Office of the County Engineer

John R. Blount, P.E.

February 2018

Hurricane Harvey

A Response to Disaster

Hurricane Harvey

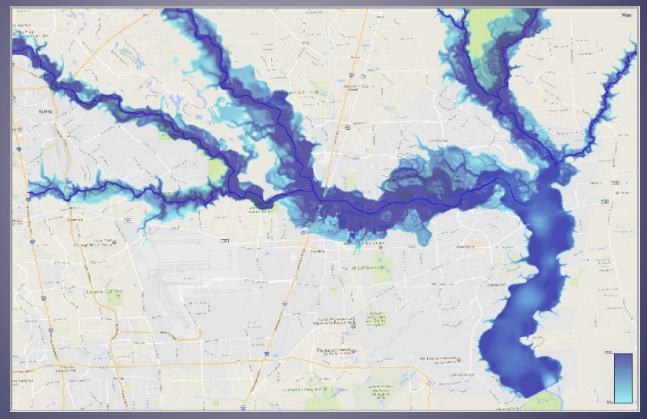
Harris County Rainfall Statistics

- 1 Trillion gallons of water over 4-days (1,777 sq mi)
  - Would run Niagara Falls for 15 days
  - Fill the Astrodome 3200 times
- 33.7 inches average Harris County rainfall over 4 days
  - 68% of Harris County yearly rainfall in 4 days

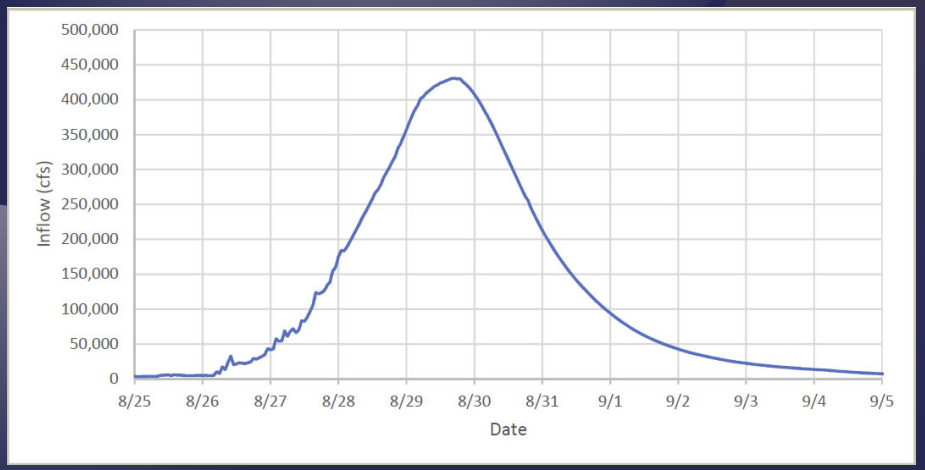
Lake Houston

- Reached peak inflow of approximately 430,000 cfs
  - At peak inflow could fill empty Lake Houston in just under 5 hours

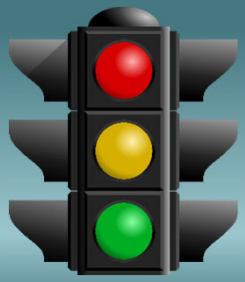
Inundation Extents during Hurricane Harvey



