CHAPTER 3
IDENTIFICATION OF PROBLEMS AND NEEDS

This chapter identifies and investigates the problems and needs of the study area with regard to flood damage reduction, ecosystem restoration, and recreation.

IDENTIFICATION OF FLOODING PROBLEM

PROBABILITIES OF FLOOD EVENTS

The graph of the probabilities of all flood events forms a continuous curve. For the sake of clarity, flood events have been broken into individual recognizable flood events and the naming conventions simplified. Each of these events has an annual chance of exceedance (ACE) probability. The ACE probability is defined as that (level of) event that has a particular chance of occurring once in any year. Formerly, the 20% ACE was commonly called the 5-year event. This naming convention is a misnomer because it implies that it will only occur once in a five-year time span. In reality, the 20% ACE event is that magnitude of flooding that has a 20% chance, or 1 in 5, of happening in any year. However, it is not restricted to happening only once in a year. A table of the most recognized probabilities and their common reference is shown below (Table 3-1):

Table 3-1
Probabilities of Flood Events

50% ACE	2-year
20% ACE	5-year
10% ACE	10-year
4% ACE	25-year
2% ACE	50-year
1% ACE	100-year
0.2% ACE	500-year
ACE = Annual Chance of Exceedance	

HISTORIC FLOODS

The city of Austin and Travis County have experienced rainfall events in excess of 19 inches over a 24-hour period, as was the case in 1921, the second highest recorded flood event at the Highway 183 Bridge on Onion Creek. Other historic floods occurred in 1869, 1929, and 1941 all of which produced flood flows around 100,000 cubic feet per second (cfs) in the lower portion of Onion Creek, with two of these events possibly exceeding 125,000 cfs. According to a 1997 Loomis & Moore Onion Creek Study, the 1% ACE flood flow around the Onion Creek Forest/Yarrabee Bend area is 117,000 cfs and the 4% ACE is 55,000 cfs. Table 3-2 provides a summary of the major historical floods and their flows at the Highway 183 Bridge on Onion Creek. Between 1941 and 1998, few notable events occurred within the Onion Creek watershed, although Shoal Creek, located north of the Onion Creek Study Area, was devastated by a flood in 1981. More recent floods, occurring in October 1998 and November 2001, are described in more detail below.

Table 3-2 Summary of Historic Flood Events		
Date	**Peak Flow**	**Comments**
July 1869	140,000 cfs	1-2% ACE. Largest recorded flood to date
Sep. 1921	138,000 cfs	1-2% ACE. Over 19 inches of rain in a 24-hour period
May 1929	76,000 cfs	4-10% ACE
Jun. 1941	100,000 cfs	1-2% ACE
Jun. 1981	46,200 cfs	4-10% ACE. Approximately 8 inches of rain overnight actually 2 floods over a weekend
Oct. 1998	53,900 cfs	4-10% ACE
Nov. 2001	93,200 cfs	1-2% ACE

June 1981 Floods

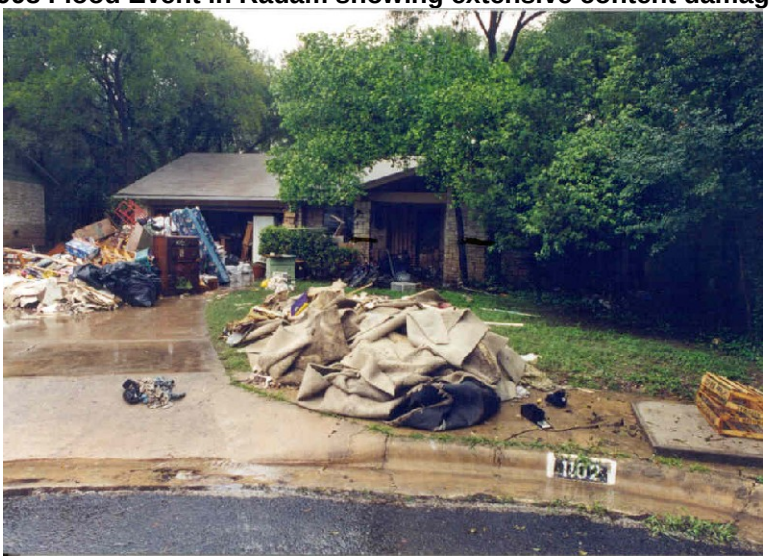
In June 1981, two major flood events occurred in one weekend. According to a post flood report prepared by the Corps, on Thursday, June 11, 1981 there were unofficial reports of up to 8 inches of rainfall in south Austin which produced overbank flooding in Williamson and Onion Creeks in Austin. Several homes were flooded, but no lives were lost. Then on the evening of June 13, the creek experienced out of bank flooding again. Over 1800 residents in Williamson Creeks had to evacuate houses twice in two days. According to the Corps' reconnaissance reports, significant damages occurred in Timber Creek with 5 mobiles homes being completely lost and 29 more being damaged. Over 21 people lost their lives as a result of the flooding statewide, but no lives were lost in Onion or Williamson Creek. According to local newspapers, the flooding damage in the Austin area was estimated at over $40 million.

October 1998 Flood

In October 1998 an approximate 4% ACE storm event occurred in the Onion and Williamson Creek Watersheds. Flows in Onion Creek at the Highway 183 Bridge were approximately 53,900 cubic feet per second (Figure 3-1). Prior to 1998, government officials were warning local citizens of the risk. Many homes were damaged (Figure 3-2), but no loss of life occurred on Williamson or Onion Creek.

Figure 3-1
1998 Flood in Heartwood Edition

Figure 3-2
1998 Flood Event in Radam showing extensive content damage



November 2001 Flood

Three years later, an even larger event with a return interval of approximately once every 40 years (2.5% ACE), struck the same area. Each of these storms inundated hundreds of homes and caused millions of dollars in property damage. Figures 3-3 and 3-4 are pictures taken after the November 2001 event and illustrate the significance of the flooding problem within the study area.

Figure 3-3
2001 Flood Event in Timber Creek

Figure 3-4

2001 Flood Event showing extensive content damage

ECONOMIC REACHES

Economic analyses were conducted to quantify single event and average annual flood damages under the existing conditions scenario within the study area. Results of these analyses formed the baseline for determining estimated flood damage reductions for the various structural and non-structural alternative plans investigated.

The economic study encompasses the five areas of interest on Onion Creek, as well as one area on Williamson Creek, which was further subdivided into four sub-areas. The study includes all properties lying within the Onion Creek flood plain as it flows through Travis County, and all properties along Williamson Creek from South Congress Avenue to the Brodie Lane. This also includes various structures adjacent to the Sunset Valley Tributary, and the Cherry Creek Tributary. These two tributaries, together with the main stem of Williamson Creek, form a highly complex flow regime near Westgate Boulevard. A summary of designated areas of interest used for this study is shown in Table 3-2 below and displayed on Figure 3-5.

Table 3-2 Areas of Interest	
Onion Creek	
Reach Name	**Description**
Timber Creek	Colorado River to US 183
Onion Creek Forest/Yarrabee Bend	US 183 to William Cannon Drive
Bluff Springs/Perkins Valley	William Cannon Drive to Slaughter Lane
Onion Creek Subdivision	Slaughter Lane to I-35
Bear/Onion Confluence	I-35 to Hays County Line
Williamson Creek	
Heartwood	South Congress Avenue to Jeffburn Cove
Radam/Salem Walk	Jeffburn Cove to Manchaca Road
Broken Bow/Buckskin Pass	Manchaca Road to Remuda Trail
Westgate Blvd/Bayton Loop	Remuda Trail to Westgate Boulevard

DEPTHS OF FLOODING

In order to accurately describe the flooding problem within an area, it is necessary to determine the depths of flooding so that appropriate alternatives can be analyzed during plan formulation. Figure 3-6 – 3-12 are color coded plates to show existing conditions depths of flooding by damage reach. As shown on the figures, depths range from a few inches to several feet. Some structures, especially in the Timber Creek area, are located in the FEMA designated "floodway." The 1997 Loomis and Moore Report indicates that approximately 840 structures are inundated by the 1% ACE event in Onion Creek Forest/Yarrabee Bend, with 40 houses flooded to a depth of more than 10 feet. In addition to knowing the depth of flooding, one must know the types of structures that are being inundated to know the severity of the problem. The structure types vary by area of interest. There are a total of 1,385 structures within the study area that receive damages in a 1% ACE event, including 1,149 on Onion Creek and 236 on Williamson Creek.

