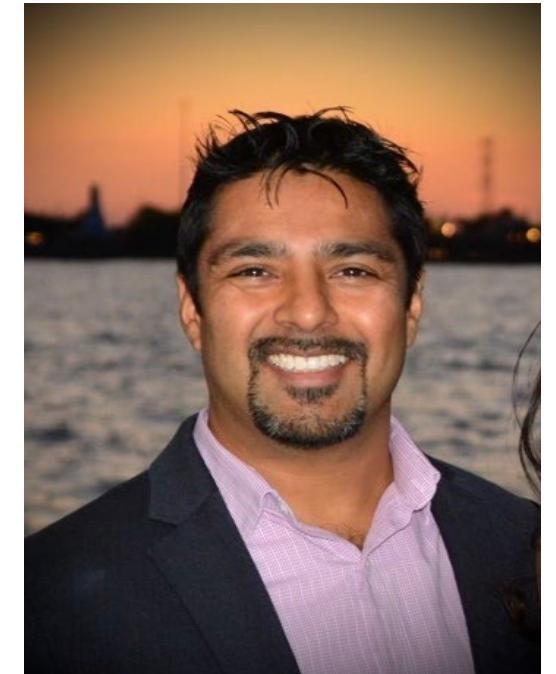




## **City of Houston Stormwater Master Plan**

**Paresh Lad**

Division Manager  
Transportation & Drainage Operations





# STORMWATER MASTER PLAN AND MODEL

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PARESH LAD, ENV SP  
TRANSPORTATION AND DRAINAGE  
OPERATIONS PLANNING





# OUTLINE

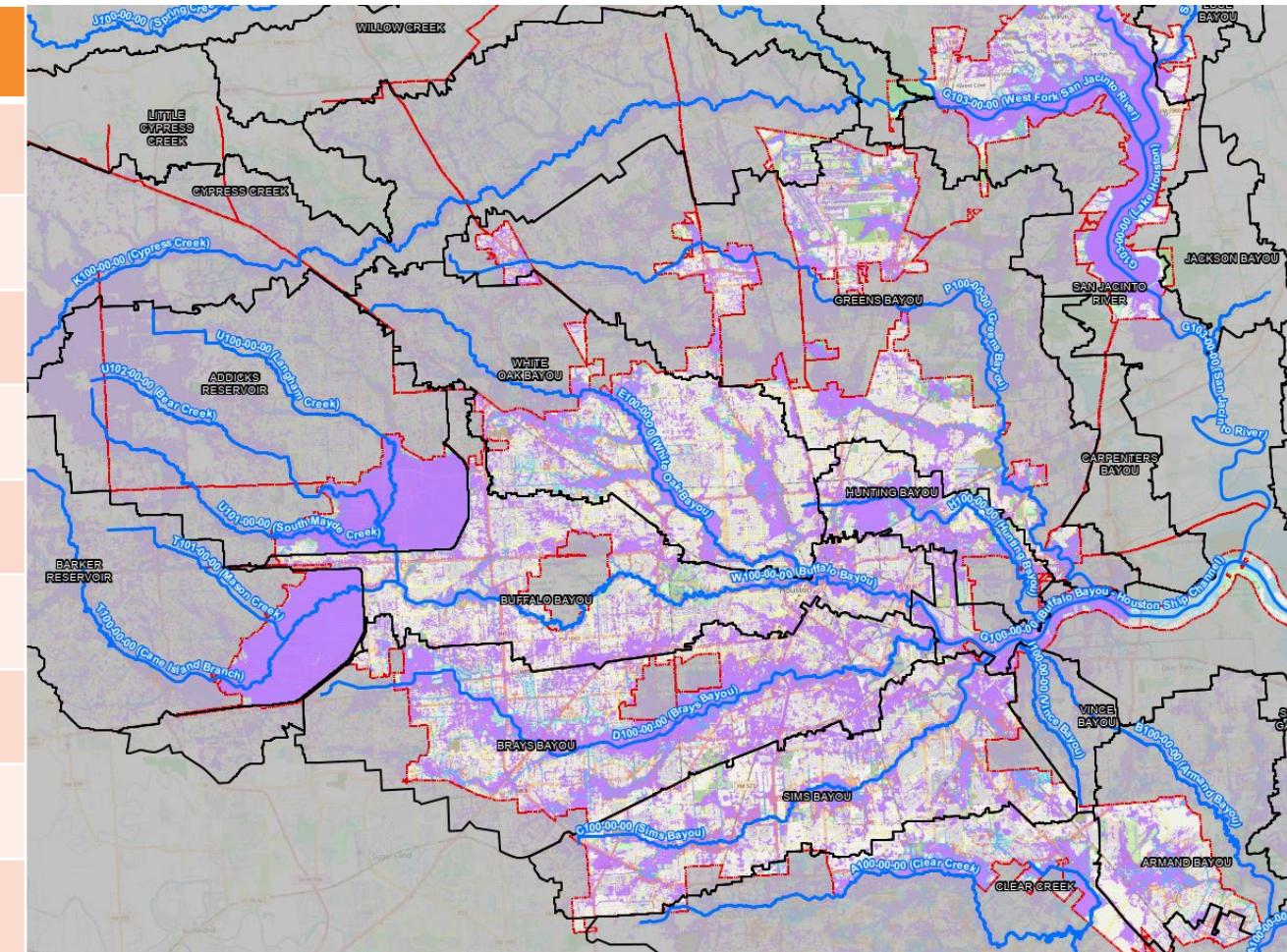
- **Project Goal**
- **Purpose**
- **Prioritization**
- **Focus Area**



