Summary of Flood Reduction Studies in Shoal Creek Watershed
August 2014

The purpose of this summary is to provide a brief recap of known studies that have been completed that investigate ways to mitigate flooding risks within the Shoal Creek Watershed. Based on known records, the most significant study to date is the United States Army Corps of Engineers (USACE) study titled Interim Report and Environmental Assessment (latest available version dated November 1991). Since then, the Watershed Protection Department (WPD) has performed brief conceptual analyses that build upon the USACE study with the most recent analysis completed in June 2014. The USACE study and the most recent WPD analysis are discussed below.

1991 USACE INTERIM REPORT SUMMARY

Scope of Study

The USACE report is approximately 500 pages in length. The study was undertaken based on various Congressional directives to look at water and other related land resource problems in the Shoal Creek watershed. Over the years, there have been multiple flood related issues that have caused property damage and loss of life. The study was initiated upon the request of the City of Austin in 1983 with the need for flood control as the primary problem identified. Several alternatives were investigated for flood prevention designs to include structural and nonstructural measures. Sufficient work was done for each alternative measure to determine its feasibility and to determine the best alternative based on engineering, economic feasibility, area needs, and environmental and social acceptability.

Plans Considered

Structural Measures

1. Detention Reservoirs – No detention reservoirs were considered since the City had already constructed two detention ponds in Northwest Park and developed three detention ponds north of US Highway 183 in the northern part of the Shoal Creek watershed. Additional ponds would not have been beneficial due to the lack of available land and little benefit to most of the watershed by building such a structure.
2. Channel Improvements – The improvements would decrease flood stage levels by increasing the improved channel velocity and permitting higher flows. The improvements considered included minimum, intermediate, and maximum channel improvements for Shoal Creek and Hancock Creek. Even the maximum channel improvements for Shoal Creek, which would vary from grass lined, trapezoidal to concrete lined, rectangular channels that have bottom widths ranging from 45 feet to 90 feet and costs of approximately $67 Million (1991 dollars), only provided protection up to the 50-year (2-percent chance) storm and not the 100-year (1-percent chance) storm. The City chose to proceed further with the Hancock Creek Channel Improvement, and a Project Design Memorandum was completed in August 1993. The improvements per the Project Design Memorandum consisted of selective clearing of the existing creek, grass lined channel, gabion and concrete trapezoidal channel, a diversion box

culvert, rectangular concrete-line channel, and bridge and road alterations at an estimated project cost of $7.3 Million (1993 dollars) and provide protection against the 10-year (10-percent chance) storm.

3. Levees – Levees were not considered feasible due to adverse environmental impacts, extensive relocations of the numerous residential and commercial structures located along Shoal Creek, and the required continuing maintenance to prevent failure.
4. Tunnels – Diverting the floodwaters directly into the Colorado River was considered as a viable option as it would minimize the relocations and help provide adequate flood protection. The tunnel sizes that were considered included diameters of 10', 14', 16', 18.5', and 23'. The sizes were selected based on available tunnel boring machines at the time of the study. Below is an economic summary table for the tunnel plans that was extracted directly from the report:

ECONOMIC SUMMARY
TUNNEL PLANS
(February 1991 Price Level)

Plan	Tunnel Diameter	Total First Cost	Average Annual Cost 1/	Average Annual Benefits	Benefit-to-Cost Ratio	Residual Damages	Net Benefits
			(in thousands of dollars)				
Northwest Park							
Dry Creek Alignment 2/	18.5	40,100	4,001	5,231	1.3	8,625	1,230
	23	60,432	6,024	5,255	0.9	8,601	-
Bull Creek Alignment	14	42,024	4,192	5,168	1.2	8,224	976
	18.5	46,288	4,616	5,231	1.1	8,625	615
45th Street	18.5	34,193	3,571	2,425	0.7	11,431	-
	23	70,122	7,307	6,425	0.9	7,431	-
Hancock-45th Street	18.5	47,466	4,734	4,126	0.9	9,730	-
24th Street	14	26,742	2,563	2,603	1.0	11,253	40
	18.5	31,830	3,048	3,102	1.0	10,754	54
	23	37,396	3,578	3,304	0.9	10,552	-
19th Street	14	23,964	2,294	2,433	1.0	11,422	139
	16	25,422	2,432	2,533	1.0	11,322	101
	18.5	28,329	2,709	2,774	1.0	11,081	65