In Timber Creek, the structures within the 4% ACE floodplain consist mostly of mobile homes with varying first floor elevations ranging from less than a foot to 10 feet or more above ground level. However, many of these structures are located in the floodway; consequently, when flood waters rise above finish floor elevations many of the mobile homes get swept off of their foundations and float several hundred feet downstream. The 1% ACE floodplain in the Timber Creek area consists of a combination of slab-on-grade residences and mobile homes.

The Onion Creek Forest/Yarrabee Bend and the Bluff Springs/Perkins Valley areas of interest contain a combination of mobile homes with varying floor corrections and slab-on-grade residences.

Williamson Creek, Bear/Onion Confluence and Onion Creek Subdivision areas of interest contain mainly slab-on grade residences. Most of the slab-on-grade residences have less than one foot floor correction from ground elevation to finished floor elevation. Few, if any, of the structures contain basements.

SOCIAL AND ECONOMIC ANALYSIS

STRUCTURES AND INVESTMENT IDENTIFIED

Of major importance to determination of estimated flood damages is the floodplain investment that is present. Tables 3-4 and 3-5 display the number and estimated value of properties located within the study areas in Onion Creek and Williamson Creeks, respectively, as of 2001. Field investigations identified 1,411 damageable structures, not including vehicles, located throughout the five reaches within the 0.2% ACE floodplain of Onion Creek and 528 damageable structures, not including vehicles, on Williamson Creek. Tables 3-4 and 3-5 show the total estimated value of the 0.2% ACE floodplain investment, including vehicles, is $211,346,000 based on December 2004 prices and level of development. Content values for residential structures are not specifically collected, but are correlated to structure value in the economic software program used to calculate damages from flood events. While assigning no value to residential contents in Tables 3-4 and 3-5 results in a lower total investment value than is actually in place, the damages associated with content values are appropriately accounted for in the calculation of expected annual damages under without-project and with-project conditions. Residential values constitute well over 95 percent of the total floodplain investment. The table values have been updated from 2001 prices to 2004 prices to reflect the market value. Values at 2001 price levels are located in Appendix A.

SINGLE OCCURRENCE FLOOD LOSSES

Structure values obtained from the Travis County Appraisal district have been updated to 2004 using Marshall and Swift Estimator© and local sales data. Travis County or its contractors surveyed finished floors. The new structure data was compiled and run through the FDA program for more accurate results. Updated single event and expected annual damages are presented in Tables 3-6 and 3-7 for those reaches that are being assessed further.

EXPECTED ANNUAL DAMAGES

Damages to the various structures, accumulated by frequency, produce a frequency-damage function. An integration process using this frequency-damage data calculates estimates of Expected Annual Damages (EAD). Specifically, this involves aggregating the multiplication of the mean damage between each pair of flood events by the difference in exceedance probabilities. This is then repeated for the range of flood events in each property category. The Hydrologic Engineering Center's Flood Damage Assessment Program (HEC-FDA) was developed to facilitate the plan formulation and evaluation of flood damage consistent with Federal and Corps policy regulations. Expected annual damage is the mean damage obtained by integrating the damage exceedance probability curve for each flood event. The damage exceedance probability curve results from the discharge-exceedance probability, stage-discharge, and stage-damage functions derived for each defined reach along the stream. It is the reduction in EAD which serves as the indicator to derive total annualized benefits for any flood damage alternative that is evaluated. The total annualized benefits are then divided by annualized costs of an alternative to determine the benefit-to-cost ratio for each alternative. If the ratio is greater than 1.0, then the alternative is considered to be economically feasible. For this reason, the computation of the EAD for each area of interest is considered to be one of the most important economic aspects.

Table 3-6 and 3-7 also provide a summary of the EAD for all areas of interest investigated in the detailed investigation of alternatives in the last column. Please refer to Appendix A, Economics for a detailed breakdown of the EAD by category. Appendix A also provides details for other portions of the economic analysis.

Table 3-4
Floodplain Investment: Structures and Contents
Onion Creek
($000; December 2004 price level)

Reach	Damage Category	Number	Structure Value	Content Value	Total Value
Timber Creek	Single-Family	8	486	0	486
	Mobile Homes	135	3,166	0	3166
	Sub-Total	**143**	**3,652**	**0**	**3,652**
	POVs	143	822	0	822
	Total	**286**	**4,477**		**4,477**
Onion Creek Forest/ OCFYB	Single-Family	666	41,498	0	41,498
	Mobile Homes	130	3,051	0	3,051
	Multi-Family	57	4201	0	4,201
	Sub-Total	**853**	**48,750**	**0**	**48,750**
	POVs	869	10,352	0	10,352
	Total	**1722**	**59,102**	**0**	**59,102**
Bluff Springs Road/ Perkins Valley	Single-Family	69	5,232	0	5,232
	Mobile Homes	5	92	0	92
	Multi-Family	4	146	0	146
	Industrial	1	33	58	91
	Commercial	2	319	398	717
	Sub-Total	**81**	**5,822**	**456**	**6,278**
	POVs	73	1,101	0	1,101
	Total	**154**	**6,923**	**456**	**7,379**
Onion Creek Subdivision	Single-Family	242	45,037	0	45,037
	Multi-Family	61	9,212	0	9,212
	Commercial	2	3,791	926	4,717
	Sub-total	**305**	**58,040**	**926**	**58,966**
	POVs	283	8,908	0	8,908
	Total	**588**	**66,948**	**926**	**67,874**
Bear Onion Confluence	Single-Family	29	3,900	0	3,900
	Sub-total	**29**	**3,900**	**0**	**3,900**
	POVs	26	565	0	565
	Total	**55**	**4,465**	**0**	**4,465**
TOTAL ALL REACHES	Single-Family	1,014	96,153	0	96,153
	Mobile Homes	270	6,309	0	6,309
	Multi-Family	122	13,559	0	13,559
	Industrial	1	33	58	91
	Commercial	4	4110	1324	5,434
	POVs	1394	21,748	0	21,748
GRAND TOTAL		***1,411****	***141,912***	***1,382***	***143,294***

** Total number or values do not include Privately Owned Vehicles (POVs).*

Table 3-5
Floodplain Investment: Structures and Contents
Williamson Creek
($000; December 2004 price level)

Reach	Damage Category	Number	Structure Value	Content Value	Total Value
Heartwood	Single-Family	146	12,583	0	12,583
	Multi-Family	3	3,156	0	3,156
	Sub-Total	***149***	***15,739***	***0***	***15,739***
	POVs	156	3,297	0	3,297
	Total	***305***	***19,036***	***0***	***19,036***
Radam	Single-Family	168	15,089	0	15,089
	Multi-Family	7	776	0	776
	Sub-Total	***175***	***15,865***	***0***	***15,865***
	POVs	179	3,348	0	3,348
	Total	***304***	***19,213***	***0***	***19,213***
Broken Bow	Single-Family	75	9,382	0	9,382
	Multi-Family	1	230	0	230
	Sub-Total	**76**	**9,612**	**0**	**9,612**
	POVs	76	1,998	0	1,998
	Total	**152**	**11,610**	**0**	**11,610**
Bayton Loop	Single-Family	64	4,987	0	4,987
	Multi-Family	49	8,319	0	8,319
	Sub-Total	***113***	***13,306***	***0***	**13,306**
	POVs	168	2,829	0	2,829
	Total	***281***	***16,135***	***0***	**16,135**
Sunset Valley	Single-Family	15	1,702	0	1,702
	Sub-Total	***15***	***1,702***	***0***	***1,702***
	POVs	8	355	0	355
	Total	***23***	***2,057***	***0***	***2,057***
TOTAL ALL REACHES	Single-Family	468	43,743	0	***528***
	Multi-Family	60	12,481	0	***528***
	POVs	587	11,828	0	***528***
GRAND TOTAL		***528****	***68,052***	***0***	***68,052***

** Total number does not include POVs. Total values do include POVs*

Table 3-6
Total Single Event and Expected Annual Damages – Onion Creek
Onion Creek Reaches
($000s; December 2004 Price Level)