Inflows to Lake Houston during Hurricane Harvey

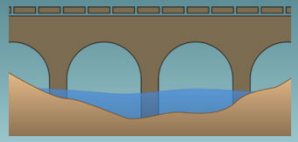


Public Damage



72 hours

All 900+ traffic signals were inspected and in safe condition

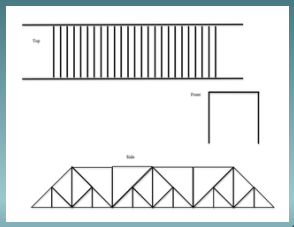


5 days

13,556 lane miles and 836 bridges were inspected for damage

6 days

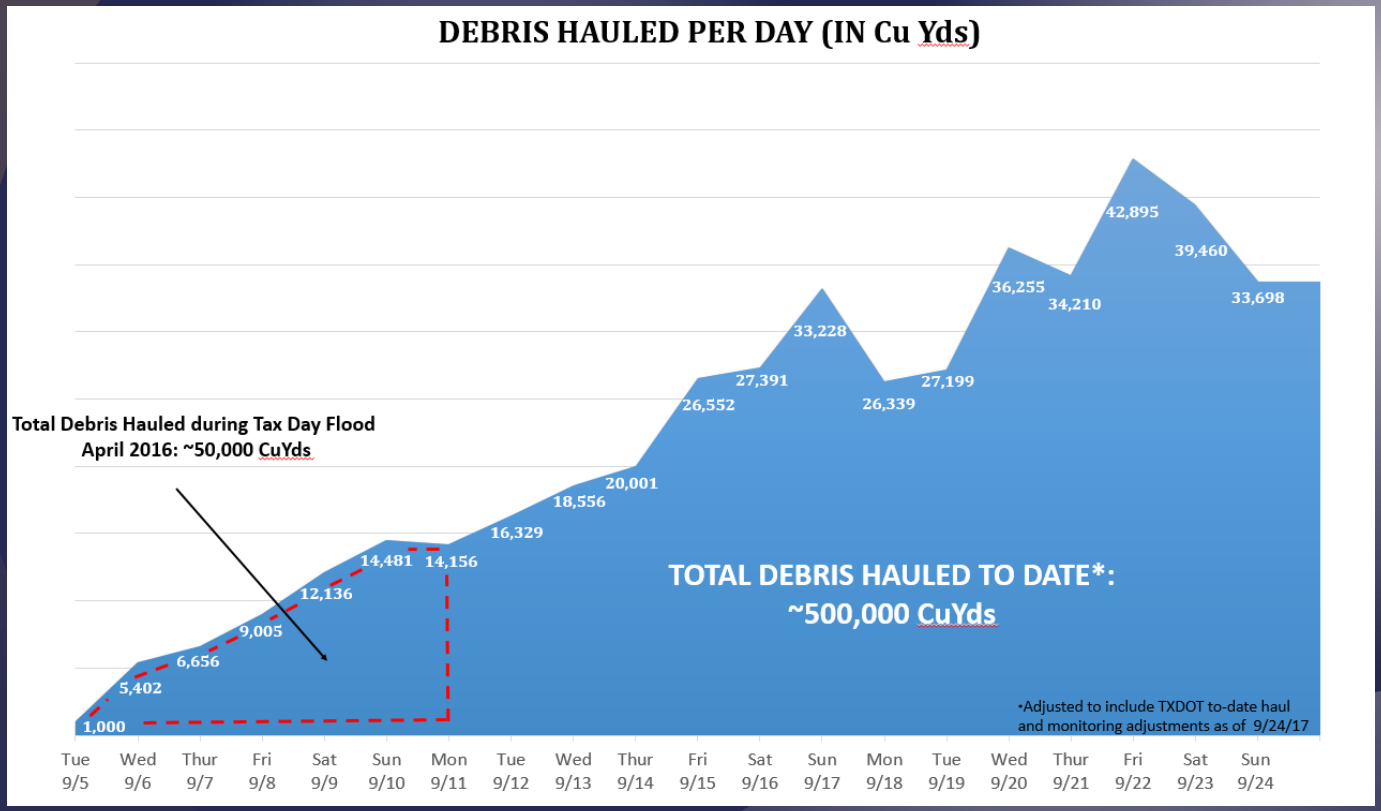
All 180+ Harris County operated buildings were assessed for damage and all damaged structures were already repaired or in proposal process for repairs



2 weeks

All road washouts and damaged bridges were repaired to safe working conditions

Debris Removal



Highlights

- Started hauling 4 days after the event
- Hauled the equivalent of Tax day floods every two days
- 1.2 Million Cubic Yards Hauled To-Date

Private Damage

Unincorporated Harris County

- 505,000 structures visually inspected
- 4,300 in-home residential inspections
- 29,200 Residential permits issued Free of Charge