5. Combination Plans – In an effort to provide a comprehensive solution, various channel improvements and tunnel options were combined and analyzed. The combination plans are identified with a letter followed by the number. The number indicates the tunnel diameter size.

ECONOMIC SUMMARY
COMBINATION PLANS
(February 1991 Price Level)

	Plan	Tunnel Diameter	Total First Cost	Average Annual Cost*	Average Annual Benefits	Benefit-to-Cost Ratio	Residual Damages	Net Benefits
			(in thousands of dollars)					
A	Channel, Northwest Park Tunnel	14	59,097	5,896	8,037	1.3	5,819	2,141
		18.5	66,241	6,607	8,065	1.2	5,791	1,458
		23	72,278	7,208	8,274	1.1	5,582	1,066
B	Channel, Northwest Park Tunnel, 45th Street Tunnel	18.5	92,913	9,691	10,122	1.0	3,734	431
C	Channel, Northwest Park Tunnel, Hancock-45th Street Tunnel	10	53,019	5,543	7,503	1.4	6,353	1,960
		18.5	96,041	10,016	11,530	1.2	2,326	1,514
		23	118,119	12,312	12,728	1.0	1,128	416
D	Channel, Northwest Park Tunnel, 24th Street Tunnel	14	85,748	8,946	9,854	1.1	4,002	908
		18.5	88,371	9,219	10,356	1.1	3,500	1,137
E	Channel, Northwest Park Tunnel, 19th Street Tunnel	10	62,669	6,546	8,425	1.3	5,431	1,879
		14	74,485	7,775	9,970	1.3	3,886	2,195
		18.5	87,303	9,108	10,407	1.1	3,449	1,299
F	Channel, Northwest Park Tunnel, 19th Street Tunnel, Hancock Channel	10	70,922	7,404	9,513	1.3	4,343	2,109
		14	81,697	8,525	11,560	1.4	2,296	3,035
		18.5	93,514	9,754	11,898	1.2	1,958	2,144

Nonstructural Measures

The intent of the nonstructural measures is not to reduce or eliminate the flooding issues. Instead, the intent is to manage the floodplain to minimize the negative impacts. Some of the recommendations considered included the following:

1. Floodproofing – The primary benefit is to reduce or eliminate flooding of existing structures. Methods include water-tight coverings, raising minimum floor elevations, raising access roads and escape routes, constructing levees or floodwalls and waterproofing walls around structures. This alternative was not recommended due to minimal benefits.
2. Zoning – This alternative requires modifications to existing land use and zoning regulations to control future development. This alternative was not recommended due to the already existing high damage potential.
3. Permanent Evacuation – A buy-out project would be implemented to eliminate structures in the floodplain for whatever frequency event is chosen as the desired level of protection. For the 5-year (20-percent chance) floodplain, it was determined that 157 residential structures would be impacted. This alternative was not recommended due to the low benefit-to-cost ratios of 0.6 to 1.0 that were determined.
4. Flood Warning – Warning systems can be implemented in cooperation with the National Weather Service.

No Action Alternative

It is expected that development in the existing Shoal Creek floodplain will remain stable and the existing flood threat will continue. This will discourage repairs and improvements to the structures. Since the City participates in FEMA's National Flood Insurance Program (NFIP) it is expected the floodplain management regulations will prevent further developments within the 100-year floodplain. It was further

noted that the average annual damages will be about $13.9 million for the study area. It was recommended that the City continue to enforce the zoning regulations, participate in the NFIP, encourage individual flood proofing of structures, and provide flood warnings.