ACE Event			10%		4%		2%		1%		0.20%		EAD
Reach	Category	Structure Value	#	Damage	#	Damage	#	Damage	#	Damage	#	Damage	
Timber Creek	Mobile Home	$3,585	22	$210	95	$1,370	106	$2,559	110	$3,356	135	$5,084	$197
	Single-Family	$459	2	$69	4	$170	5	$249	8	$314	8	$432	$24
	Sub-Total	**$4,044**	**24**	**$279**	**99**	**$1,540**	**111**	**$2,808**	**118**	**$3,670**	**143**	**$5,516**	**$221**
	POV	$953	13	$101	71	$467	96	$634	97	$644	143	$953	$38
	Total	**$4,997**	**37**	**$380**	**170**	**2007**	**207**	**3442**	**215**	**4314**	**286**	**6469**	**259**
OCFYB	Mobile Home	$3,557	18	$132	94	$1,108	119	$2,195	130	$4,243	130	$6,652	$198
	Multi-Family	$5,767	12	$312	25	$981	34	$1,494	40	$2,102	57	$3,945	$138
	Single-Family	$56,030	3	$343	241	$8,801	420	$17,919	588	$28,855	666	$50,809	$1,391
	Sub-Total	**$65,354**	**33**	**$787**	**360**	**$10,890**	**573**	**$21,608**	**758**	**$35,200**	**853**	**$61,406**	**$1,727**
	POV	$13,467	21	$120	268	$2,017	461	$4,849	687	$7,902	869	$12,083	$361
	Total	**$78,821**	**54**	**$907**	**628**	**$12,907**	**1034**	**$26,457**	**1445**	**$43,102**	**1722**	**$73,489**	**$2,088**
Bear Creek	Single Family	$5,288	1	$19	1	$100	9	$702	16	$1,577	29	$4,140	$67
	Sub-Total	**$5,288**	**1**	**$19**	**1**	**$100**	**9**	**$702**	**16**	**$1,577**	**29**	**$4,140**	**$67**
	POV	$826	1	$3	1	$5	6	$66	10	$170	26	$457	$15
	Total	**$6,114**	**2**	**$22**	**2**	**$105**	**15**	**$768**	**26**	**$1,747**	**55**	**$4,597**	**$82**

Table 3-6 Continued
Total Single Event and Expected Annual Damages – Onion Creek
Onion Creek Reaches
($000s; December 2004 Price Level)

ACE Event			10%		4%		2%		1%		0.20%		EAD
Bluff Springs	Commercial	$312	0	$0	2	$362	2	$460	2	$487	2	$535	$28
	Industrial	$33	0	$0	0	$0	0	$0	1	$20	1	$41	$1
	Multi-Family	$259	0	$0	1	$9	3	$59	4	$111	4	$179	$4
	Mobile Home	$105	0	$0	1	$1	4	$19	4	$42	5	$117	$199
	Single Family	$6,457	0	$0	11	$370	38	$1,737	53	$3,076	69	$5,149	$334
	Sub-Total	**$7,166**	**0**	**$0**	**15**	**$742**	**47**	**$2,275**	**64**	**$3,736**	**81**	**$6,021**	**$566**
	POV	$869	0	$0	4	$20	37	$253	55	$529	73	$817	$1,917
	Total	**$8,035**	**0**	**$0**	**19**	**$762**	**84**	**$2,528**	**119**	**$4,265**	**154**	**$6,838**	**$2,483**
Onion Creek Subdivision	Commercial	$3,702	0	$0	2	$840	2	$1,178	2	$1,618	2	$2,673	$106
	Multi-Family	$11,498	0	$0	19	$1,110	36	$3,219	47	$5,030	61	$7,677	$197
	Single Family	$58,661	0	$0	24	$3,763	68	$9,483	144	$20,081	242	$42,854	$155
	Sub-Total	**$73,861**	**0**	**$0**	**45**	**$5,713**	**106**	**$13,880**	**193**	**$26,729**	**305**	**$53,204**	**$458**
	POV	$8,165	0	$0	34	$777	74	$1,906	166	$3,721	283	$7,318	$889
	Total	**$82,026**	**0**	**$0**	**79**	**$6,490**	**180**	**$15,786**	**359**	**$30,450**	**588**	**$60,522**	**$1,347**
Total	**Structure**	**$155,713**	**58**	**$1,085**	**520**	**$18,985**	**846**	**$41,273**	**1,149**	**$70,912**	**1,411**	**$130,287**	**$3,039**
Grand Total		***$179,993***	***93***	***$1,309***	***898***	***$22,271***	***1520***	***$48,981***	***2164***	***$83,878***	***2805***	***$151,915***	***$6,259***

Table 3-7
Total Single Event and Expected Annual Damages – Williamson Creek
($000s; December 2004 Price Level)

ACE Event			20%		10%		4%		2%		1%		0.20%		EAD
Reach and	Category	Structure Value	# Damage		# Damage		# Damage		# Damage		# Damage		# Damage		
Heartwood	Single-Family	$12,583	0	$0	0	$0	4	$161	20	$580	47	$1,500	146	$5,724	$87
	Multi-Family	$3,156	0	$0	0	$0	0	$0	0	$0	0	$0	3	$1,123	$9
	Sub-Total	**$15,739**	**0**	**$0**	**0**	**$0**	**4**	**$161**	**20**	**$580**	**47**	**$1,500**	**149**	**$6,847**	**$96**
	POVs	$1,027	0	$0	0	$0	4	$29	20	$102	47	$265	156	$1,027	$17
	Total	**$16,766**	**0**	**$0**	**0**	**$0**	**8**	**$190**	**40**	**$682**	**94**	**$1,765**	**305**	**$7,874**	**$113**
Radam	Single-Family	$15,089	0	$0	0	$0	5	$1,466	25	$2,184	53	$2,250	168	$7,510	$121
	Multi-Family	$776	0	$0	0	$0	0	$0	0	$0	0	$759	7	$206	$2
	Sub-Total	**$15,865**	**0**	**$0**	**0**	**$0**	**5**	**$1,466**	**25**	**$2,184**	**53**	**$3,009**	**175**	**$7,716**	**$123**
	POVs	$937	0	$0	0	$0	5	$243	25	$415	53	$577	179	$937	$22
	Total	**$16,802**	**0**	**$0**	**0**	**$0**	**10**	**$1,709**	**50**	**$2,599**	**106**	**$3,586**	**304**	**$8,653**	**$145**
Broken Bow	Single-Family	$9,382	0	$0	12	$382	27	$1,151	35	$1,999	48	$2,888	75	$5,680	$185
	Multi-Family	$230	0	$0	0	$0	1	$26	1	$49	1	$65	1	$105	$5
	Sub-Total	**$9,612**	**0**	**$0**	**12**	**$382**	**28**	**$1,177**	**36**	**$2,048**	**49**	**$2,953**	**76**	**$5,785**	**$190**
	POVs	$1,021	0	$0	9	$67	21	$208	39	$361	47	$521	76	$1,021	$33
	Total	**$10,633**	**0**	**$0**	**21**	**$449**	**49**	**$1,385**	**75**	**$2,409**	**96**	**$3,474**	**152**	**$6,806**	**$223**
Bayton Loop	Single-Family	$4,987	2	$181	12	$541	27	$1,466	35	$2,184	48	$2,954	64	$4,659	$267
	Multi-Family	$8,319	0	$0	3	$82	12	$377	19	$581	31	$893	49	$1,588	$68
	Sub-Total	**$13,306**	**2**	**$181**	**15**	**$623**	**39**	**$1,843**	**54**	**$2,765**	**79**	**$3,847**	**113**	**$6,247**	**$335**
	POVs	$1,157	0	$0	0	$0	5	$44	25	$141	53	$338	168	$1,157	$59
	Total	**$14,463**	**2**	**$181**	**15**	**$623**	**44**	**$1,887**	**79**	**$2,906**	**132**	**$4,185**	**281**	**$7,404**	**$394**
Sunset Valley	Single-Family	**1,662**	0	$0	2	$127	3	$265	7	$876	8	$1,098	15	$1,345	$139
	Sub-Total	**1,662**	**2**	**0**	**2**	**127**	**3**	**265**	**7**	**876**	**8**	**1,098**	**15**	**1,345**	**$139**
	POVs	$124	0	$0	3	$18	4	$44	6	$94	8	$109	8	$124	$9
	Total	**1,786**	**2**	**$0**	**5**	**$145**	**7**	**$309**	**13**	**$970**	**16**	**$1,207**	**23**	**$1,469**	**$148**
Structure	**Total**	**56,184**	**2**	**181**	**29**	**1,132**	**79**	**4,912**	**142**	**8,453**	**236**	**12,407**	**528**	**27,940**	**883**
Total		**$60,450**	**4**	**$181**	**32**	**$1,217**	**80**	**$5,480**	**171**	**$9,566**	**289**	**$14,217**	**772**	**$32,206**	**$1,023**

IDENTIFICATION OF ECOSYSTEM DEGRADATION

In order to identify the extent of degradation to the ecosystem, it was necessary to perform a habitat assessment of the study area. The methodology, as well as the results of the analysis, and the existing habitat values of the areas of interest is described within this section.