City of Houston

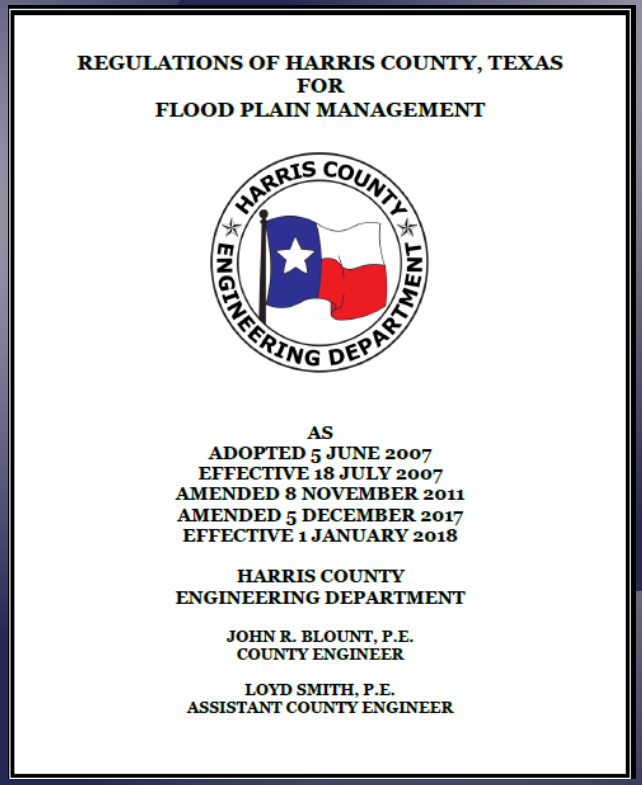
- $139 Residential permit fee
- $360 Commercial permit fee

Analysis of Homes Built in Subdivision Development in 2009 and later

- 75,000+ homes were built in subdivisions developed in 2009 and later utilizing the current infrastructure requirements for drainage and extreme event flow analysis.
- Of those homes, only 467 flooded during Harvey, or 0.6%
- Zero homes were substantially damaged

Harris County Floodplain Regulations

Jan 1 2018 Revision



REGULATIONS OF HARRIS COUNTY, TEXAS
FOR
FLOOD PLAIN MANAGEMENT

HARRIS COUNTY ENGINEERING DEPARTMENT

AS
ADOPTED 5 JUNE 2007
EFFECTIVE 18 JULY 2007
AMENDED 8 NOVEMBER 2011
AMENDED 5 DECEMBER 2017
EFFECTIVE 1 JANUARY 2018

HARRIS COUNTY
ENGINEERING DEPARTMENT

JOHN R. BLOUNT, P.E.
COUNTY ENGINEER

LOYD SMITH, P.E.
ASSISTANT COUNTY ENGINEER

Conforming Subdivision

SECTION 2.09 – CONFORMING SUBDIVISION

- "Conforming Subdivision" means a subdivision where the lots are above the 1% or 100 year flood elevation and the infrastructure (streets, building pads, etc.) meet the requirements of the "Regulations of Harris County, Texas for the Approval and Acceptance of Infrastructure" as adopted August 11, 2009 or previous additions where the subdivisions meets the criteria for Extreme Event Analysis, Relationship of Structures to Street, and Calculation of Flow provisions of the 2009 regulations

Permits Within Conforming Subdivisions

- Structures on lots in Conforming Subdivisions mapped outside of the 1 percent or 100-year flood plain shall be issued a Class I Permit.
- Where a conditional letter of map change has been obtained or will be obtained from the Federal Emergency Management Agency for property which has been elevated by the use of fill above the elevation of the 1 percent or 100-year flood, and detailed plans have been approved by Harris County a Class I permit will be issued. The inspections required in Sections 5.02 (b) (1 & 2) must be made.

Definition of Lots (CW 1712-001)

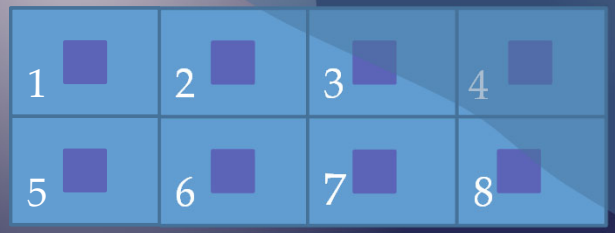
Subject:	Definition of Lots as used in Section 4.04 Conditions of a Class 1 Permit
Code Ref:	Harris County Floodplain Management Regulation – Section 4.04
Question:	What's the definition of "Lot" within the Harris County Floodplain Regulations?
Answer:	In the Harris County Flood Plain Management Regulations effective January 1, 2018 the term "lot" is referenced but not defined. For the purpose of Section 4.04 of the Flood Plain Regulations. "Structure on lots in conforming subdivisions mapped outside the 1%or 100 year flood plain, not that the entire "lot" is outside the 1%. The most accurate reading of this intent is, "Structures in conforming subdivisions mapped outside the 1% or 100 year floodplain shall be issued a Class 1 permit."