# DRAINAGE INFRASTRUCTURE

## City Infrastructure Statistics

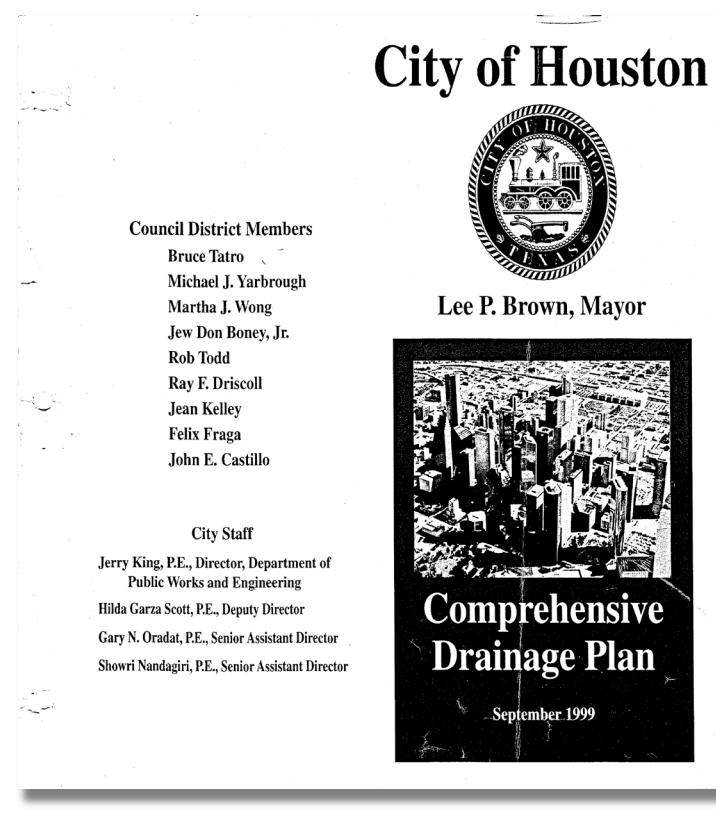
Area	609 sq. miles
Manholes	47,000
Pipe > 24"	3,000 miles
Pipe > 36"	1,700 miles
Roadside Ditches	2,500 miles
Unstudied Channels	310 miles
Studied Channels	776 miles
Area in 500-year Floodplain	479 sq. miles
FEMA Flood Claims (since 2015)	55,000