HABITAT EVALUATION

The United States Fish and Wildlife Service's Habitat Evaluation Procedure (HEP) was used to evaluate habitat conditions that would result from alternative plans. A habitat suitability index (HSI) for indicator species is derived by aggregating suitability indices (SIs) critical for habitat variables. These SIs are based on field measurements for existing conditions and on professional judgment for future conditions under alternative plans. The index ranges from 0.0 to 1.0, with 1.0 representing the highest habitat quality possible. A habitat unit (HU) is the product of the HSI multiplied by an area (acre) of available habitat. HSIs and HUs were developed for different times during the period of analysis (at year 1, 5, 15, 25, and 50), and HUs are annualized to estimate an average annual habitat unit (AAHU). Therefore, HEP provides information for two general types of wildlife habitat comparisons. The first is the relative value of different areas at the same point in time. The second is the relative value of the same area at future points in time. Therefore, the impact of land and water use changes on wildlife habitat can be estimated.

Evaluation of Riparian Habitat

For central Texas, the wooded uplands, prairie uplands, and riparian corridors work in unison to provide the habitat needs for many species of wildlife that call this unique part of Texas home. Upland areas in this part of the state are mostly prairie with some woodland consisting of legumes and other small and/or short-lived species. These wooded uplands do not typically progress to late successional woodlands because the climate of the area is not favorable for late successional species except where associated with riparian corridors. Therefore, many species of birds and other wildlife, which occupy upland habitats exclusively in other areas of the U.S., occupy the riparian areas of central Texas exclusively or in conjunction with the upland habitats. For many species, the riparian areas of central Texas are needed to meet the needs of their circadian and circannual rhythms. However, riparian areas of the region are small and less diverse than their northeastern counterparts; therefore, connection to upland woodlands is also important to provide the full range of habitat requirements of a species. Additionally, due to fragmentation of upland habitats, a riparian corridor serves as the only travel conduit for species to migrate to other habitats needed to complete their life requisites.

The USFWS, with assistance from the TPWD and the Fort Worth District, completed HEP for the without-project and with-project condition of riparian natural resources. Because the resource agencies are most concerned in the restoration of lost aquatic and riparian habitat functions, the focus was to use models containing variables measuring important components of riparian corridor structure. A review of the available models providing the variables necessary to build quality riparian habitat was undertaken. The team decided it was appropriate to measure the existing habitat value of the current vegetation state even though the restoration measures were for converting or restoring existing vegetation to riparian woodlands. The following indicator species were utilized for the habitat evaluations indicative of the mostly urban mammalian and avian species found within the Onion and Williamson Creek Watersheds. The species by cover type are as follows:

- Riparian Woodlands: raccoon, barred owl, fox squirrel, downy woodpecker
- Grasslands: red-tailed hawk, scissor-tailed flycatcher, eastern meadowlark
- Transitional Woodland: raccoon, scissor-tailed flycatcher, eastern cottontail
- Wetlands: raccoon, green heron, wood duck

It is important to understand that while these species are relatively common, their HSI models serve as good indicators of a healthy, functioning ecosystem and therefore provides a good basis for comparing outputs from alternatives plans. They should not be used to judge the importance or significance of those outputs in terms of habitat scarcity, connectivity or contribution to regional restoration planning.

An overall habitat evaluation was performed and the results are shown in a Planning Aid Letter dated October 11, 2002, in Appendix D, Fish and Wildlife Coordination Act, of the Onion Creek Report. A summary of the existing conditions by area of interest is provided below. In addition, the riparian woodland vegetative cover type was further broken down into parkland and riparian woodlands. These cover types generally are missing the needed understory to function as a high quality habitat. In order to assign habitat suitability to it, the team evaluated the models and decided that a parkland habitat exhibited about one half the value of the existing woodland value next to the parkland habitat. Therefore, one half of the riparian habitat suitability index was assigned to the existing value of parklands. Finally, residential cover types were assigned a value because they functioned much like a parkland cover type. There are large trees that provide minimal habitat without understory.

ENVIRONMENTAL SETTING OF AREAS OF INTEREST

A vegetation classification of each area of interest was developed using ArcMAP and a vegetation classification provided from the city of Austin. Acreages by vegetative cover were determined for the 1% ACE floodplain. The habitat suitability indices (HSI's) from the habitat evaluation and the acres of each existing vegetative cover were then used to determine the existing habitat units within each cover type (Table 3-10). The overall indices were of high quality except in certain areas of interest where there has been substantial degradation of the riparian zone due to existing development or clearing. It is noted, however, that while the analysis shows that an area has a high existing condition of a certain cover type like grassland, for example, the area may in fact have historically been riparian woodland that was converted to grassland, and would have a poor value as riparian woodland if it were measured against historical conditions instead of existing conditions. Each area of interest is described in detail below.

Table 3-10
Existing Habitat Suitability Indices and Habitat Units

Area of Interest	Riparian Woodland		Grassland		Shrubland/ Transitional		Wetland	
	HSI	HU	HSI	HU	HSI	HU	HSI	HU
Timber Creek	0.82	73	0.94	979	0.80	64	NA	NA
OCF/YB	0.80	286	0.71	524	0.93	55	NA	NA
Perkins Valley/Bluff Springs	0.89	47	0.71	250	NA	NA	NA	NA
Onion Creek Subdivision	0.55	94	0.56	359	0.85	32	NA	NA
Bear/Onion Confluence	0.76	248	0.79	73	0.83	42	0.86	3.4
Williamson Creek	0.53	77	0.57	22	0.78	57	NA	NA
Total		**825**		**2207**		**250**		**3.4**

Timber Creek

General

The Timber Creek area of interest is located in the lower end of Onion Creek watershed, east of Highway 183 from about Burleson Road northeast to State Highway 71. Farm Road 973 runs through the middle of the area. The Timber Creek Subdivision falls totally within the floodplain. This reach has been extensively farmed/grazed, and has little forest cover except along the riparian zone of Onion Creek. This reach has high soil/clay banks typical of the blackland prairie ecoregion, and a large deciduous canopy where it has been undisturbed. There are several sections of this stream where row-crops have been cut right up to the edge of the stream, leaving virtually no riparian zone. In other areas the riparian zone is large (more than 200 meters wide), dense and intact. The Bergstrom International Airport is also within this reach. The airport lands are managed mostly as grasslands. These grasslands, similar to the rest of the grasslands along Onion Creek, have relatively high SIs, but are comprised mostly of non-native invader species. In general, this reach is highly degraded from agricultural and grazing activities and appears to have areas susceptible to erosion due to a non-continuous and low-quality riparian zone. The Timber Creek area of interest contains approximately 18,000 linear feet of Onion Creek.

Riparian Resources

The Timber Creek area of interest covers about 1,466 acres within the 1% ACE floodplain and contains several habitat and non-habitat land use types, including:

Riparian Woodlands: 89 acres (6%)
Grasslands: 1,042 acres (71%)
Shrublands: 89 acres (6%)
Wetlands: 5 acres (0.3%)
Urban/bare soil: 241 acres (16%)

The riparian zones in this reach are mature stands of mast producing deciduous trees. The canopy has a high-density closure with very dense understory. The overall riparian woodland HSI value for the Timber Creek area of interest is 0.82 with 73 habitat units providing good habitat. The majority of the trees in these riparian areas were greater than twenty inches in diameter, which improved the overall habitat rating for raccoon cover and reproduction. Barred owl habitat was fair, though the relatively thick understory reduces cover and reproductive values. Similarly, fox squirrel habitat value for cover and reproduction was reduced by the relatively thick understory. Barred owls and fox squirrels require a more open understory.

Most of the grasslands along the creeks in the Timber Creek area have very high HSI values with an overall HSI value of 0.94, with 979 habitat units. The grasslands generally have dense ground cover and a mixture of grasses and forbs. The grasslands are adjacent to wooded riparian areas, providing good red-tailed hawk nesting and perching areas. A pair of nesting red-tailed and red-shouldered hawks was observed during site visits. Meadowlark habitat value is very good (0.82) because of the higher percentage of grass present in the areas. Scissor-tailed flycatcher habitat is high at all three sites. Habitat diversity in these areas is good; however, non-native invasive plant species dominate the grassland area and limit the habitat potential of these sites. Removing non-native species and restoring native grasses and forbs into the area could improve the habitat.

