

September 13, 2017

Board of Directors  
Big Oaks Municipal Utility District  
c/o Coats Rose Yale Ryman Lee, P.C.  
9 Greenway Plaza, Suite 1100  
Houston, Texas 77046

Reference: District Engineer's Hurricane Harvey Report No. 1  
IDS Job No. 740-M&R

Members of the Board:

As you are aware, Hurricane Harvey resulted in major flooding across the Houston area, including the District.

### **Storm Data**

We collected rain data from three Harris County Flood Warning System rain gauges near the District, which were used to estimate the amount of rainfall the District received as a result of Hurricane Harvey.

Gauge 2025 – Buffalo Bayou @ Peek Road:	32.56 inches (max 10.32 inches in 12 hours)
Gauge 485 – Brays Bayou @ SH 6:	31.24 inches (max 8.24 inches in 12 hours)
Gauge 495 – Keegans Bayou @ Rocky Valley:	30.80 inches (max 7.24 inches in 12 hours)

From the morning of August 25 to the evening of August 29, these rain gauges measured an average of 31.53 inches of rainfall. To put this in perspective, we reviewed our report from May 2016, and these same gauges measured an average of 8.92 inches of rain in a 24-hour period. On August 26, 2017 the rainfall total was nearly the same as the 2016 Tax Day Event; then the next 12 hours there was an event that was again nearly the same as the 2016 Tax Day Event; then the subsequent 12 hours there was a rainfall total that exceeded the 2016 Tax Day Event; and the storm wrapped up over the next day and a half by dropping one more 2016 Tax Day Event.

The area in and around the District suffered through a historic rain event. We have not calculated the return rate on this storm, but it has certainly broken weather records for the area.

The 500-year storm event for this area is defined as 21.1 inches in a 4-day period. From this data, the District experienced a storm event that was at least 50% greater than a 500-year event.

## Background

As many of you have probably already noticed, there seem to be more occurrences of 100-year, 500-year, or greater events that seem to happen certainly more than anyone would have expected. Questions have been raised as to why we have seen so many 100-year events in a short period of time. The definition of a 100-year event is a statistical probability, meaning that there is a 1% chance that a certain rain event with a certain intensity and duration will happen within a given year. Below are some samples of the various storms:

- 2-year = 50% Chance
- 25-year = 4% Chance
- 100-year = 1% Chance
- 500-year = 0.2% Chance

The drainage system within the District include: curb inlets, storm sewers, streets, stormwater detention facilities, and outfalls.

The inlets and storm sewers are sized to accommodate the 2-year storm. In a 2-year storm the inlets and storm sewers will be full, and will discharge into the stormwater detention facilities and will then outfall into Clodine Ditch.

The streets, stormwater detention facilities, and outfalls are sized to accommodate the 100-year storm. In a 100-year storm the inlets and storm sewers fill and cause water to rise in the streets. As the water rises in the streets, the water begins to flow overland to the stormwater detention basin. The stormwater detention basin begins to fill and the outfall releases water into Clodine Ditch.

The goal of a stormwater detention basin is to release water to a stream at a rate that is equal to the rate that the stream received from this area before development occurred. The system can handle more than the 100-year storm, however the system cannot release much more water if the receiving stream is out of banks or is very high. In that type of condition this system continues to fill, which resulted in structural flooding.

## Review

Based on a review of aerial photography, stream gauges, and eye witness accounts, the drainage system filled completely on Saturday, including street ponding. Then on Sunday with nowhere for the water to go, as the receiving stream was full, the system continued to pond resulting in structural flooding.

Based on an inspection of the neighborhood we estimate that 920 homes had structural flooding. We have reviewed this information with Fort Bend County as well as FEMA. The District is the floodplain administrator, but since there are not any structures within the special hazard zones (ie. 100-year floodplain), there will not be any requirements to bring structures to code.

After the 2016 Tax Day Flood, we reviewed areas of the drainage system where there were reports of severe street ponding, and our review of the system was that the system functioned properly. Additionally, the District performed cleaning of a number of storm sewers within the system. Further, the District has a Contractor inspect and maintain the stormwater detention facilities on a monthly basis.

### **Questions/Answers**

We received some questions from residents after the storm, below is a summary of those questions and answers:

**Question:** Does FM 1464 drain through the District, and did this result in flooding within the District?

**Response:** Yes, FM 1464 drains through the District. FM 1464 was originally constructed long before Twin Oaks Village, and has always drained through this property. When Twin Oaks Village was developed, the flow from FM 1464 was considered in the sizing of the system. Further, when FM 1464 was expanded, TxDOT reviewed the drainage study for Twin Oaks Village and reviewed their design to ensure that their design matched the existing system in Big Oaks MUD.

**Question:** Did the new development to the south and west enter the system and contribute to flooding within the District?

**Response:** Based on a review of the on-going construction project, the adjacent projects have a separate drainage system than the Districts. After reviewing aerial photography, it does not appear that any water from off-site entered the District.

**Question:** Why were there areas near the District without structural flooding?

**Response:** Areas west of FM 1464 drain into Buffalo Bayou, where areas east of FM 1464 either drain into Brays Bayou or Keegans Bayou. Both Brays and Keegans near the District stayed within banks during the entire storm event. While Buffalo Bayou was out of banks by the afternoon of the 27<sup>th</sup> and continued to be out of banks until September 9<sup>th</sup>.

**Question:** Did the Barker's Reservoir cause flooding within the District?

**Response:** The District's system outfalls into Clodine Ditch, which bypasses the reservoir, and ultimately connects to Buffalo Bayou. The water surface elevation within Clodine Ditch can get higher than the elevation in Big Oaks, but the District's system includes flap gates. These gates prevent water from Clodine Ditch from entering the system.

## Summary

The District's drainage system was designed and constructed in accordance to regulations at the time of construction. The drainage system was just not large enough to handle the sheer volume of rain that this storm produced. We will be happy to answer any questions the Board or residents may have.

Respectfully,



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Senior Project Manager

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