# 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



## City of Houston



Lee P. Brown, Mayor

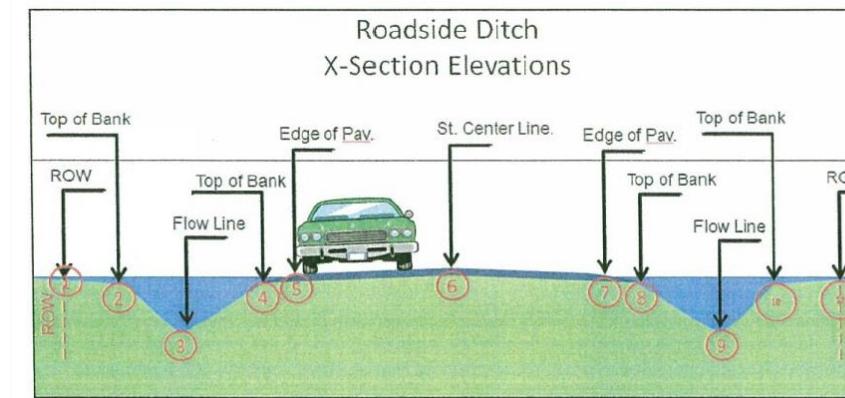
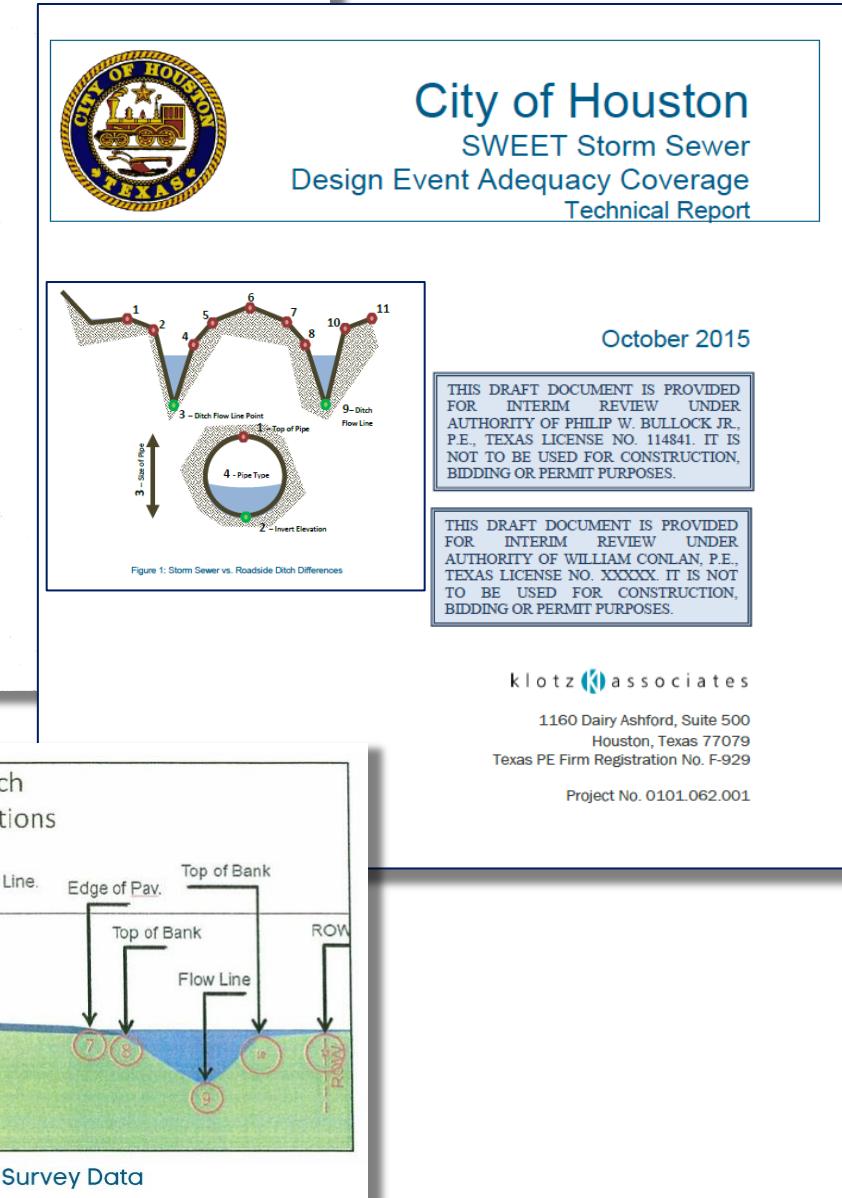
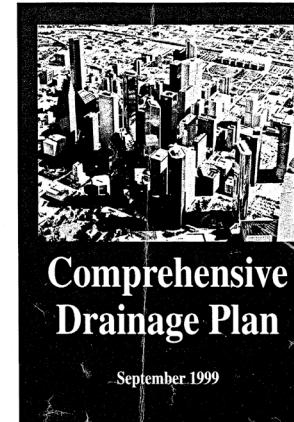
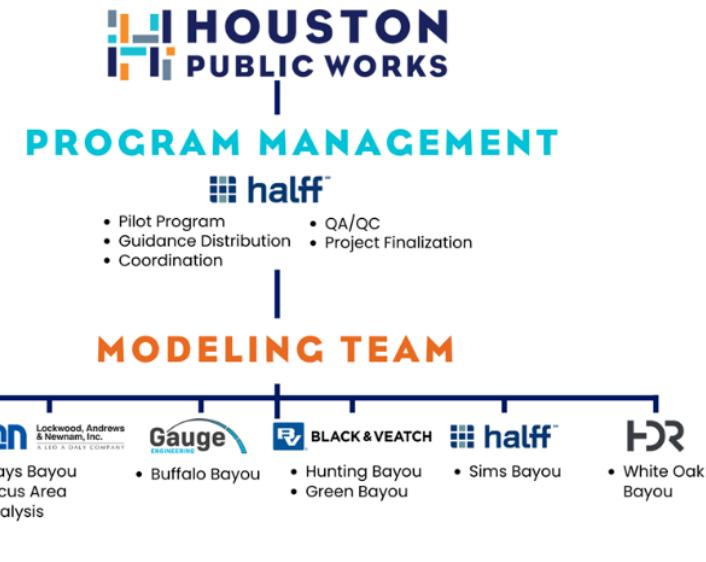