The shrubland sampled in Timber Creek had very good habitat for scissor-tailed flycatchers and eastern cottontails. There is good ground cover and a good mixture of forbs and grasses (above reference to grasses applies here also). There is a paucity of suitable denning habitat for raccoons, which lowered the habitat value for that species. Removing some of the non-native

invasive species and restoring native vegetation to the area could improve the overall diversity of the area. The overall HIS value of the shrubland is 0.80, with 64 habitat units.

Aquatic Resources

This reach of Onion Creek also retains water throughout the year. There are several deep pools that retain water throughout even most drought years. Several different species of fish have been observed during site visits of this segment. Large mouth bass, perch, and minnows species were all observed. The large floods have disturbed the habitat along and inside the creeks by leaving the trash from previous flood events in place. This disturbance is mainly because the habitat along the creek is densely vegetated in some areas. According to local residents, the creek has also been filled in from construction activities associated with the new bridge and underground storm water discharge lines. This area also incurs slumping from flood events due to high cut banks comprised of sandy soils. The vegetation has been completely removed from past agricultural, and with the sandy soil, the banks erode during high water events.

Onion Creek Forest/Yarrabee Bend

General

The Onion Creek Forest/Yarrabee Bend area of interest is east of I-35 and William Cannon Drive runs almost through the middle of the area. This area has experienced a high density of residential and commercial development within the 500-, 100- and 25-year floodplains, which has reduced the width of the riparian corridor. However, this segment of Onion Creek has average quality riparian areas with very mature cypress trees due to the fact it contain the Onion Creek Greenbelt. There are invasive species, such as Chinese Tallow, ligustrum and chinaberry, within the area of interest, which leaves room for improvement for fish and wildlife species. In addition, the cut bank side of the creek in this area is experiencing erosion, primarily due to the vegetation being removed from the tops of the banks. Reestablishing vegetation on these banks would help stabilize the banks, which would benefit the overall aquatics in the area. However, even with the state of degradation, due to the very large water dependant cypress trees, this area should be protected to the extent possible and would require substantial mitigation if impacted. This segment contains approximately 20,000 linear feet of creek.

Riparian Resources

The Yarrabee Bend area of interest covers about 1414 acres within the 100-year flood plain and contains several habitat and non-habitat land use types, including:

Riparian Woodlands: 358 acres (25%)
Grasslands: 738 acres (52%)
Transitional Woodlands: 105 acres (7%)
Wetlands: 3 acres (0.2%)
Urban/bare soil: 210 acres (15%)

The overall HSI value for riparian woodlands in Onion Creek Forest/Yarrabee Bend is 0.80 with 286 Habitat Units providing good habitat. However, the majority of the trees in these riparian areas were less than ten inches in diameter, which lowered the overall habitat rating for raccoon cover and reproduction. The barred owl habitat is fair, and the relatively thick understory reduces cover and reproductive values. Similarly, fox squirrel habitat value for cover and reproduction is reduced by the relatively thick understory. Barred owls and fox squirrels require a more open understory. Mast producers greater than or equal to 6 inches diameter at breast height (dbh) are fairly common throughout the woodlands, producing good food value for fox squirrels. Downy woodpecker habitat rated very well with an HSI value of 1.00.

The grasslands along the creeks in the Onion Creek Forest/Yarrabee Bend area are in good condition with an overall HSI value of 0.71, with 524 habitat units. The grasslands were adjacent to wooded riparian areas providing good red-tailed hawk nesting and perching habitat. However, the percent of herbaceous canopy and the lower amount of grass within the sample areas depresses red-tailed nesting success; therefore, these areas only provide fair habitat for red-tailed hawks. Meadowlark habitat value is similarly lower because of the lower herbaceous cover of grass present in the areas. The lower herbaceous cover also impacts scissor-tailed flycatcher habitat. Habitat diversity in these areas could be improved by establishing a few native tall grassland areas along the floodway grassland boundary with scattered shrubs and scattered brush piles.

The transitional woodland sampled in Onion Creek Forest/Yarrabee Bend had good habitat for raccoons, scissor-tailed flycatchers, and eastern cottontails. There was good ground cover and a good mixture of forbs and grasses. There are also many suitable refuge sites for raccoons. The overall HIS value for the shrubland is 0.93, with 55 habitat units.

Aquatic Resources

The aquatic resources in Onion Creek Forest/Yarrabee Bend are of pretty fair quality. The creek in this area retains water throughout the year in most all of the segment. There are many deep pools that retain permanent water throughout most drought years. The creek, as well as the deep pools seen during site visits, provides habitat for catfish, bass, sunfish, frogs, and water snakes. Most of the creek habitat in this area is protected from the Onion Creek Greenbelt, which follows the creek on one or both sides throughout most of the area. The main problem associated with water quality and habitat in this area is from flood events that cause the banks to slump off into the water, causing increased sediment loading and destruction of fish habitat.

Bluff Springs Road/Perkins Valley

General

The Bluff Springs Road/Perkins Valley area of interest is in the middle of the Onion Creek Country Club and the Onion Creek Forest/Yarrabee Bend Areas of Interest. It is directly east of Interstate Highway 35, and Slaughter Lane runs through the middle of the area.

Riparian Resources

Bluff Spring Road/Perkins Valley covers about 475 acres within the 100-year flood plain and contains several habitat and non-habitat land use types, including:

Riparian Woodlands: 54 acres (6%)
Grasslands: 352 acres (71%)
Shrublands: 17 acres (6%)
Urban/bare soil: 52 acres (16%)

This small stretch of Onion Creek is dominated by agricultural, rural residential, and some commercial land use. The riparian zone is continuous, but ranges from less than 30 meters to greater than 200 meters, with some areas that are mowed and/or cleared up to one bank of the stream. Since there is no dense residential development, the only activity within the riparian zone is row cropping and cattle grazing, which directly contributes to erosion and sedimentation from the steep soil banks where riparian vegetation has been removed. In general, the riparian zone in this area is poor to fair with many areas that are dominated by newer invasive species (most of the lower section), with some higher quality older communities interspersed (primarily in the upper end).

The overall HSI value for the riparian woodlands at Bluff Springs Road/Perkins Valley is 0.89 with 47 Habitat Units, providing very good habitat. The raccoon and barred owl require large diameter trees, which were fairly common throughout the woodlands. The trees in these riparian areas were large (many over 20 inches dbh), which increased the overall habitat rating for raccoon cover and reproduction and barred owl habitat. Mast producing trees greater than or equal to 6 inches dbh are fairly common throughout the woodlands, producing good food value for fox squirrels. Downy woodpecker habitat also rated very high overall 0.97 HSI (FWS 2002). The riparian woodlands that are established are of high quality; however, there are several areas along the creek where the riparian zone has been reduced due to agricultural practices. The fish and wildlife habitat would benefit from extending the riparian zone and creating a larger buffer zone.

The grasslands along the creeks in Bluff Springs Road/Perkins Valley are in fair condition with an overall HSI value of 0.71, with 250 habitat units. The grasslands are adjacent to wooded riparian areas, providing good red-tailed hawk nesting and perching habitat. However, the percent of herbaceous canopy and the lower amount of grass within the sample areas depresses red-tailed nesting success and, therefore, these areas provide only fair habitat for red-tailed hawks. Meadowlark habitat value is similarly lower (fair) because of the lower herbaceous cover of grass present in the areas. The lower herbaceous cover also impacts scissor-tailed flycatcher habitat. Habitat diversity in these areas could be improved by establishing a few native tall grassland areas along the floodway grassland boundary with scattered shrubs and scattered brush piles. As with many other grassland areas within the Onion Creek watershed, the herbaceous species were mostly non-native invasive species.

Aquatic Resources

The aquatic resources in Bluff Springs Road/Perkins Valley are limited by the intermittent nature of stream flow throughout the area. Throughout the area of interest there are several deep pools that retain permanent water throughout most years. These pools act as refuges for fish and aquatic macroinvertebrates. These creeks have evolved with this flow regime. The deep pools and the creeks when flowing provide habitat for catfish, bass, sunfish, frogs, and water snakes. The Slaughter Road Bridge has caused some adverse impacts to the stream. There are gullies underneath the bridge caused by soil erosion of the bare soil surface during rain events, which leads to increased sediment loading of the creek during rain events. Planting vegetation or placing rock rubble under the bridge could minimize erosion and provide habitat for fish and wildlife species.