National Economic Development (NED) Plan

Plan F14 was recommended as the NED plan. It consists of channel improvements in the upper reaches of Shoal creek, the 14-ft diameter Northwest Park Tunnel, the 14-foot diameter 19th Street Tunnel, and channel improvements to the Hancock Branch Creek. The recommended plan had an estimated 1991 project initial cost of approximately $82 Million with a Benefit to Cost (B/C) ratio of 1.4 to 1.0. The B/C value was estimated based on a 100-year period of analysis. Benefits include monetary savings or benefits due to damages prevented, reduction in the cost of emergency services, and the reduced disruption of the economy. Costs include initial project cost (which include construction and associated costs to support construction), the interest of the initial cost during construction, the operation and maintenance costs, and the interest to amortize the project cost over the life of the project.

In 1991, an Environmental Assessment (EA) was performed for the recommended plan. The costs that were identified in the EA were slightly different than indicated in the interim report; however, the scope of work remained the same. The EA indicated that no mitigation for the proposed project was required. In a letter from Colonel Brown dated August 19, 1991, he wrote "I have concluded that the proposed action will not have a significant adverse effect on the human environment nor is it environmentally controversial." The letter also indicated that an Environmental Impact Statement would not be required.

2014 WPD ANALYSIS

In June 2014, WPD revisited the USACE recommended plan and focused on the 19th Street Tunnel option. Channel improvements to Shoal Creek and Hancock Creek were deemed impractical because clearing out natural creeks and making them uniform, grass lined and concrete channels do not meet the overall goals of WPD, which aside from reducing the impacts of flooding also include reducing the impacts of erosion and water pollution. The Northwest Park Tunnel also appeared to be impractical because of its length and it having to go under Loop 1 to get to Lake Austin.

The 19th Street Tunnel was chosen for further analysis for the following reasons:

1. It appears feasible based on the results of the ongoing Waller Creek Tunnel project. The 19th Street Tunnel would be similar in diameter and length.
2. It has potential to mitigate flooding risks to many properties and roadways downstream of 19th Street.

The 19th Street Tunnel, which from herein will be referred to as the Shoal Creek Tunnel, would start at Pease Park at 19th Street (Martin Luther King Jr. Boulevard) and outlet into Lady Bird Lake. Figure 1 presents the general location and alignment of the tunnel. The Shoal Creek Tunnel would be 26 feet in diameter (matching the largest Waller Creek Tunnel segment) and approximately 6,100 feet long. Assuming similar hydraulics to the Waller Creek Tunnel, WPD estimated that up to 10,000 cubic feet per second (cfs) of flow would be diverted out of Shoal Creek and into Lady Bird Lake during the 100-year storm event. The potential flood reduction benefits of the tunnel include:

- 100-year (1% chance) storm event: 59 structures would have the risk of inundation eliminated; 18 remaining structures would have reduced inundation depths. Two roadways would have the risk of overtopping eliminated; five remaining roadways would have reduced inundation depths.

- 25-year (4% chance) storm event: 57 structures would have the risk of inundation eliminated, 3 remaining structures would have reduced inundation depths. Five roadways would have the risk of inundation eliminated; two remaining roadways would have reduced inundation depths.
- 10-year and 2-year (10 % and 50% chance) storm events: all structures and roadways would have the risk of inundation eliminated.

The Shoal Creek Tunnel has an estimated initial project cost of approximately $133 Million. The initial project cost includes the construction cost, engineering, project management, construction inspection, Right-of-Way acquisition, utility relocation, and permitting costs. The construction cost is based on the Waller Creek Tunnel construction bid documents (2012 dollars). The other costs are estimated as percentages of the construction cost.

WPD recognizes the flooding risks within the Shoal Creek watershed and the importance of reducing these risks. The lower part of Shoal Creek is ranked number four on the creek flood mission's Regional Top 15 Flooding Priorities. The first influx of funding is currently planned for Fiscal Year 2017 for preliminary engineering.

