

# LID 7

## North Levee Proposal



V 1.1

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**Contributors**

<b>Date</b>	<b>Name</b>	<b>Version</b>	<b>Position</b>

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## 1 Overview

The FEMA 100-year floodplain for LID 7 is based on the larger of two separate flooding events:

1. High Brazos River water flowing north & east from the channel south of LID 7.
2. High Brazos River water overflowing from the Rio Vista/FM359 area east to LID 7.

This document describes the threat from these events, it reviews proposed solutions and presents a recommended approach.

## 2 Northern Flood Threats

These events present three separate threats to the northern boundary of LID 7.

### Bull Head Slough

Bull head slough is a small creek running west to east, underneath highway 99 about 0.5 mile north of highway 90. Under heavy rain conditions it overflows its banks and floods the 90/99 intersection. The creek does not appear to be a true threat to LID 7 as the elevation of the creek bank is equivalent to the high point of the highway 99 frontage road just north of Sandhill. During Hurricane Harvey, the water just reached the tiger dams placed across the frontage road at this location, but did not rise more than a couple of inches up the dams. The water height remained stable even as the slough continued to drain tremendous amounts of water east past LID 7.

### Brazos River (from Rivers Edge)

The primary flood threat from the north occurs when the Brazos River tops its bank in the Rivers Edge subdivision along highway 359 (just north of highway 90). These flood waters travel east across highway 359, Pitts and Harlem roads. These waters become a threat to LID 7 at an elevation of about 57 ft. At 59 ft, tiger dams would probably prove inadequate. The water migration path into LID 7 would be underneath the railroad bridge at the 90/99 intersection. This threat would be eliminated if the Rivers Edge, Rio Vista and Pecan Grove communities built an adequate levee along their section of the Brazos.

In 1913, the Brazos River reached a height of 61.2 ft at the Richmond gauge. Since then, a series of reservoirs have been built upstream along the Brazos with the primary goal of controlling the waters flowing downstream. These reservoirs proved very effective during the 2015 Memorial Day and 2016 Tax Day floods. Without question, the FBC river elevations would have been higher during these floods without the reservoirs. It is unknown how high the river can reach with these controls in place. Brazos Rivers studies, scheduled to concluded in 2018, should provide some answers.

### Brazos River (through the RR culvert)

Another migration path into LID 7, from the north, is from the Brazos River exceeding its banks just upstream of LID 7, flooding north across the Smith Ranch, topping highway 90 and flowing through the culverts under the railroad tracks. This occurred on a limited scale in both the Memorial Day and Harvey events. The extent during the Memorial Day flood is shown in red below under Section 2.3. At

higher levels, the flood waters would then migrate east towards highway 99 and then under railroad tracks into LID 7.

## 2.1 Flood Events

LID 7 has experienced five separate flood events since 2015.

### Recent Historic Crests (Richmond Gauge)

Rank	Elevation	Date	Event
3	55.20 ft	08/29/2017	Harvey
4	55.10 ft	06/02/2016	Memorial Day
6	49.97 ft	06/03/2015	
8	49.67 ft	04/21/2016	Tax Day
13	44.46 ft	03/17/2016	

The highest levels were record just over 100 years ago.

Rank	Elevation	Date	Event
1	61.2 ft	12/10/1913	
2	58.6 ft	July 1899	

None of the recent events have threatened to breach the northern boundary or LID 7. The mandatory evacuation ordered during Harvey was a result of a hastily developed model which predicted, with a 30% probability, a 59 ft Brazos river crest at the Richmond gauge.