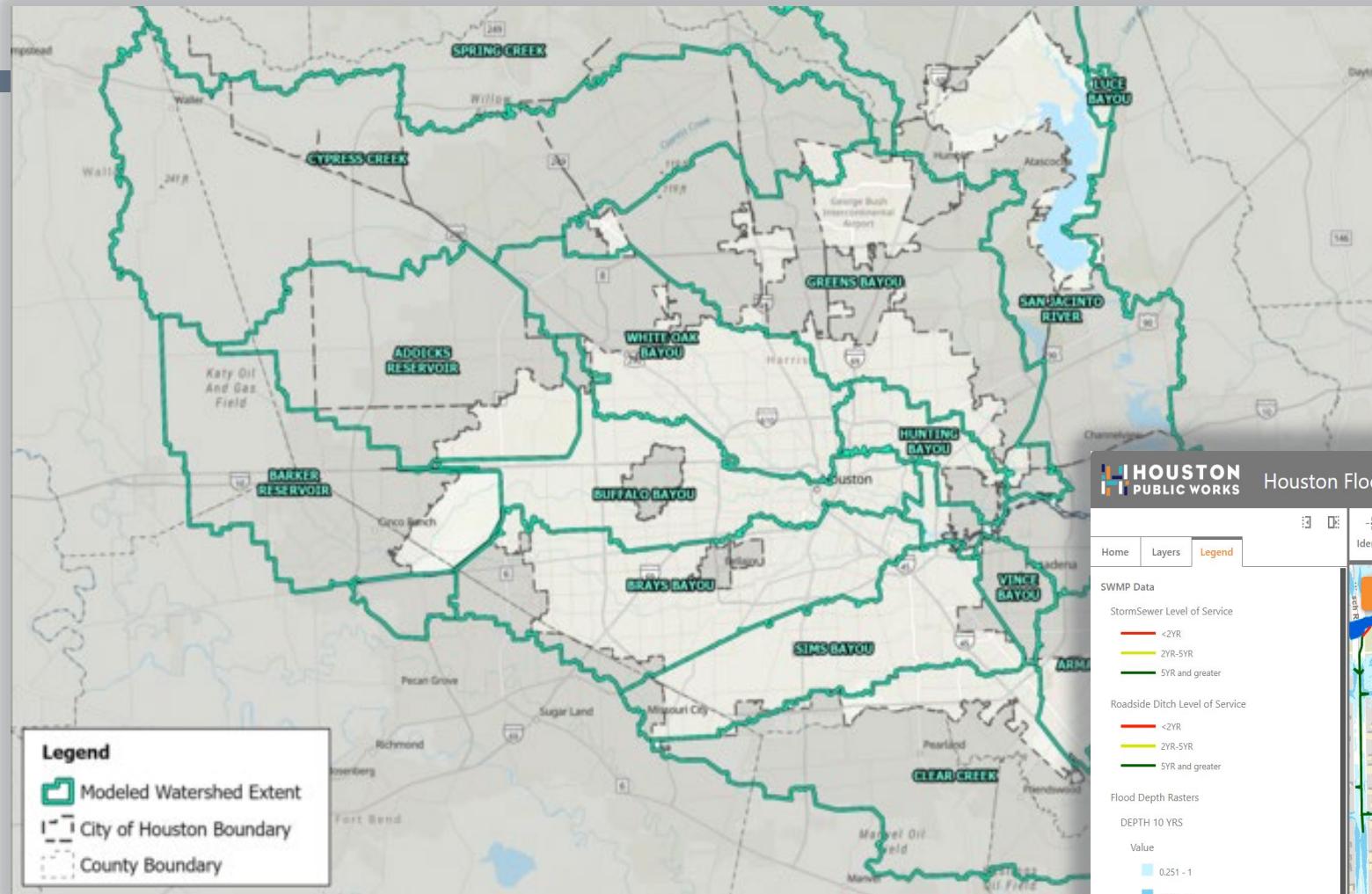
Figure 3: Cross Sectional Survey Data

# STORMWATER MASTER PLAN STARTUP

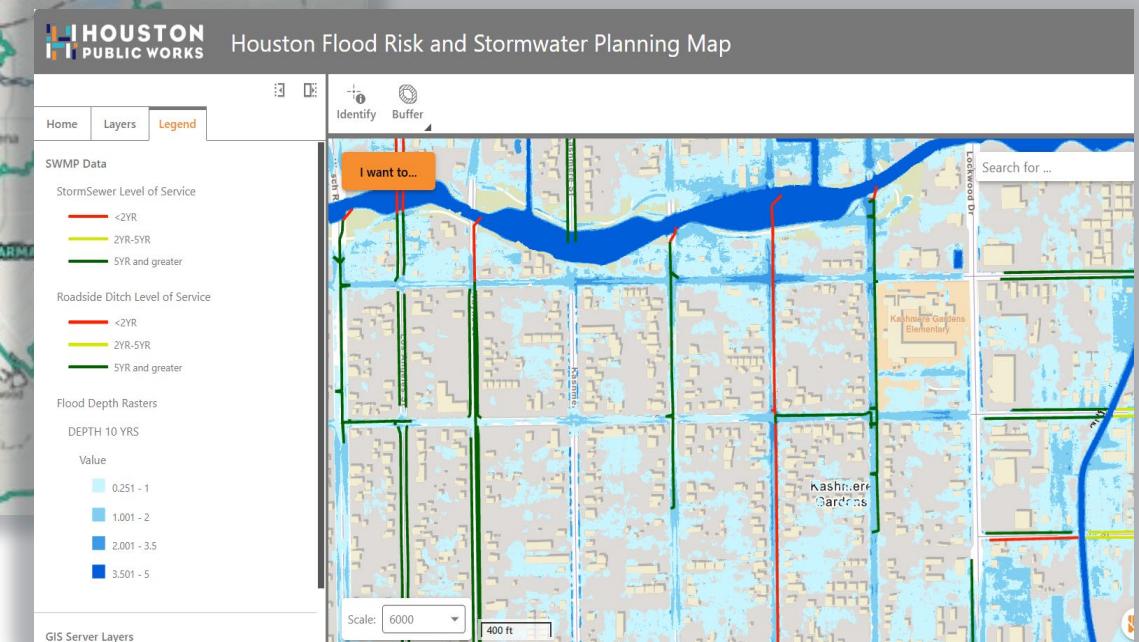
- **2018**
  - Funding release from CDBG-DR 17 and application submitted by COH
- **Funding:**
  - CDBG-MIT 2017 – 5 Consultants, 11 Watersheds
  - TWDB – Sims Bayou Watershed (Pilot) and Project Technical Management
- **Project Organization:**
  - Reviewed infrastructure similarities and differences 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