Onion Creek Subdivision

General

The Onion Creek Subdivision area of interest begins at Interstate 35 (I-35) and ends just above Slaughter Creek. The area downstream of I-35 includes a large residential development and 3 golf courses that dominate this section of Onion Creek. The riparian zone in this reach is extremely narrow (less than 30 meters) and relatively non-functional, particularly within Onion Creek Subdivision, where the understory and much of the canopy cover has been cleared. This area needs an active riparian management strategy to reclaim the high potential value for riparian species.

Several raw banks have developed along the stream with little protective vegetation. The golf course has sustained major erosion and has stability problems throughout the floodplain. This area has been greatly altered and provides minimal habitat for fish and wildlife resources.

Restoration potential in this area is great, but there would more than likely be great opposition to the restoration, as the golf course would have to be closed to properly implement ecosystem restoration. The fairways and greens are within 10-20 feet from the creek in many places. In order to provide for valuable ecosystem restoration, a minimum of a 50-foot buffer would be recommended with over 300-foot being optimal.

Riparian Resources

The Onion Creek Subdivision covers about 971 acres within the 100-year flood plain and contains several habitat and non-habitat land use types, including:

Riparian Woodlands: 171 acres (18%)
Grasslands (includes golf course): 641 acres (66%)
Shrublands: 38 acres (4%)
Urban/bare soil: 121 acres (12%)

The riparian woodlands of the Onion Creek Subdivision area are probably the most degraded of all of the Onion Creek areas of interest, with an overall HSI value of 0.55, with 94 habitat units. According to local residents, the Onion Creek Country Club Golf Course removes trees when they show signs of distress. This practice, along with the management of the area as a golf course, has caused there to be very little true native riparian woodlands within the country club area. Along the south side of the creek, the riparian zone is relatively native riparian woodland with large stands of mature deciduous trees composed of pecan, cypress, and cedar elm trees. However, agricultural fields are directly adjacent to the riparian zone, offering very little wildlife edge effect. Directly downstream of the Onion Creek Subdivision, there is a very good

reference reach that shows what the undisturbed riparian zone should look like. There is a large riparian buffer zone even though residential development has extended right to the edge.

The grasslands along the creeks in the Onion Creek Subdivision are in poor condition with an overall HSI value of 0.56, with 359 habitat units. The grasslands are adjacent to wooded riparian areas, providing good red-tailed hawk nesting and perching habitat. However, the interspersion of urban impacts severely depresses red-tailed nesting success and, therefore, these areas do not provide good habitat for red-tailed hawks. Meadowlark habitat value is similarly lower (fair) because of the lower herbaceous cover of grass present in the areas. The lower herbaceous cover also impacts scissor-tailed flycatcher habitat. Habitat diversity in these areas could be improved by establishing a few native tall grassland areas along the floodway grassland boundary with scattered shrubs and scattered brush piles (FWS 2002).

The shrubland sampled in Onion Creek Subdivision had good habitat for scissor-tailed flycatchers and eastern cottontails. There is good ground cover and a good mixture of forbs and grasses (above reference to grasses applies here also). Removing some of the non-native invasive species and restoring native vegetation to the area could improve the overall diversity of the area. The overall HSI value of the shrubland is 0.85, with 32 habitat units.

Aquatic Resources

Onion Creek in this stretch of river is intermittent at times, but several large pools of water remain throughout most years. During site visits, several different species of fish were observed in the large pools including: large mouth bass, sunfish, and various species of minnows. Turtles, cricket frogs, leopard frogs, and snakes were also observed during the site visits.

The clearing of riparian habitat, especially the bottomland hardwoods, has affected the aquatic environment by raising water temperatures in some parts of the stream. Large growths of algae were noted along the stream. The management of the area as a golf course may be acting synergistically with the cleared canopy to promote high levels of algae growth. In other areas where the trees have not been cleared, habitat for fish is fair in value. Aquatic vegetation is established and fish communities are using the areas as spawning and rearing grounds.

Bear/Onion Confluence

General

The Bear/Onion Confluence area of interest is located near the confluence of Bear Creek and Onion Creek west of Interstate Highway 35. There are several older neighborhoods built on the isthmus between these two streams and on the banks of both streams.

Riparian Resources

Bear/Onion Confluence covers about 476 acres within the 100-year flood plain and contains several vegetation cover types, including:

Riparian Woodlands: 326 acres (68%)
Grasslands: 93 acres (20%)
Shrublands: 49 acres (10%)
Wetlands: 4 acres (0.8%)
Urban/bare soil: 4 acres (0.8%)

The riparian zone here is starting to take on more of an eastern character with flatter topography, soil/clay banks and large deciduous trees. The understory, for at least 20 meters on either side of Onion Creek, is well established and diverse. The canopy is dense, including

primarily pecan, walnut, cypress, and cedar elm. The extent of the riparian zone for both streams is about 75 meters on either side of the stream (150 meters total), but is encroached upon regularly by residential development. Outside the riparian zones, there is a mix of upland juniper and live oak, residential development and light agriculture and grazing. The habitat in this area is fair (Table 3-10).

The bottomland hardwoods in this area had an HSI value of 0.76 with 248 habitat units providing good habitat. A limiting factor in this area is the lack of trees over ten inches of diameter at breast height (dbh). In order to increase habitat units in this area, trees should be protected to allow them to grow in size. Extension of the riparian zone would also provide for better habitat diversity.

Most of the grasslands along the creeks in this area are in good condition with an overall HSI value of 0.79, with 73 habitat units. The grasslands generally had good ground cover and a fair to good mixture of grasses and forbs (FWS 2002). However, the mixtures of grasses and forbs were primarily nonnative invader species. One grassland site was a heavily grazed pastureland. The grasslands were adjacent to wooded riparian areas providing good red-tailed hawk nesting and perching. Habitat diversity in these areas could be improved by establishing a few native tall grassland areas along the floodway grassland boundary with scattered shrubs and scattered brush piles. It is believed that some of these grasslands are cleared riparian woodland communities and should be restored back as such.

The shrubland sampled in Bear/Onion Confluence had good habitat for scissor-tailed flycatchers and eastern cottontails. There is good ground cover and a good mixture of forbs and grasses (above reference to grasses applies here also). There is a paucity of suitable denning habitat for raccoons, which lowered the habitat value for that species. Removing some of the non-native invasive species and restoring native vegetation to the area could improve the overall diversity of the area. The overall HSI value of the shrubland is 0.83, with 42 habitat units.

Wildlife in this area is consistent of normal wildlife species in the Texas Hill Country. There is habitat that supports normal rodent and non-game species as well as game species. This area of interest is on the edge of the city of Austin where there is a substantial deer population utilizing the riparian zones. Non-game species include but are not limited to skunks, rabbits, opossums, raccoons, snakes, turtles and various birds.

Aquatic Resources

A couple of low water dams in this area of Interest have altered the natural channel of Onion Creek. Above the upstream dam the channel is flat and filled in with cobble and gravel. The gradient of Onion Creek from the top of the area of interest to the dam is very low. Water willow and other emergent vegetation are dominant in this wide flat section of the stream. Stream flow through this section typically goes subsurface by July with water found only in several deep pools throughout the area.

The second low water dam in this area is formed by the old low water crossing of the original San Antonio road. This old bridge is just upstream from the confluence of Bear Creek and Onion Creek. Onion Creek is a bedrock channel in this section of stream. The bridge creates a deep pool upstream and is a popular fishing spot. The pool holds water throughout most years. The bridge does act to back water up and the culverts beneath the bridge routinely clog with woody debris. Although these dams exist and have altered the natural channel, they have little if any effect on the hydrology or hydraulics during a flood event.

The aquatic resources in Bear/Onion Confluence are limited by the intermittent nature of stream flow throughout the area. This area lies directly below the recharge zone of the Barton

Springs segment of the Edwards Aquifer. The streams crossing the Edwards Aquifer recharge zone tend to go dry during the summer months because much of the flow is infiltrated into the aquifer through recharge features in the streambeds. There are several deep pools throughout the area of interest that retain permanent water throughout most years. These pools act as refuge for fish and aquatic macroinvertebrates. These creeks have evolved with this flow regime. The deep pools and the creeks when flowing provide habitat for catfish, bass, sunfish, frogs, and water snakes.

