Comments on the Houston flood of August 31, 2017

September 2017

The surface area of the city of Houston is 667 sq. mi. The metropolitan area is 10,062 sq. mi.

The floods above the Addicks and Barker reservoirs covered at their peak 7 square miles and 4.5 square miles above the normal water lines of 105 and 100 ft, respectively. Those floods are quite normal whenever the level in the reservoirs rise. The reservoir dikes seem to have been built at an elevation of 115 and 110 ft respectively. The floods reached 110 ft at Addicks and just short of 105 ft at Barker.

The flood along Buffalo Bayou covered at its peak 8.5 square miles. A total of 6 flow restrictions, or bottlenecks, can be counted along the course of the Bayou, each creating its own pool around the restriction (not only above), from elevation 85 ft just east of Highway 6, to 40 ft or so just east of I 610. The level was 25 ft when reaching downtown. The restrictions were compounded in some cases with the confluence with other water outlets: South Mayde Creek, Turkey Creek, Rummel Creek, the aqueduct merging with Buffalo Bayou at S. Gessner.

The restrictions appear to have been, from west to east: Eldridge Parkway, Kirkwood Road, Sam Houston Tollway, Gessner Road, Chimney Rock Road, the I 610 Loop, and seem to have consisted of the very bridges across the bayou.

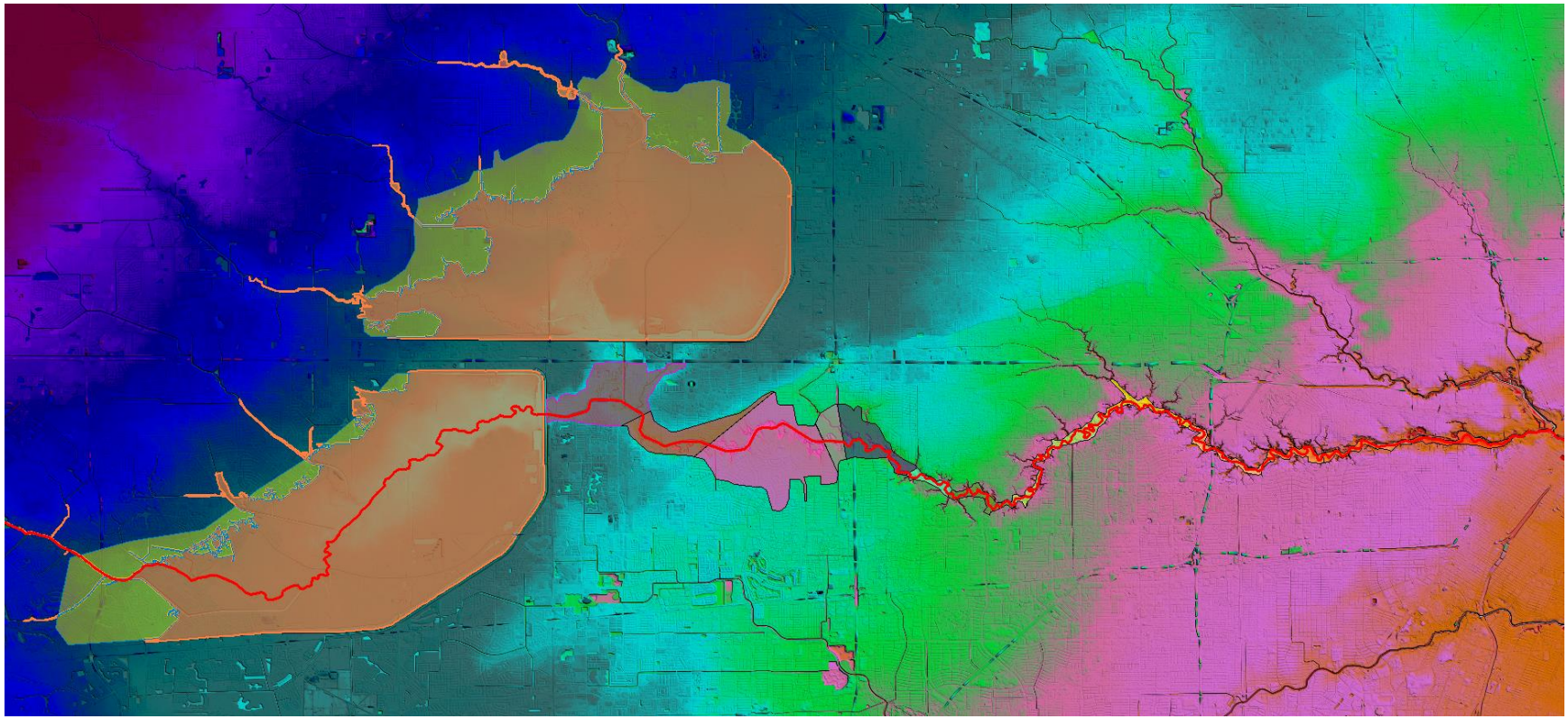
Shepherd Drive did not create a bottleneck.