## 2.2 Brazos River Flood Control History

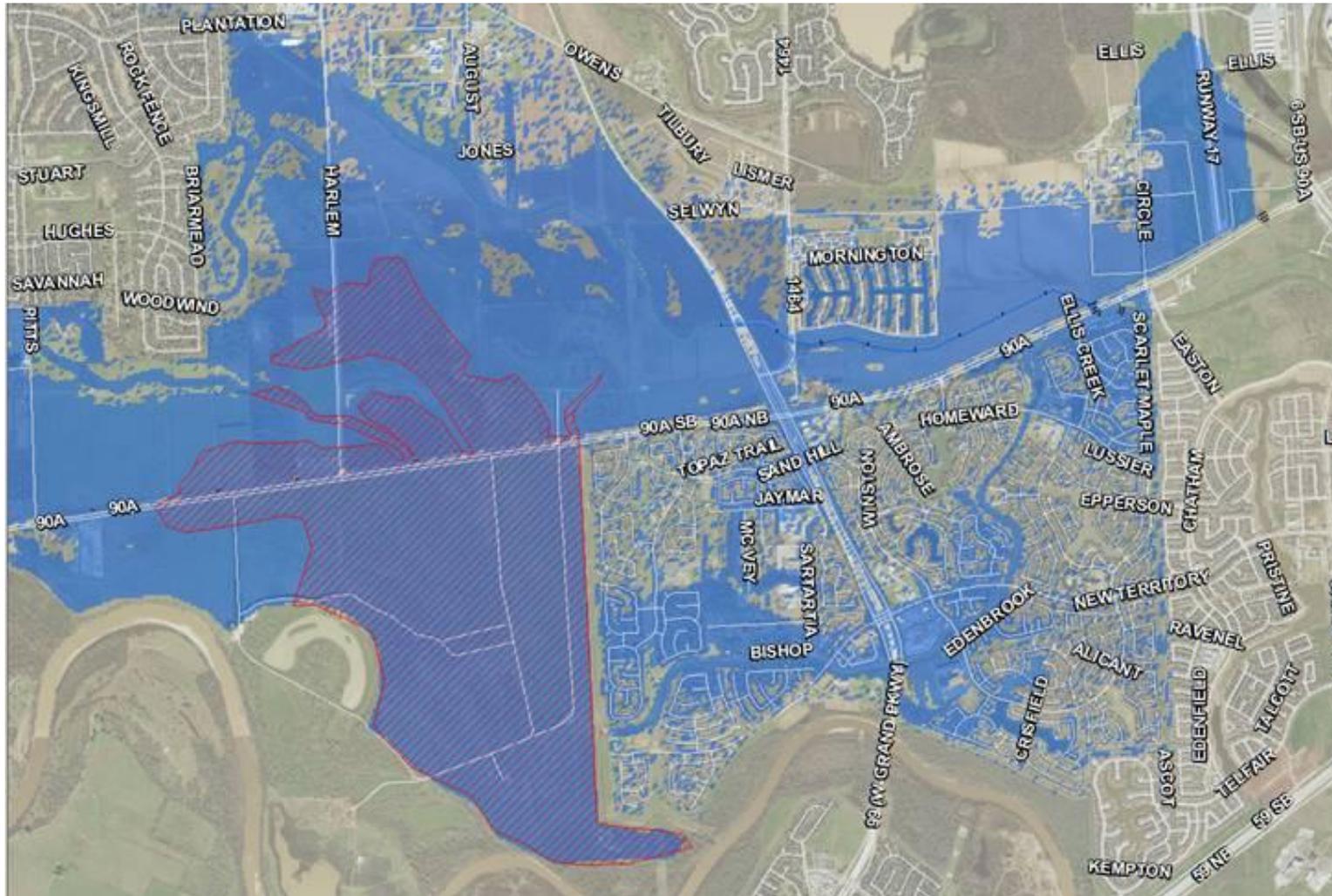
In 1929 the Texas Legislature creates the Brazos River Authority (BRA) to develop a master plan for managing both river flooding and water supply during droughts. The master plan proposed the creation of 13 dams on the Brazos and its tributaries. The first dam is completed in 1941 creating Possum Kingdom Lake. To date, 11 reservoirs have been created.

These reservoirs are designed to maintain minimum water levels to be used during drought conditions. They also keep a reserve capacity to detain water during flood conditions. These reservoirs were instrumental in limiting the height of the Brazos during the 2016 Memorial Day flood.

Having said this, the nearest reservoir is near Waco. Consequently, these reservoirs do not protect against a major rain event south of Waco.

### 2.3 Memorial Day Flood Map

The following diagram shows the extent of the Memorial Day Flood (Jun 2016). Stephen Wilcox (Costello) mapped out the floodplain (in red) that occurred on the north side during this event based on field surveys and high water marks.



Memorial Day 2016 (Red - June 2016 flood, Blue - 100 year flood, Entire picture - 500 year flood)

### 3 Northern Elevations

Based photographic evidence of Harvey high water elevations combined with laser level telemetry, the following elevations (in ft) have been determined along LID 7’s northern boundary. All elevations are based on the Richmond Gauge (RG) datum. True elevation = RG + 27 ft (approx.).

Location	Existing elevation	Proposed levee elevation	FEMA Certification
NW Corner			
RR track	58.9	61.5	60.0
90A	59.0	No change	60.0
Flood wall	61.7	No change	60.0
NE Corner			
RR track	63.5	No change	60.0
90A	61.0	No change	60.0
New flood wall	NA	62.0	60.0

### 4 Levee Options

Costello has presented 4 options for protecting the northern boundary.

- A. 100 year + 0 ft Freeboard  
Maintain status quo and protect using Tiger dams and sandbags
- B1. 100 year + 2 ft Freeboard (Option A)  
Improve Sandhill, NW & NE corners with flood walls and earthen fill
- B2. 100 year + 2 ft Freeboard (Option B)  
Improve 99 frontage north of 90, NW & NE corners with flood walls and earthen fill
- C. 100 year + 4 ft Freeboard  
Improve entire northern perimeters with flood walls and earthen fill
- D. Regional Levee  
Participate in regional levee reaching from Rivers Edge to LID 7

This document present the following 5<sup>th</sup> option.

- E. 100 year + 5 ft Freeboard  
Implement West-Central levee north of RR track with NW & NE improvements.