One wetland site was sampled on Onion Creek. The Site is just downstream of Old San Antonio Road and just upstream of Interstate Highway 35. According to the landowner, this wetland was enhanced by excavation 30 to 50 years ago. There is permanent water year round in this wetland. The overall HSI for this four-acre wetland was 0.86 with 3.4 habitat units (FWS 2002). This area is really outside of the area of interest and would not be affected by any of the proposed alternatives.

Williamson Creek

General

The identified areas of interest on Williamson Creek are densely developed with residential and commercial land uses, with an impervious cover of the entire watershed at 21 percent. It is expected that by year 2040, there will be 31 percent impervious cover of the watershed (Chan & Associates 1997). The upper portion of the area of interest is located in the recharge zone for the Barton Springs segment of the Edwards Aquifer. A small area downstream of the recharge zone is classified as a contributing zone because water flowing from this area actually flows into the recharge zone. The lower portion of the area of interest is in the artesian zone and does not contribute water to the Edwards Aquifer.

Williamson Creek is an intermittent stream while it crosses the recharge zone that routinely goes dry in the summer months and is typical of a hill country recharge zone stream. However, the lower end of the creek, starting in the lower Bayton Loop and Broken Bow areas, does retain water throughout most, if not all, of the year. Perennial pools that exist throughout the areas of interest provide valuable wildlife habitat and some pools provide limited fisheries between fluvial periods. According to local residents, the stream retained water further upstream in the past then it does today. The riparian habitat quality throughout this area of interest is poor to average. The riparian zone through Williamson Creek is narrow (less than 50 meters) and very disturbed. A sewer line runs through most of the area of interest and is located in the bottom of the streambed. There are numerous streambank erosion problems through this channel. The majority of the erosion within the active channel is related to the sewer line. However, there are several large raw banks that are actively eroding that are not related to the sewer line.

Riparian Resources

The Williamson Creek area of interest covers about 428 acres within the 100-year floodplain and contains several habitat and non-habitat land use types, including:

Riparian Woodlands: 145 acres (34%)
Grasslands: 38 acres (9%)
Shrublands: 73 acres (17%)
Urban/bare soil: 172 acres (40%)

The riparian vegetation in this area is dominated by mostly young invasive species of low habitat quality. Three invasive species, including Chinaberry, ligustrum, and Chinese tallow, are dominant along the floodplain throughout the area. Other tree species present include willow, pecan, sycamore, cottonwood, Ashe juniper, cedar elm, hackberry, and live oak.

Several of the smaller tributaries in this area have no riparian zone, while some of the headwaters are in their natural state with relatively large undisturbed and forested areas. In general, the riparian zone along this portion of Williamson Creek is of low quality and of minimal benefit to stream integrity. The habitat quality for wildlife resources is poor, however there is a great diversity of species. This is attributed to the cover value the riparian habitat provides along with the "wildscaping" of adjacent residents. There is potential for habitat restoration within this area; however, given the current density of urban development, restoration would be difficult. The area does provide habitat for typical urban riparian species. Signs of armadillos, deer, raccoons, and opossum are fairly numerous throughout the area. Cricket frogs and leopard frogs were observed during site visits. The area does provide some habitat for white-tailed deer. Herons, egrets and hawks are reported on an annual basis and other bird species seen during site visits included limited migratory waterfowl including wood ducks and neotropical migrants, which are listed in Appendix B, Addendum B-4.

Riparian woodland habitat was assessed at five sites along Williamson Creek. The overall HSI value for Williamson Creek is 0.53 with 77 habitat units providing fair habitat. However, the majority of the trees in these riparian areas are less than ten inches in diameter and mostly invasive species, which lowers the overall habitat rating for raccoon cover and reproduction. However, there are significant sized trees throughout Williamson Creek, as seen during site visits and preliminary tree surveys. Barred owl habitat is fair, and the relatively thick understory reduces cover and reproductive values. Similarly, fox squirrel habitat value for cover and reproduction is reduced by the relatively thick understory. Barred owls and fox squirrels require a more open understory. Mast producers greater than or equal to 6 inches dbh are fairly common throughout the woodlands, producing good food value for fox squirrels.

The grasslands along the creeks in Williamson Creek are in fair condition with an overall HSI value of 0.57, with 22 habitat units. The grasslands were adjacent to wooded riparian areas, providing good red-tailed hawk nesting and perching habitat. However, the interspersion of urban impacts severely depresses red-tailed nesting success and, therefore, these areas do not provide good habitat for red-tailed hawks. Meadowlark habitat value is similarly lower (fair) because of the lower herbaceous cover of grass present in the areas. The lower herbaceous cover also impacts scissor-tailed flycatcher habitat. Habitat diversity in these areas could be improved by establishing a few native tall grassland areas along the floodway grassland boundary with scattered shrubs and scattered brush piles.

The shrublands in the area have good habitat for scissor-tailed flycatchers and eastern cottontails. There is ground cover and a good mixture of forbs and grasses. There was a paucity of suitable denning habitat for raccoons, which lowersd the habitat value for that species. The overall HIS value for shrublands is 0.78, with 57 habitat units.

Aquatic Resources

This area lies upon the recharge zone of the Barton Springs segment of the Edwards Aquifer. Streams crossing the Edwards Aquifer recharge zone tend to go dry during the summer months because much of the flow is infiltrated into the aquifer through recharge features in the streambeds. This stream section typically goes dry throughout the area, but retains water throughout the lower portions of the stream near the confluence. This area probably serves as a migration area for fish that are spawning and rearing. Fish and aquatic insects are quick to populate the area when stream flows are present. These fish and insects either move upstream from perennial water sources or move downstream from deep pools that may hold water throughout the year. Frogs and toads are fairly common throughout this area; however, these species do not need permanent water throughout the year.

In the past, there have been some water quality problems with the sewer lines running down the streambed. During times of high water, the stream flows over the top of the manholes and the pressure from the current removes the covers and raw sewage leaks into the stream. According to the City of Austin, this problem has been corrected to the best of their knowledge by fastening the covers down with screws. Williamson Creek was removed from the 2002 TCEQ Impaired Stream List.

EXISTING DEGRADATION TO THE ECOSYSTEM

Riparian woodlands occur in the transition zone between aquatic and upland ecosystems. Riparian woodland systems are considered to be Texas' most diverse ecosystem. Prior to European settlement, Texas had approximately 16 million acres of bottomland hardwood riparian habitat. Today, the state has less than 5.9 million acres (Texas Center for Policy Studies 1995).

Riparian woodlands serve a variety of important functions. They contribute to the state's biodiversity. According to the Texas Environmental Almanac (1995), 189 species of trees and shrubs, 42 woody vines, 75 grasses, and 802 herbaceous plants occur in Texas' bottomlands. They are also known to support 116 species of fish, 31 species of amphibians, 54 species of reptiles, 273 bird species and 45 mammals. At least 74 species of threatened and endangered animals depend directly on bottomland hardwood systems and over 50 percent of neotropical songbirds are associated with these systems. In addition to providing critical wildlife and bird habitat, riparian woodland systems: 1) serve as catchments and water retention areas in times of flooding; 2) help control erosion; 3) contribute to the nutrient cycle, and 4) play a vital role in maintaining water quality by serving as a depository for sediments, wastes and pollutants from runoff. Despite these important functions, riparian woodland ecosystems are one of the most endangered ecosystems in the United States (MacDonald et al. 1979). For all of these reasons, losses of the riparian woodland vegetation system are of great environmental concern in the analysis of the project area.

According to the Texas State Almanac (1995), interior wetlands which include bottomland hardwood forests, riparian vegetation, inland freshwater marshes, and the playa lakes of west Texas account for 80 percent of the total wetland acreage in Texas and the vast majority are located on private property. In the last 200 years, Texas has lost over 60 percent of these inland wetlands due to agriculture conversion, timber production, reservoir construction and urban and industrial development. Therefore, there is a need to restore as many of these wetlands, including riparian woodlands, as possible. This is especially true in urban areas where a large portion of the riparian zone has been lost and only small fragmented portions of low quality exist today. Much of the land within the proposed project area, especially Williamson Creek, has been highly disturbed by human activities that have altered the topography of the landscape. These include construction of roads and instream sewer lines, mining of gravel by commercial business enterprises, and construction activities associated with encroaching industries, commercial businesses, residential neighborhoods, and parklands.