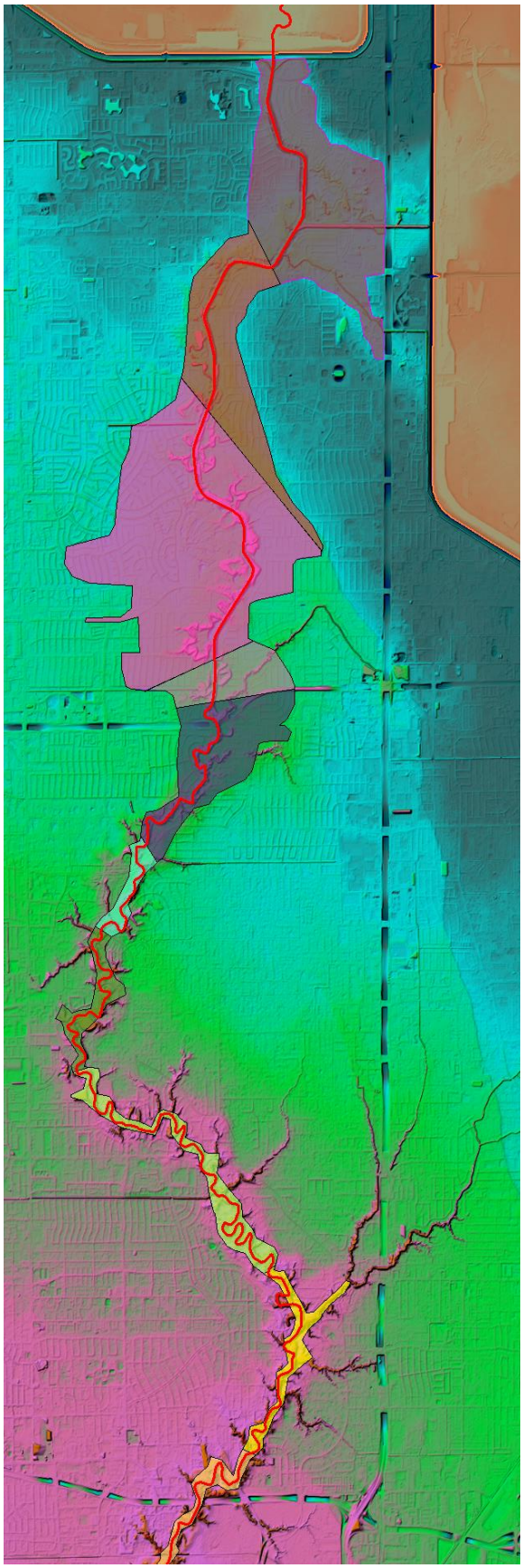
It is yet unclear what the real operational situation was at the time the reservoirs were flushed, and in particular whether water was actually going around the ends of the dams or was feared to do so, but for the water in the reservoir to rise another 5 ft and reach the top of the dams, the equivalent Buffalo Bayou flood should have been an hyperbolic 32 ft, between 10 and 30 times the actual.

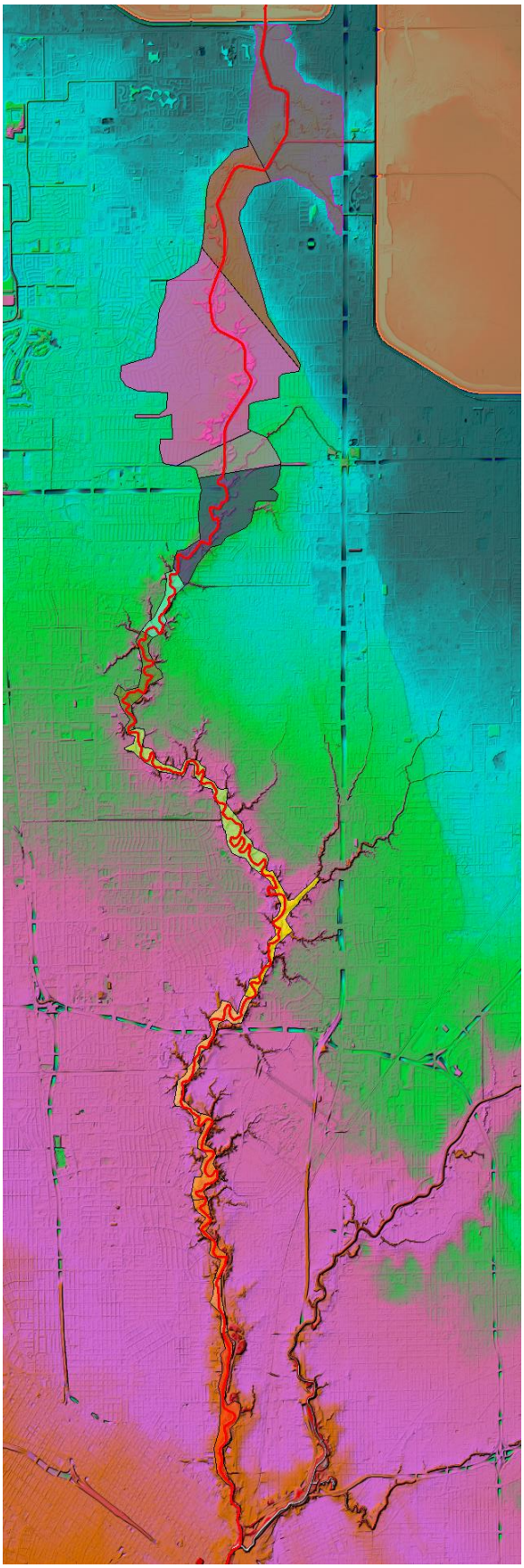
Since the water level above the reservoirs rose by 5 ft, it is reasonable to assume that the average flood depth above the normal level was 2.5 ft, and that the total volume of flood water outside the reservoir perimeters was 800 million cubic feet, plus 6 billion cubic feet inside the reservoir normal perimeters above the normal level. To reach the top of the dams, the water would have had to rise another 5 ft, adding another 8 billion cubic feet to the water already present and doubling the size of the flooded areas. For the sake of comparison, at the discharge rate of 8,000 cu. ft. per second, that would have represented 12 days of flushing.