100-yr Flood Plain Encroachment Scenario

In this scenario, the eight homes were built in a subdivision developed in conformity with the 2009 infrastructure regulations.

Question:

"Which lots are in the floodplain and which are out of the floodplain?"



Legend

- **Lot as defined by CW 1712-001**
- **Boundary of plat**
- **100-yr floodplain**

Answer:

- Lots 1, 5 6 & 7 are out of the floodplain.
- For lot 2, the lot as defined by CW 1712-001 is out of the floodplain, therefore the "lot" is out of the floodplain and would be considered a conforming lot in a conforming subdivision.
- Lots 3 and 8 would be considered in the floodplain. Thus, 3 and 8 would be non-conforming lots in a conforming subdivision.
- Finally, Lot 4 is clearly in the floodplain and would be considered a non-conforming lot in a conforming subdivision.

Permits Within Non-Conforming Subdivisions

Regulations Prior to Jan 1st 2018			
	Freeboard Elevation Above 1%	**Foundation Type**	**FF Proof**
Floodway	18 inches (Horizontal Member)	Posts or Pilings	EC
V Zone	18 inches (Horizontal Member)	Posts or Pilings	EC
10%	24 Inches	any	EC
AE	18 Inches	any	EC
AO With Depth	18 inches (above depth)	any	EC
A or AO Without Depth	36 inches (above natural ground)	any	EC
500 Year LAG below 1%	18 inches	any	EC
500 Year LAG Above 1%	none	any	Survey
Critical Facility	36 inches	any	EC
X-Unshaded	none	any	none

Regulations as of Jan 1st 2018			
	Freeboard Elevation Above .2%	**Foundation Type**	FF Proof
Floodway	36 inches (Horizontal Member)	Pier & Beam + Windspeed	EC
V Zone	36 inches (Horizontal Member)	Pier & Beam + Windspeed	EC
10% (remove from regulations)	na	na	na
AE	24 inches	Pier & Beam + Windspeed	EC
AO With Depth	36 inches (above depth)	Pier & Beam + Windspeed	EC
A	72 Inches (above natural ground)	Pier & Beam + Windspeed	EC
500 Year LAG below 1%	24 inches	any	EC
500 Year LAG below .2%	At or Above 500 Year	any	EC
500 Year LAG Above .2%	12 Inches above HAG at 10 feet or crown (greatest)*	any	EC or HC Form
Critical Facility	36 inches or 24 above crown (greatest)	any	EC
X-Unshaded	12 Inches above HAG at 10 feet or crown (greatest)*	any	EC or HC Form

***Whichever is greater and not based on .2%**
EC = Elevation Certificate, FF = Finished Floor Elevation, HC = Harris County

Structural Requirements

Regardless of the class of permit issued (I or II), all Non-Conforming Subdivisions must show, in addition to any other requirements, the following elevations are met:

1. If the structure is a single family residence the finished floor shall be a minimum of 12 inches above the highest adjacent natural grade when measured 10 feet from the edge of the slab or 12 inches above the crown of the adjacent street which ever results in the highest elevation (An exception may be granted on sloping properties where the crown requirement is not achievable).

2. If the structure is other than a single family residence the slab shall have a minimum of 6 inches of exposure to adjacent grade and be at least 12 inches above the crown of the adjacent street (An exception may be granted on sloping properties where the crown requirements cannot be achieved).