### Supporting Documents

Executive Summary  
Technical White Papers

### Watershed Plans

Armand Bayou  
Brays Bayou  
Buffalo Bayou  
Clear Creek  
Greens Bayou  
Hawing Bayou  
IAH (Greeves)  
Luce Bayou  
San Jacinto  
Sims Bayou  
White Oak



Provide a  
comprehensive  
drainage analysis  
of the city



Understand existing  
flood risk  
throughout the city

Study Goals



Identify focus areas  
for future planning  
for projects and  
studies

### 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 impact 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 that flood risk for its residents. This study analyzes the influence of the City's local storm sewer and roadside ditch, alongside the drainage patterns caused by channels, bayous and rivers that convey stormwater to the bay. With this approach, the Houston SWMP initiative provides the first comprehensive look at flooding and drainage patterns in the City.

### Previous Planning Efforts

1999

- Comprehensive Drainage Plan
- City-wide analysis of storm sewer infrastructure
- Used GIS and national 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 CDP to combine storm sewer analysis with open ditches
- Created new outlet boundaries and later assessment of drainage infrastructure
- Incorporated into the prioritization framework for a comprehensive analysis

Find out more >

## BRAYS BAYOU WATERSHED

Size: 127 sq mi  
Area within City: 99 sq mi  
Developed Area within City: 97 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 Bellaire, West University, Missouri City, Stafford, Missouri City Park, and Sugar Land. The Brays Bayou flows from the southwest to the northeast, eventually emptying into the Ship Channel. The watershed within City limits is mostly developed, consisting primarily of small-lot, single-family neighborhoods. There are areas of heavy commercial development near Interstate 45 and I-69 as well as along I-10 where NRG Stadium and the Texas Medical Center are located.

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



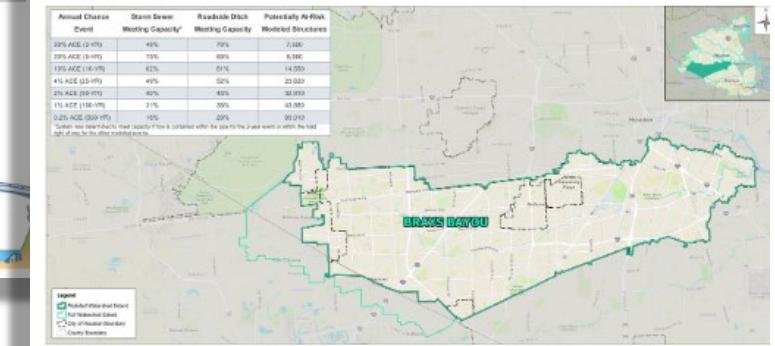
What is a watershed?  
A watershed is the area of land where runoff flows in a specific storm sewer, ditch, stream, or bayou.

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	25.2	105,640
Outside 0.2% ACE Floodplain	72.8	74,320

Conveyance Type	Length (mi)	Percent of Total
24" & Pipe Diameter < 36"	875	48%
36" & 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 confined to low-lying neighborhoods, including Alief and east Almeda 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's watershed.

During frequent events, flooding is primarily seen in the Alief neighborhood as well as in several areas east of Almeda Road. Flooding is due to underlined local infrastructure such as storm sewer and roadside ditch systems as well as low-lying terrain that prevents water from reaching outlet 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 Almeda Road experience widespread structural flooding.



[www.houstonpublicworks.org/houston-stormwater-master-plan](http://www.houstonpublicworks.org/houston-stormwater-master-plan)

# STORMWATER MASTER PLAN VIEWER

**HOUSTON**  
PUBLIC WORKS

## Stormwater Management Plan

Home Layers Legend

**Stormwater Management Plan**

Layer Information:

**Flood Risk Index (Focus Areas)**

This layer highlights areas of **Low**, **Medium**, or **High Flood Risk**. Risk levels are based on a combination of:

- How often flooding is likely to happen
- How many people and structures could be affected

For more information, visit the [Flood Risk Index technical overview](#).

**Sub-Basin Watersheds (Modeled Boundaries)**

This layer outlines **sub-basins**, which are smaller drainage areas used in the stormwater modeling. These boundaries may be different from official watershed boundaries because they are based on updated topography and flow patterns.

Data Directory: [View](#)

Identify Buffer

I want to...

Search for ...