Had there been no obstruction, a flushing rate of 8,000 cu. ft per second would have translated in a hydraulic velocity down the bayou of 3 ft per second in the narrowest parts, down to 1 ft per second in the widest. That's 2 mph and 0.5 mph respectively, a relatively moderate velocity, which needs to be checked against the slope of only 0.03 degree (0.05%). It would have taken probably about 16 to 20 hours for all the flow to reach downtown, assuming there was no obstruction. The bayou can probably accommodate about half a billion cubic feet before it overflows, in the extreme case it is severely restricted downtown. The volume of the flood water along the bayou was probably of the same order of magnitude, or less.

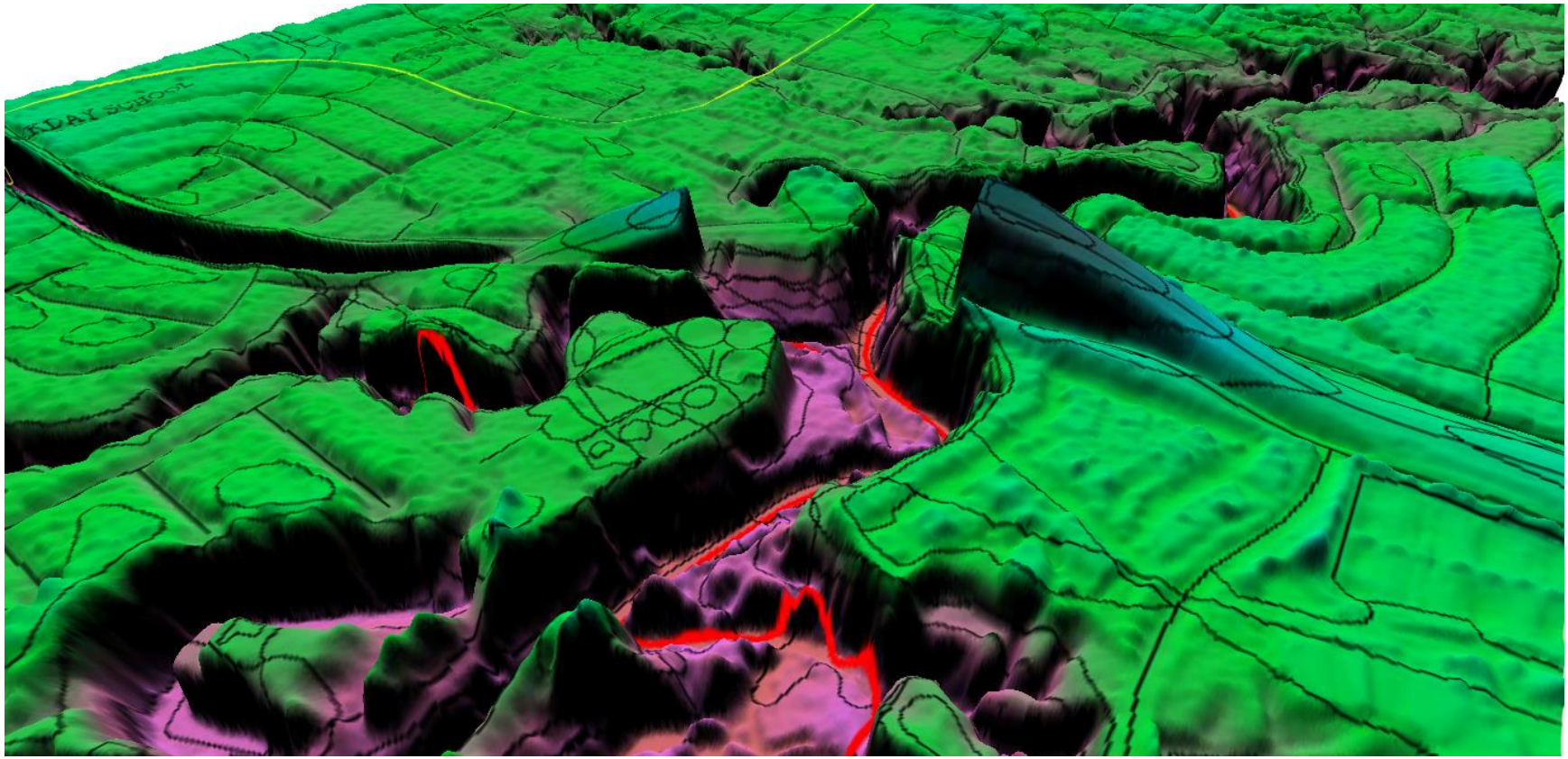
Flooded areas in different colors. Water levels 5 ft apart, and in one case 2.5 ft (grey).