3. To verify this for structures outside the floodplain, a newly created HC Foundation Certificate will be required.

HARRIS COUNTY ENGINEERING DEPARTMENT
FOUNDATION CERTIFICATE

Address: _____

Permit No: _____

Type Building: ☐Single Family Residential ☐Other than Single Family Residential ☐ Critical Facility within 500-Year Floodplain

Type Foundation: ☐Slab on Grade ☐Pier and Beam ☐Other Describe Below:

_____

_____

Single Family Residence **-** Indicate the Finished Floor Elevation in Inches _____ above the highest adjacent grade at ten (10) feet from foundation. *(Min. 12 Inches)*

Other than Single Family - Indicate average elevation of exposed slab in inches (Min. 6 Inches):_____

All - Indicate Finished Floor elevation in inches above top of curb (if one exists): _____ (Min. 12 Inches Single Family and Other, Min. 24 Inches Critical Facility)

All - Indicate Finished Floor elevation in inches above crown of adjacent street in inches: _____ (Min. 12 Inches Single Family and Other, Min. 24 Inches Critical Facility)

I _____ hereby certify that these are the results of the inspection conducted
Print Name

under my direct supervision on _____.
Date

_____
Signature

SEAL

Additional Requirements

- No fill may be used to elevate structures in the 1 percent or 100-year flood plain. Structures may be constructed on an open foundation, such as piers, or on continuous foundation walls with properly sized and located openings. All foundations are required to be designed by a registered professional engineer. The drawings shall clearly show compliance with all provisions of these regulations. Fill may be used in coastal surge zones where flood plain fill mitigation is not an issue, however the standard for foundations remain the same.
- All structures shall be designed to withstand a three second gust basic wind speed of 120 miles per hour. This will ensure structural rigidity, should design flood elevations be exceeded, or the structure requires elevation in the future.

No Standard

Old Standard

Current Standard

Building in the Floodway

All structures in the floodway must now meet the requirements that were previously only required in the San Jacinto floodway.

I. Foundation Type: The foundation system shall consist of a driven pile or a drilled pier foundation system

II. Type and Size of Driven Pile: Driven piles shall consist of either twelve (12) inch (minimum) square pre-stressed concrete piles or fourteen (14) inch (minimum) diameter steel pipe piles with a closed end.

III. Type and Size of Drilled Pier: Drilled piers shall be eighteen (18) inch diameter (minimum) and straight-sided (no belled or underreamed base)

IV. The minimum embedment below natural grade for driven piles and drilled piers shall be twenty (20) feet

V. The individual piles or piers shall be braced horizontally with reinforced concrete tie beams connecting the pier/pile caps each way (not diagonally). For piles that extend above natural grade and act as column supports for the structure, a reinforced concrete collar shall be cast around each pile at the groundline, and the collars shall be connected each way with reinforced concrete tie beams

VI. Additional construction requirements

Additional Highlights

- All requirements specific to the 10 year floodplain have been removed.
- For the purpose of rebuilding after a flood event, any single family residence that received flood damage, but the finished floor is at or above the 1 percent or 100-year flood level, cannot be substantially damaged, if they meet the minimum federal elevation requirement for rebuilding.
- Where a conditional letter of map change has been obtained or will be obtained from the Federal Emergency Management Agency for property which has been elevated by the use of fill above the elevation of the 1 percent or 100-year flood, and detailed plans have been approved by Harris County a Class I permit will be issued.
- Floodplain fill mitigation requirements do not apply to Coastal Areas where floodplain fill mitigation is not an issue.
- In areas of combined coastal and riverine flood hazard, floodplain fill mitigation requirement only applies for the portion of fill placed below the riverine flood hazard elevation as provided in the FIS or an approved hydraulic model

New Development FAQ

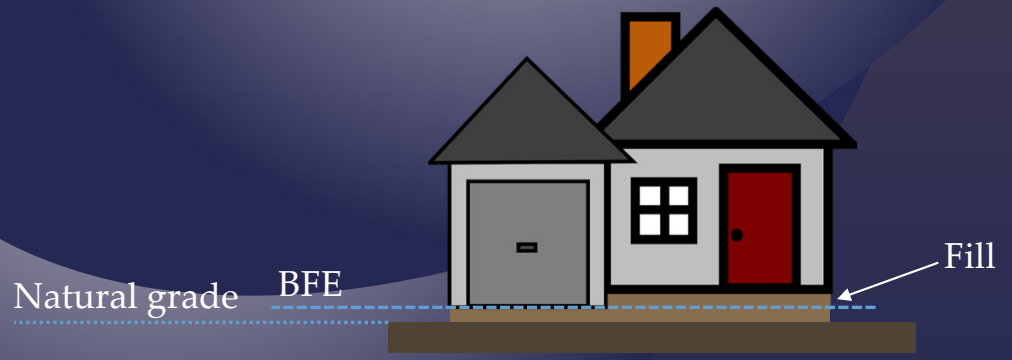
The use of fill:

During Development Process

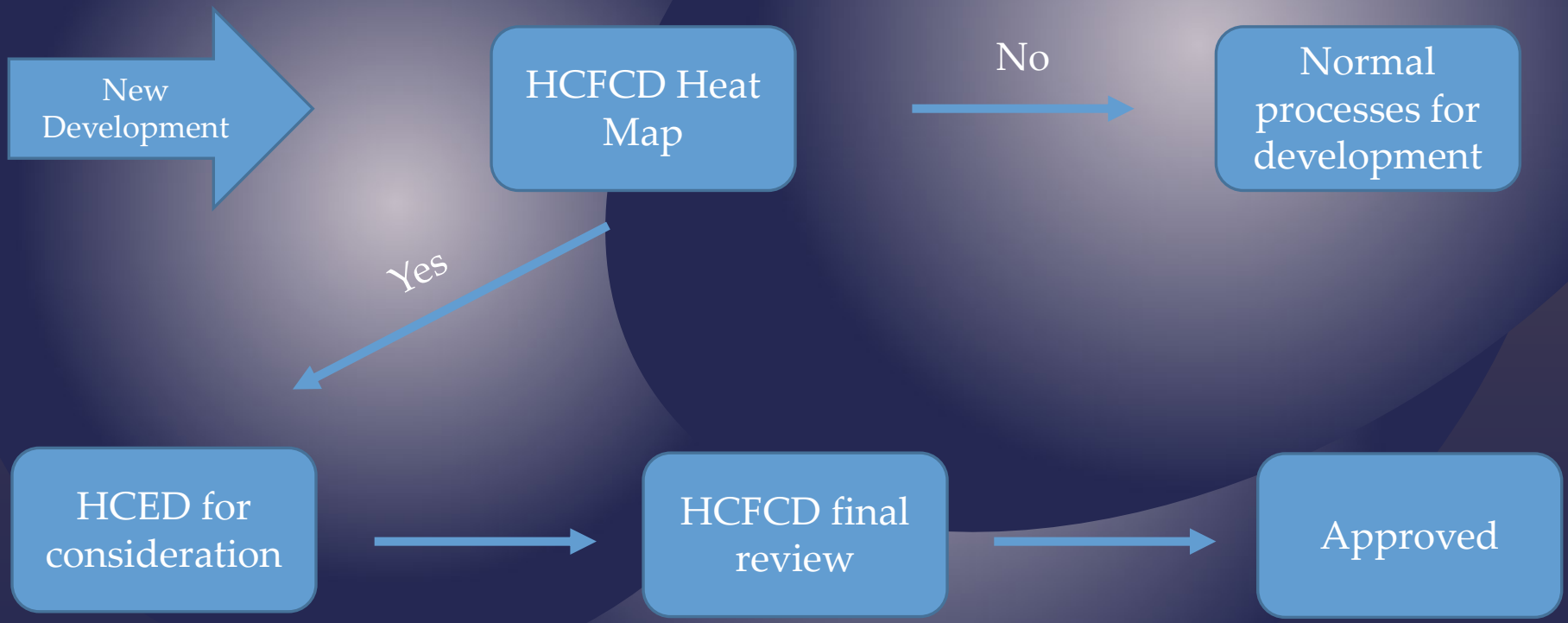
- Can still submit LOMR & CLOMR before applying for a building permit.

Post Development of Infrastructure

- Harris County has always implemented a no-net fill requirement.
- The regulations have not changed, thus no change. 1:1 mitigation



District Driven Detention Program



Additional Post Harvey Programs

- Internal program for additional detention capacity within county road and bridge projects
- Continued coordination with local MUDs and Special Districts
- Joint venture to investigate potential projects to be funded by a Post Harvey Bond Referendum

Question?

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For additional information contact
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