Option	Level of Protection	Probably Cost
A	100 year + 0 ft	\$ 0.5 MM
B	100 year + 2 ft	\$ 8.9 MM
C	100 year + 2 ft	\$ 8.6 MM
D	100 year + 4 ft	\$23.2 MM
E	Regional	\$12.8 MM
F	100 year + 5 ft	TBD

## 5 Recommendation - Proposed North Levee Closure (E)

### 5.1 Map



## 5.2 Recommendations

It is important to note that at no point during the Harvey, Tax or Memorial Day floods was the northern boundary of LID 7 ever threatened. The maximum river height, at the Richmond gauge, was 55.2 ft. That is probably about 2 ft below where flood waters would have reached the tiger dams along the highway 99 frontage road at Sandhill and probably 3 ft below where they would have seriously threatened the New Territory community.

A mandatory evacuation was ordered under Harvey because there were no models which adequately predicted the impact of a Hurricane Harvey event on the height of the Brazos river. Also, LID 7 received about 30 in. of rain during Harvey, while other nearby areas received almost 60 inches. The modelers best guess estimate was a 30% chance that the Brazos would reach a height of 59 ft.

With all this in mind, it is my opinion that we should attempt to protect the north side to a height of 62 ft. This should be sufficient and it is probably the best we can do. It is doubtful LID 7 can be protected much above 62 ft at other locations.

### Northeast (99 to NE corner of LID 7)

- Install a 62 ft floodwall from the NE corner of the LID 7 levee (Robinsons Landing), along Bull Head Slough to highway 90.
- This would include improvements to the median between the east and west lanes and to the north of 90.
- Under worst case conditions, tiger dams would be place across 90 to complete the 62 ft barrier.
- The railroad track north of 90, east of 99, provides effective flood protection to a height of 62.5 ft (verified by laser telemetry).
- Estimated cost of \$3.1 MM.

### Northwest (NW corner LID 7 to 99)

- Extend existing floodwall along the west side of LID 7 to the railroad tracks north of 90.
- This would include improvements to the median between the east and west lanes and to the north of 90.
- Estimated cost of \$120,000.

### Central (Intersection 90A & 99)

The section of highway 90, east of the 99 interchange to the proposed NE floodwall, is effectively protected to water elevations above 62.5 ft by the railroad tracks which run north of 90. The railroad tracks are not deemed to be levees, but effectively divert water east.

The section of highway 90, west of the 99 interchange to the proposed NW floodwall, is adequately protected only to a height of about 58.5 ft. Consequently, it is my opinion, that a levee be constructed north of the railroad tracks.

- Build a levee north of the railroad tracks from the NW corner of LID 7 to the 90/99 interchange.
- Build a U-shaped levee to protect the 90/99 interchange.

## 6 Other Considerations

### 6.1 Elevation

NEMA has set the 100 year highwater mark at 56.0 ft (Richmond gauge). Hurricane Harvey, along with the 1913 flood, indicate that this number is well below what should be used to design flood control systems for LID 7. The placement of 11 reservoirs along the Brazos north of LID 7 does provide significant protection. While the reservoirs almost certainly provide material protection for LID 7, it is not possible to quantify this as an elevation offset.

### 6.2 Placement

While the railroad tracks cannot be considered as levees for legal purposes, they are impermeable barriers up to approximately one foot below their ballast surface. The substructure is composed of highly compacted clay and other non-porous materials. These materials maintain the structural integrity required for the weight and motion of daily train travel. The top foot is composed of well sorted gravel (ballast). While the ballast does provide a level of flood protection, it will seep with extended exposure to high water.

At 59.8 ft, the track surface running from the NW corner of LID 7 to the 99 interchange is not sufficiently high to protect against a 62.5 ft flood.

At 63.5 ft, the track surface provides ample protection from the 99 interchange to the NE corner of LID 7.

### 6.3 Comments on Other Options

#### Regional levee

A proposal has been made to create a levee which stretches west from LID 7 to the Richmond bridge and then north past the Rivers Edge and Rio Vista subdivisions.

My concerns with this proposal include:

- A lead proponent is the Rivers Edge community which needs a levee, but is not large enough to afford one. They are expanding the scope of the project to pull in as many fund sources as possible. LID 7 would effectively be spending money outside our boundaries to fix someone else's problem.
- The proposed levee removes a portion of the Smith Ranch (west of LID 7) from the flood plain. This further constricts the Brazos and raises the river level during flooding.
- Building a levee across the Smith Ranch might encourage development of that land which would add to congestion in New Territory.

#### Full Flood Wall South of 90

This option involves building a flood wall along the northern boundary of New Territory south of highway 90. Concerns with this proposal include:

- This is an expensive option estimate at close to \$19 MM.
- This is not a passive system. It requires the deployment of flood gates at 6 separate locations:
  - High Meadows, Cunningham Creek, 99 frontage South,
  - 99 frontage North, Gateway Blvd & Ellis Creek Blvd
- Highway 90 is not protected which limits evacuation options.
- It is unlikely that the Toll Road Authority with permit construction of a permanent levee beneath highway 99 north of Sandhill.

- It is an ugly option. It makes New Territory appear as a fortress with the appearance of being unsafe.