Scale: 445512

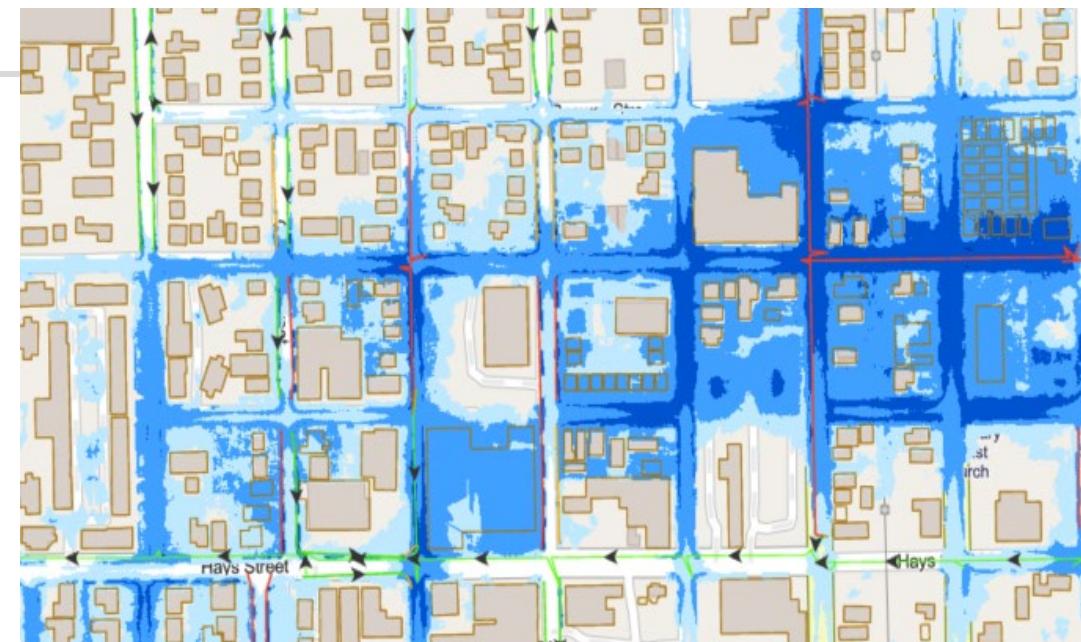
6 mi

9



# 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

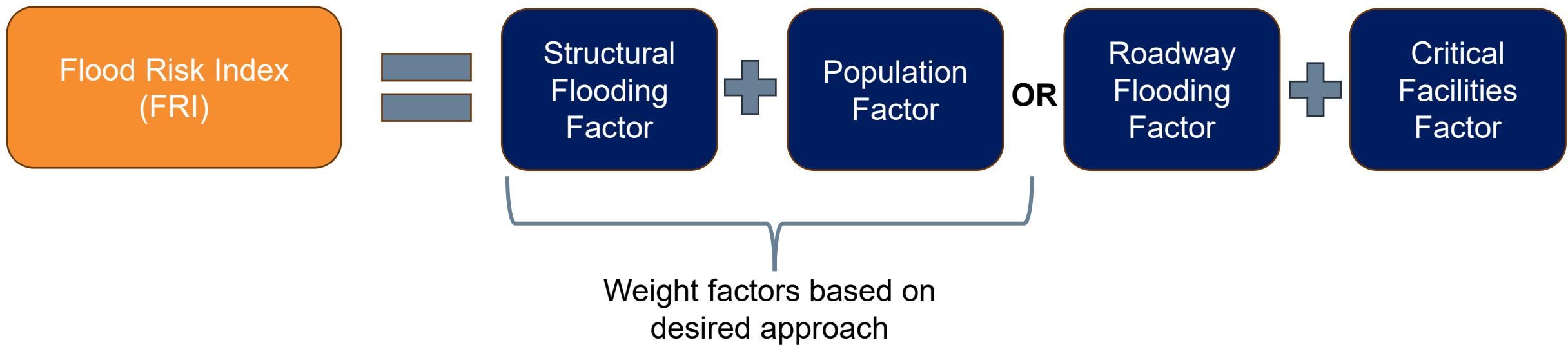
• **2,800**

- 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