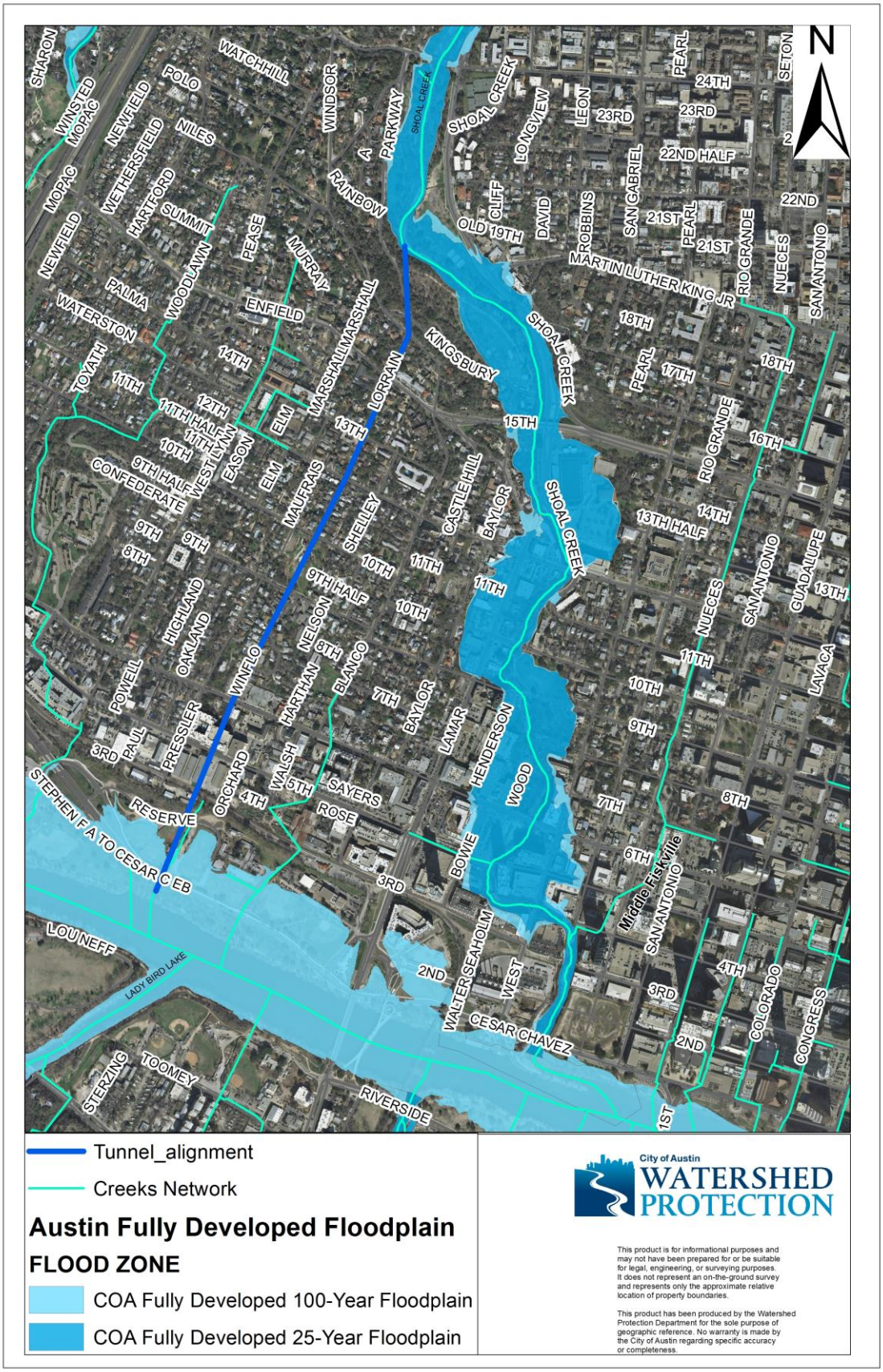

Figure 1 – Shoal Creek Tunnel General Location and Alignment Map