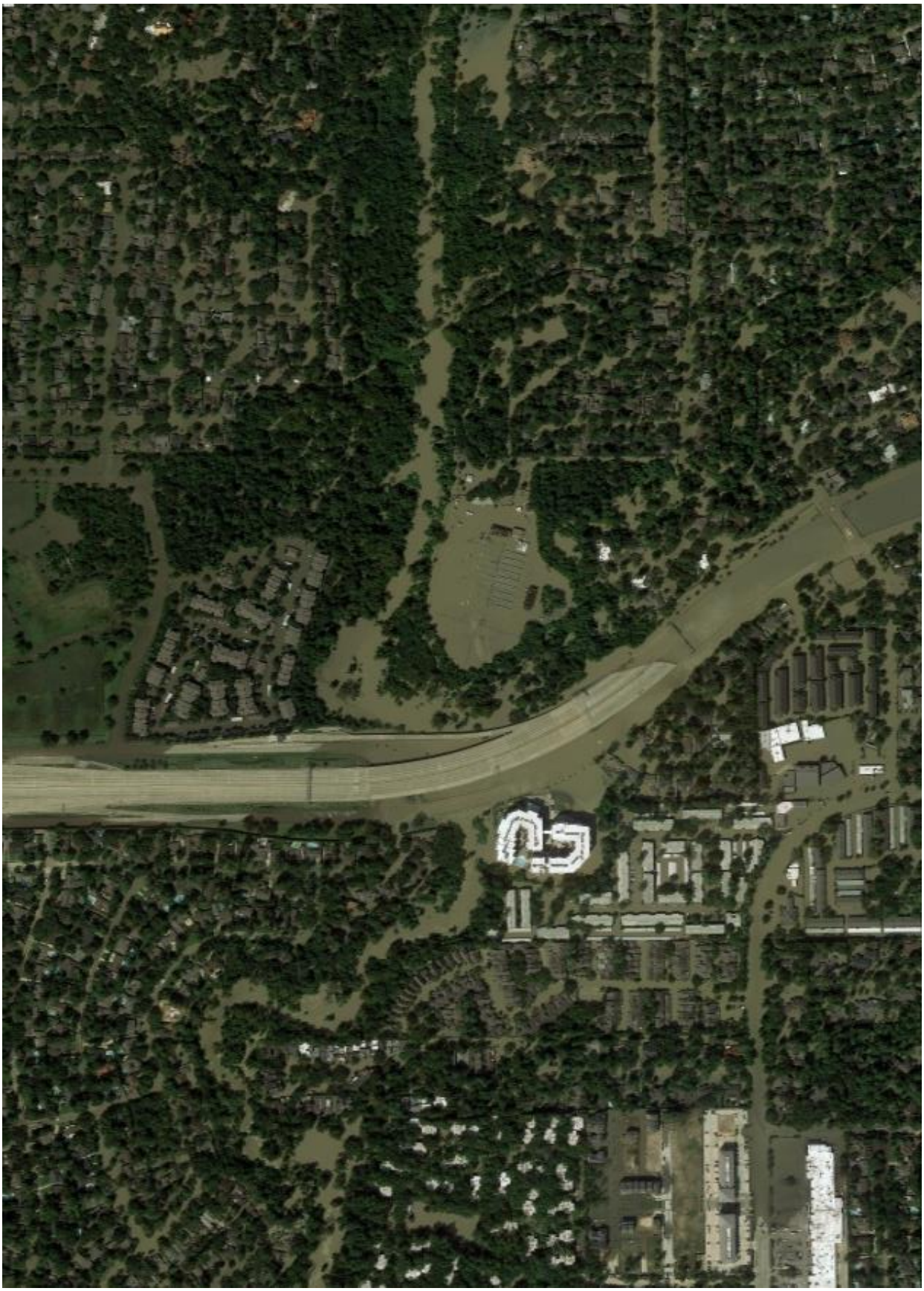




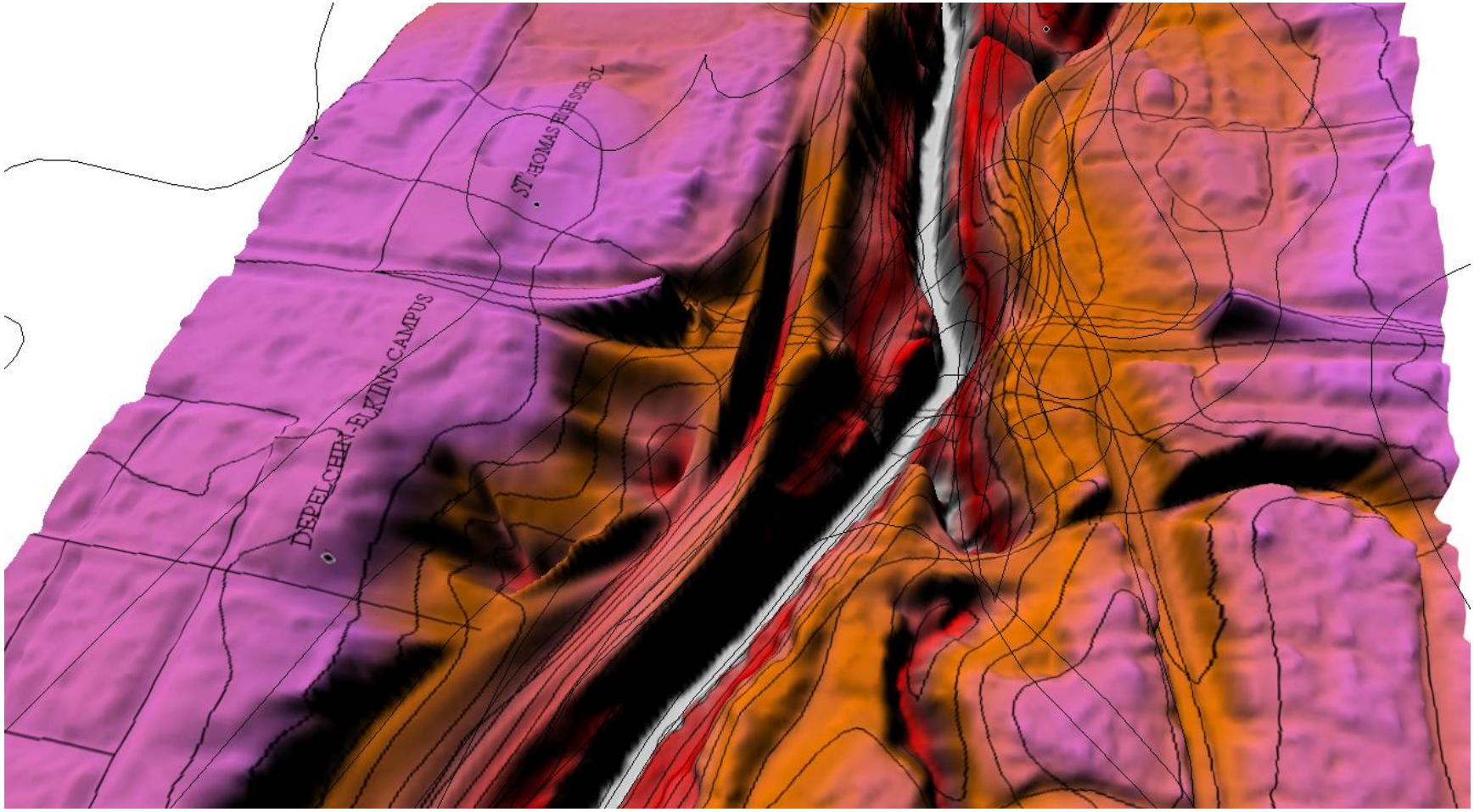
Sam Houston Tollway bridge over Buffalo Bayou:



Vertical exaggeration: 15



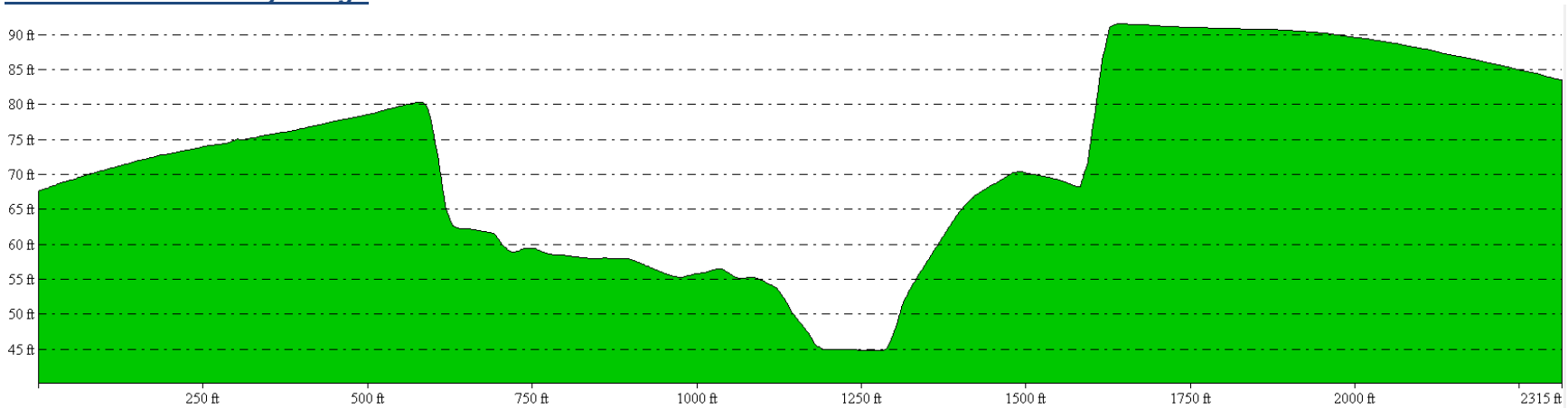
Shepherd Drive bridges over Buffalo Bayou:



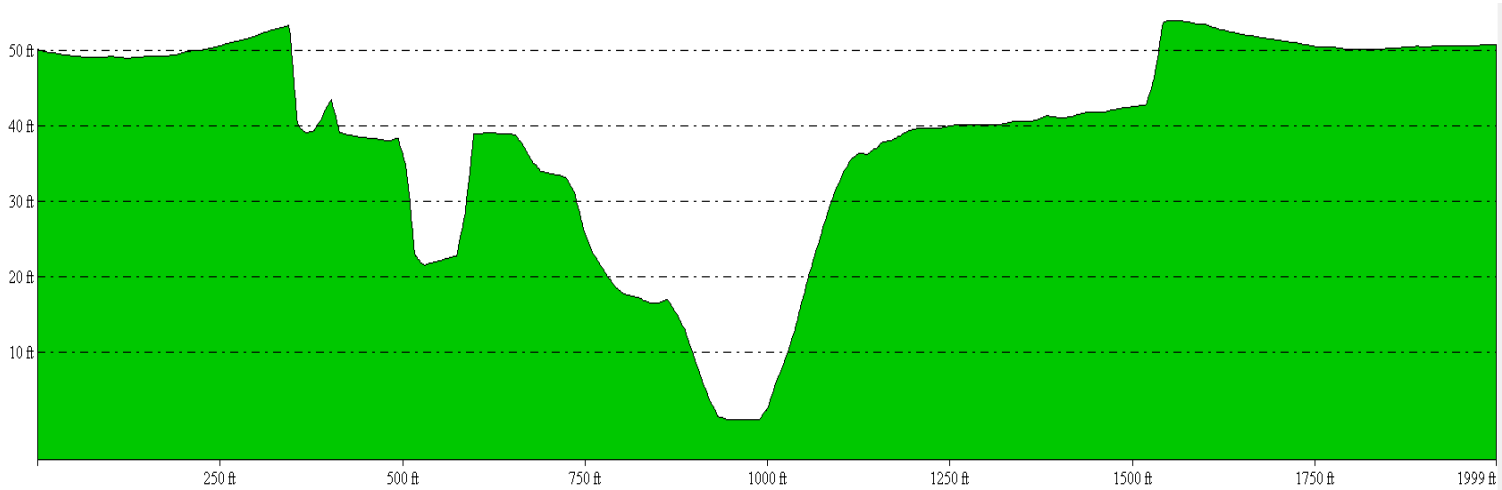
Vertical exaggeration: 15

Shepherd Dr
Shepherd Dr
Buffalo Bayou

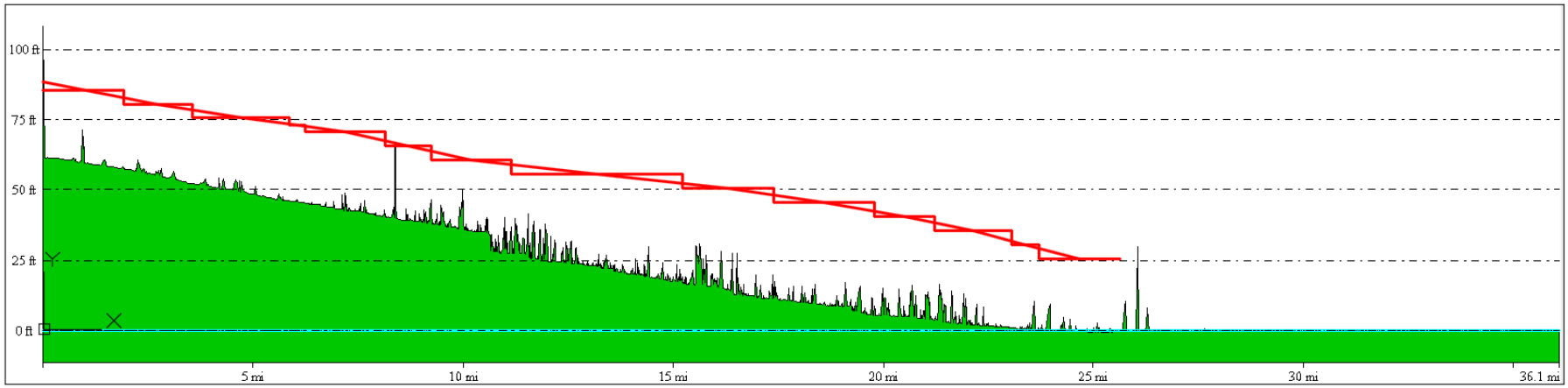
Sam Houston Tollway bridge

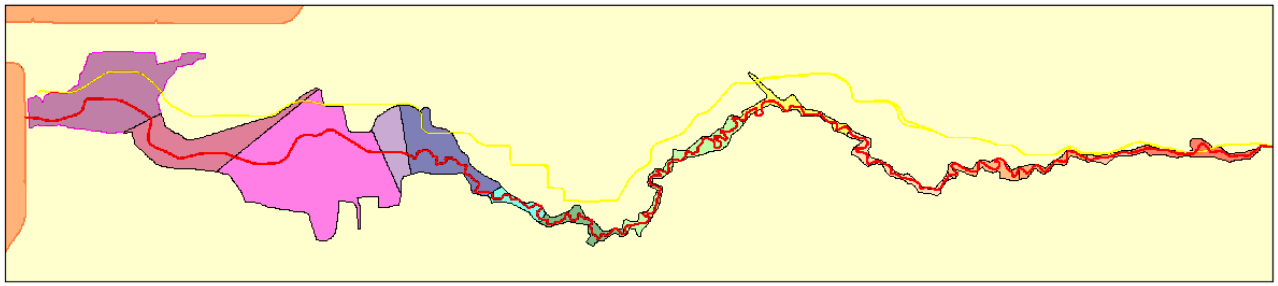


Shepherd Drive bridges



Profiles of the bottom of Buffalo Bayou and flood levels:



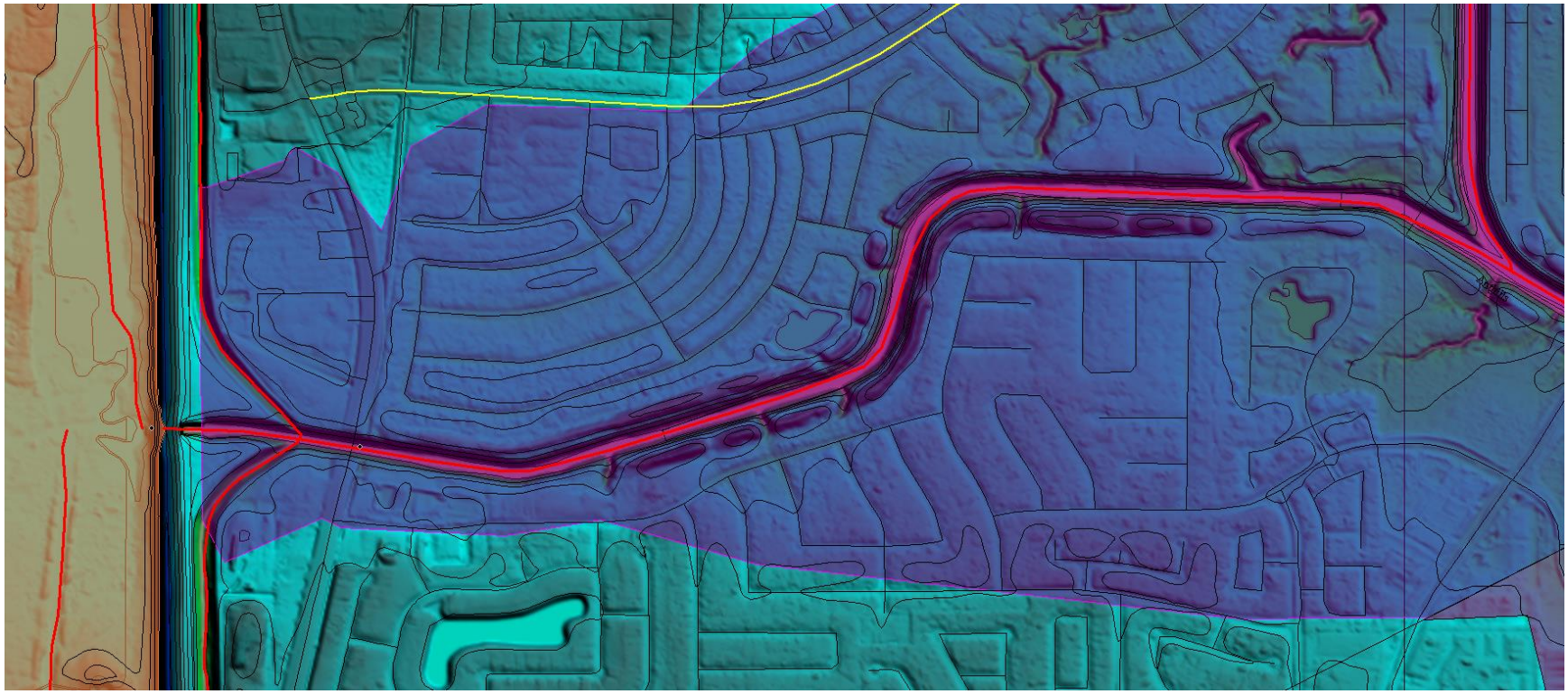


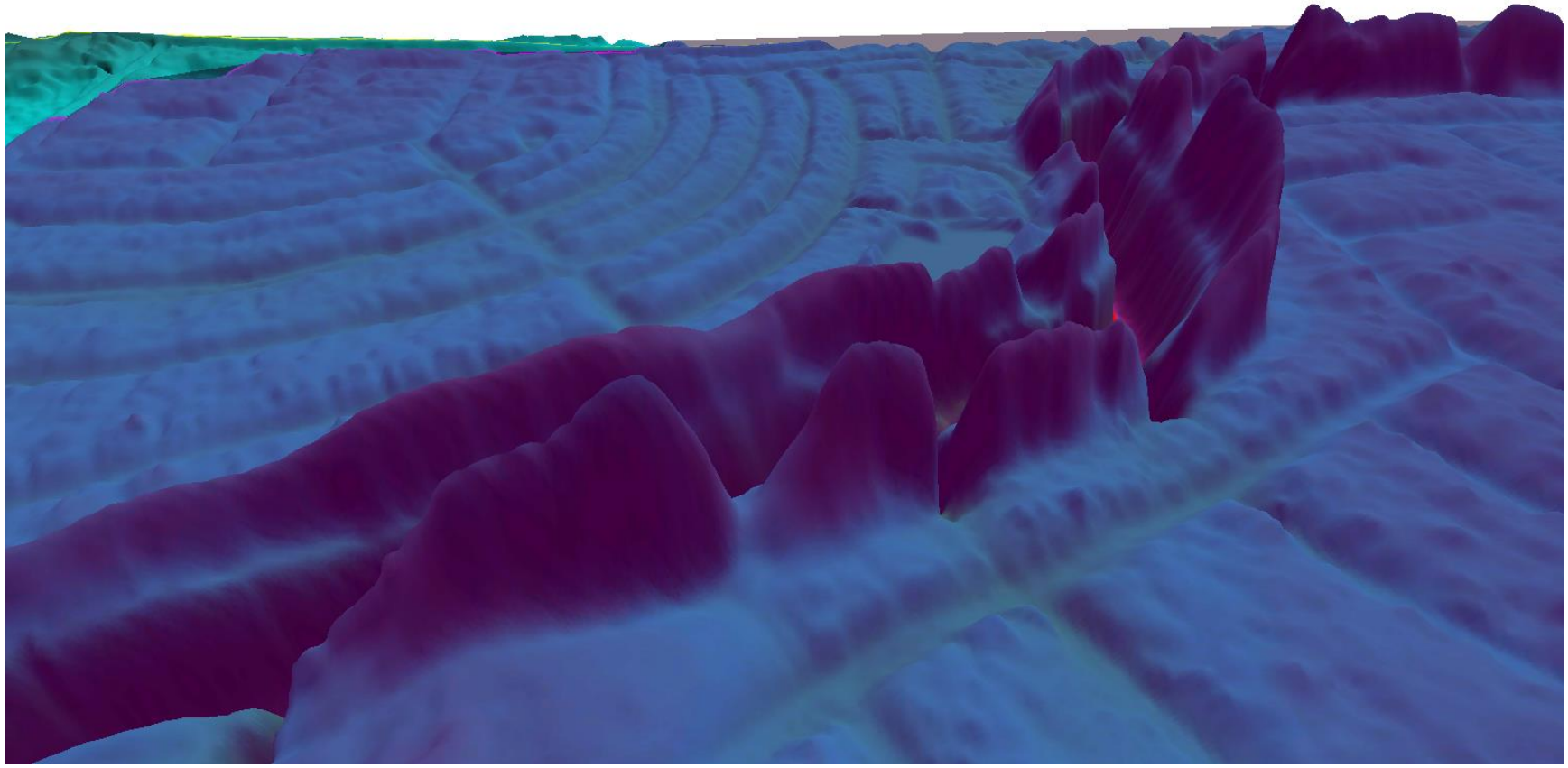
Horizontal scales do not fit, since the profile is along the deployed bayou and the map is geographic.

In the areas of maximum flooding the water level was 24 ft above the bottom of the bayou, and 36 ft in the areas of minimum flooding.

Discontinued levies on each side of Buffalo Bayou, just east of Barker Reservoir

The levies protrude about 10 to 20 ft, and probably facilitate the flooding and hamper the draining of areas located further from the bayou.





Vertical exaggeration: 15

Cross section of the bayou and levies