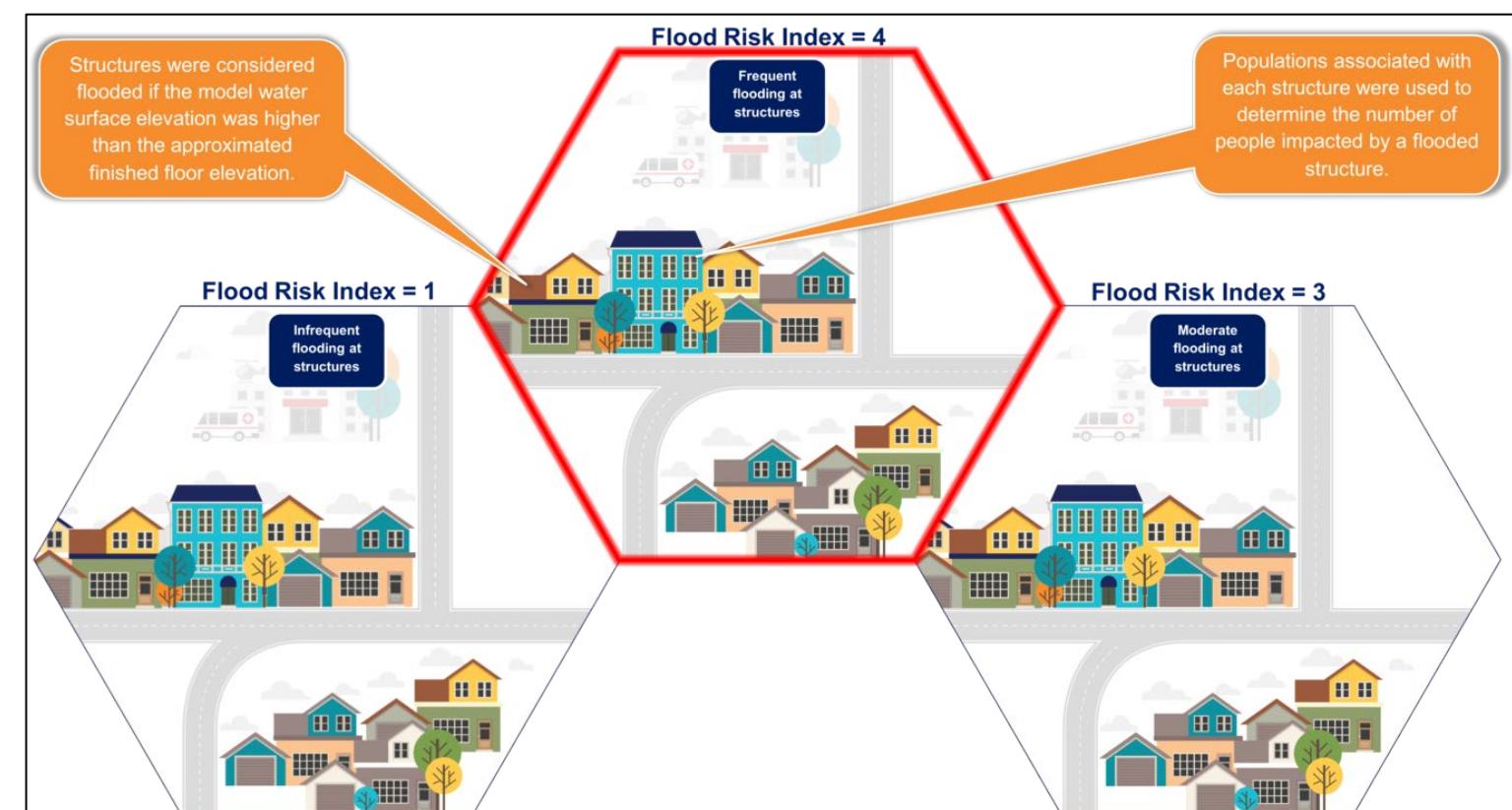




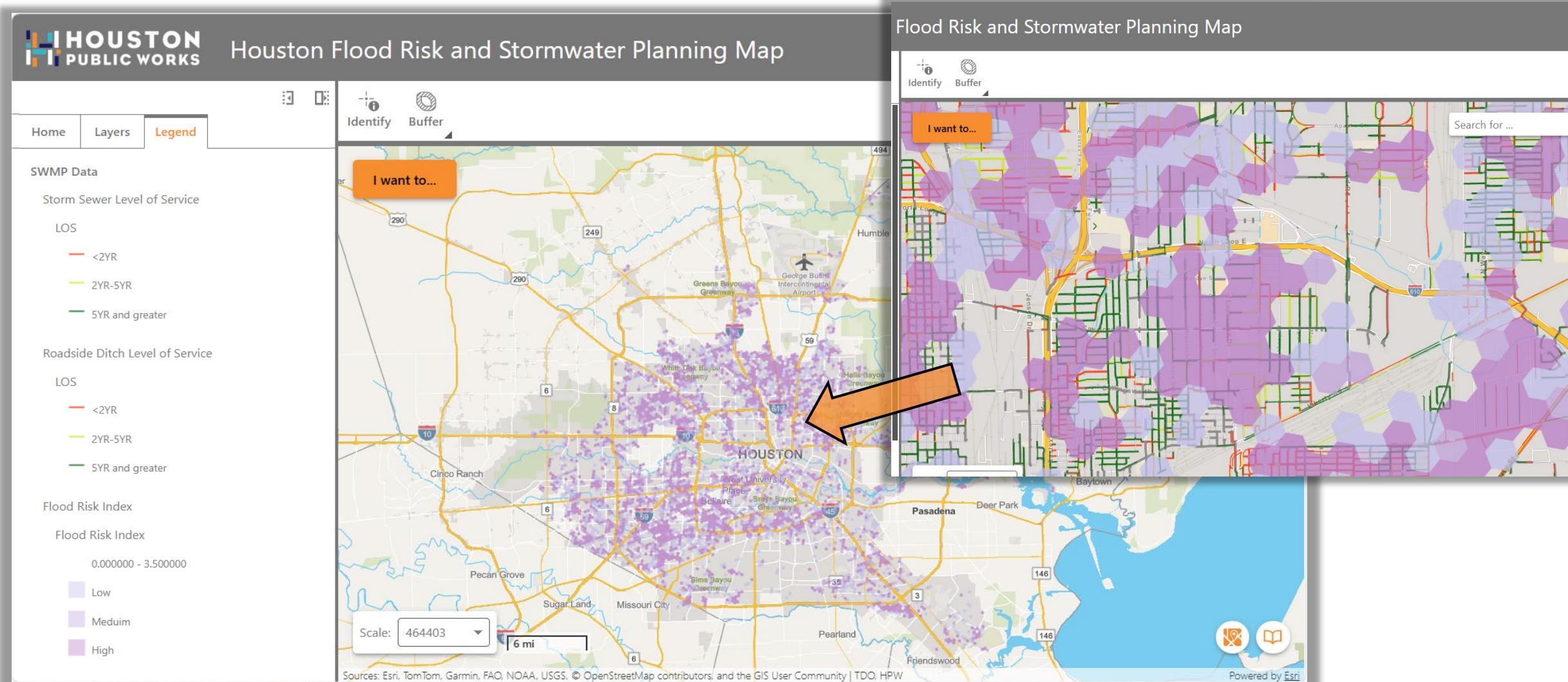
# INSTANCE FACTOR AND FLOOD RISK INDEX

## Available Data

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



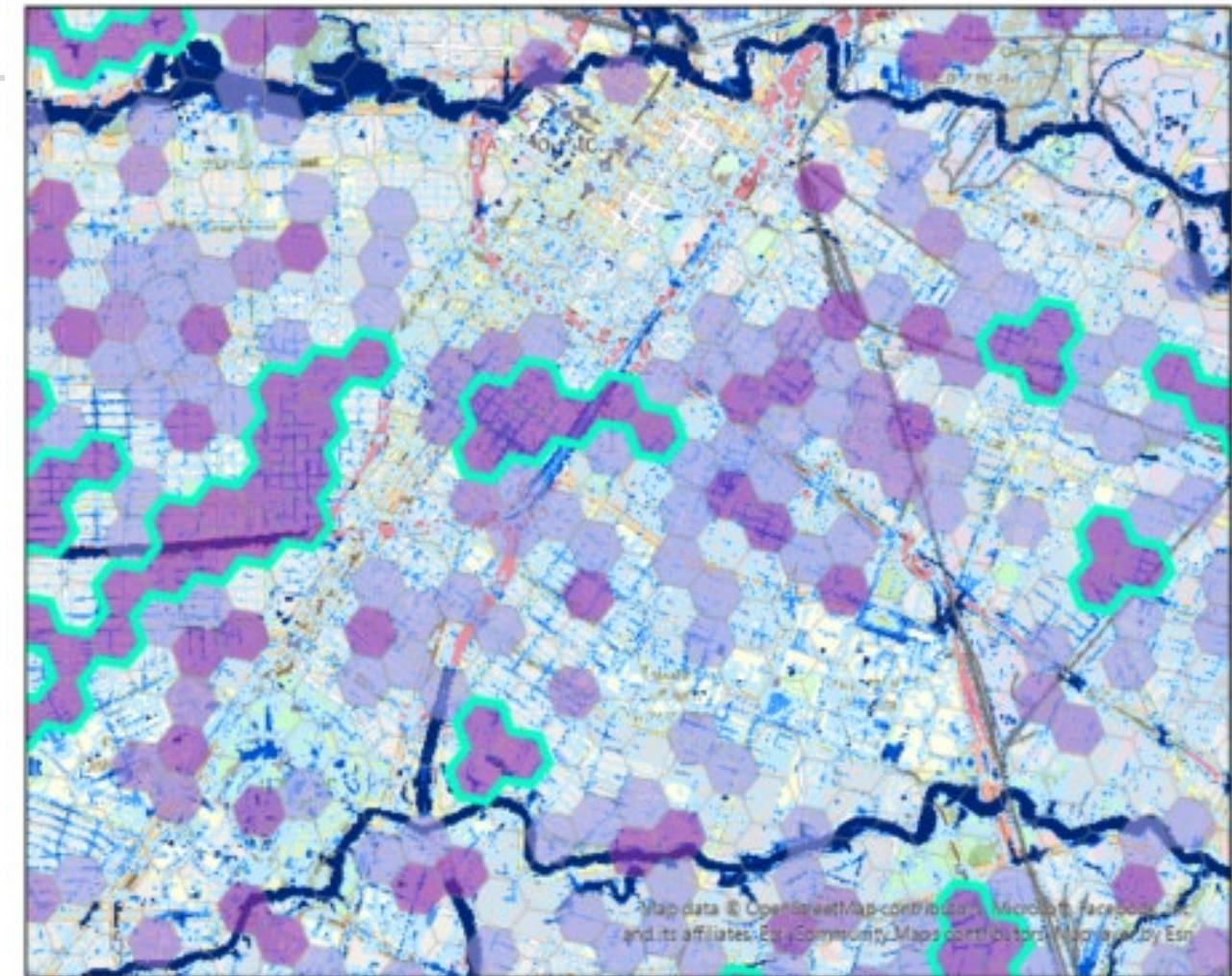
# FLOOD RISK INDEX



# 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](http://www.houstonpublicworks.org/houston-stormwater-master-plan)