There has been a large amount of urban and rural development in the Onion and Williamson Creek watersheds within the last fifty years. This has markedly reduced the overall width and quality of the riparian corridor in the watersheds degrading wildlife habitat and aquatic resources. Riparian woodlands improve the aquatic habitat and overall aquatic resources in a riverine system. They also serve as buffer zones to help remove harmful pollutants and nutrient loading of an aquatic system, serve as depositories for sediments, help stabilize the banks of creeks to prevent scour and erosion and decrease sedimentation and turbidity of aquatic resources, provide shade which lowers water temperatures which in turn helps keep dissolved oxygen levels higher serve as spawning and rearing habitat for fisheries, and serve as corridors for other wildlife resources.

In addition to the direct loss of riparian woodland habitat, there has been a further degradation to riparian habitat due to proliferation of invasive species such as ligustrum, Chinese tallow, and chinaberry. Nonnative species typically occur in disturbed areas where native species take longer to reestablish. Once established, they proliferate and result in monotypic stands of vegetation, which leads to a decrease in diversity and richness.

The quality of the water that is recharging the Barton Springs segment of the Edwards Aquifer has been degrading over time. Williamson and Onion Creeks both contribute recharge to the Edwards Aquifer and to Barton Springs, the only known habitat of the Barton Springs salamander and water quality is an issue in both of those creeks. Water quality is the main factor in the species decline of the Barton Springs and Austin blind salamanders. Since these species rely on high water quality to survive and are very sensitive to changes in water quality, water quality is the most degraded niche of their habitat.

IDENTIFICATION OF EXISTING RECREATIONAL RESOURCES

RECREATION SURVEY AND EXISTING DEMAND

As described in Chapter 2, there are currently numerous local, county and state recreational facilities in the greater Austin area and around the areas of interests. Since existing recreational facilities exist, both the city of Austin and Travis County requested that a recreation survey be conducted to determine recreation demand if proposed projects would implement recreational features as part of a project alternative. This was conducted to see if the existing facilities meet the existing demand. While it is known that there is a very high demand for recreation in Travis County, the demand had not previously been quantified. To be certain that the recreation planning met the demands of the residents, the Corps of Engineers and its partners designed and contracted a recreation needs study that covered all of Travis County. Detailed results of the survey design and results are contained in the Recreation Appendix (Appendix F).

Results of the recreation survey show that there is latent demand for several types of recreation, meaning not enough of these types of facilities exist to support the demand. The results show that trail based recreation is by far the most in demand. It accounts for more than half the annual recreation demand calculated from the survey results. The total demand for all types of recreation in the Yarrabee Bend and Timber Creek areas alone is 15.6 million annually. Of that, some 8 million trips (52%) would be trail based if the facilities were available.

Picnicking activities, outdoor cultural activities, and playground use shared a total of 36% of the demand for recreation along with open field sports like baseball and basketball. Sports courts activities made up the remaining 11% of recreation demand.

FUTURE WITHOUT PROJECT CONDITIONS

In order to effectively evaluate alternatives for a proposed project that would be implemented, it was necessary to forecast likely future conditions if no project were to occur. These conditions, known as future without project conditions, were measured against all proposed alternatives.

In the absence of any type of flood damage control project, the problems experienced in some Austin and Travis County neighborhoods as a result of Onion and Williamson flooding would continue. It is anticipated that growth and development in the watersheds would continue. As a result, there would be additional construction and increased amounts of imperious surfaces such as roads, parking lots, and structures. As mentioned earlier, the increase in future

impervious cover would increase from 6.6% to 18.1% for Onion Creek and 21% to 31% for Williamson Creek. This would add to the runoff within the creeks and would typically increase the severity and/or frequency of the flood problems within those neighborhoods currently affected by flooding problems and would likely increase the number of structures inundated; however, the city of Austin has an extensive storm water management ordinance which would reduce the impacts from future impervious cover. According to the Onion Creek Soil Erosion Assessment, it is estimated that with proper stormwater management, the instream erosion potential would average 13% over existing conditions and 50% without it. This would lead to continued degradation of the aquatic resources of Onion and Williamson Creeks. Although the peak flows would be reduced, increased construction and increase of impervious cover would contribute to increases in sediment transport and turbidity from construction activities. These increases would not affect the existing riparian zone to the point that riparian woodland restoration activities would not be sustainable. To the contrary, riparian woodland restoration would help offset some of these impacts from future impervious cover. Riparian woodlands serve as buffer zones to construction sites to help filter pollutants that enter the waterways. In addition, they help to attenuate flooding, although this would be expected to be very minor on Onion and Williamson Creeks.

It would be expected that without restoration measures and probably even with restoration measures to a certain extent, water quality in Onion and Williamson Creeks would degrade slightly to moderately in the future as the Travis County continues to develop. The construction phase of new residences and businesses would produce additional sediment load from runoff from construction sites. After completion, the increases in impervious surface area, traffic, lawn fertilizing and other human activities would have an adverse impact on the creeks. Degradation of the water quality would reduce the numbers of aquatic biota in the creeks. The overall diversity of fishes and other aquatic species is already low according to USFWS; the further loss of aquatic biota would therefore be damaging to the aquatic ecosystem. It would be expected that the cities of Austin and Sunset Valley would continue to require new developments to construct sediment quality ponds as developments occur to help offset some of these damages.

Encroaching urban and rural development activities is expected to also negatively impact the watershed's existing vegetation. As mentioned earlier, the existing forested riparian vegetation zone within much of the watershed is already very narrow with several grass and shrub openings. The number and size of the openings would continue to increase and there would be fewer acres of forest in the future. The loss of habitat, particularly the bottomland hardwoods would reduce the numbers of wildlife and bird species within the watershed. This is especially true for migratory songbirds listed in Addendum 4, which are particularly susceptible to the loss of habitat along their migration routes.

The City of Austin has a Water Quality Ordinance that protects lands that have not been platted for development prior to 2001. This ordinance requires a 400-foot setback from the center of the creek where no vegetation can be removed. Areas that were previously platted are not required to have the setback, but this should protect vegetation in areas that have not been platted along creeks and streams. Riparian woodlands areas along creeks, such as Williamson, which are already maintained as park like settings instead of densely vegetated areas are expected be continually maintained as such.

The only other scenario that can be reasonably foreseen in the Onion and Williamson Creek watersheds should implementation of the proposed plan fail to occur is that the cities of Austin and Sunset Valley and Travis County would choose to implement a non-structural buyout project sometime in the future. This would allow for the structures to be removed and the lots be maintained in their current vegetative state. Large trees would still exist, but the wildlife habitat gains would not be seen as the areas would continue to be mowed if they are located in subdivisions because of Texas nuisance ordinances. The areas would function similar to the parkland habitat and would improve habitat quality in the area if large continuous blocks were

purchased because of the lack of human presence. If large continuous segments were purchased, they could also be turned into parks or greenbelts and allowed to return to a more natural state with underbrush, which would significantly improve habitat quality. For purposes of these analyzes, it was assumed that vegetation would be maintained in its current condition. If this were to happen due to the fact that the local parks department has not taken control of existing lands that were bought out in the area for flood damage reduction purposes several years ago. This process would continue over decades as the cities and counties have a limited budget and the proposed project is an approximately $70 million dollar buyout project. If the city of Austin allocated 100% of their funds to this area and neglected other parts of the city, it would take approximately 20 years to complete the buyout without special bond elections. In addition, it would be highly unlikely that the city council would implement condemnation to ensure all of the structures were bought out, unless required to do so in order to receive some type of state or Federal assistance. Therefore, the purchase of continuous blocks would not be viable if there were even a few unwilling home owners to accept voluntary buyouts. Projections of future without project conditions are shown later in this document.

The increased impervious cover and increased residential subdivisions would continue to impact the Edwards Aquifer and the Barton Springs. Increased impervious cover limits infiltration into the aquifer and reduces storage capacity of the watershed. Barton Springs would see increased periods of low flows, which would further endanger the Barton Springs salamander and the Austin blind salamander. In addition, water quality would be reduced as mentioned above and therefore the quality of water in the aquifer and Barton Springs would continue to be degraded. Degraded water quality and quantity is the primary factor affecting the Barton Springs and Austin Blind salamanders. The Barton Springs/Edwards Aquifer Conservation District is directed to conserve, protect and enhance the groundwater resources of the Barton Springs segment of the aquifer. They help limit impacts to these resources, but impacts are occurring non-the-less and would continue under the future without project conditions. There are impervious cover regulations over the recharge zone to help reduce these impacts, but continued degradation is still projected over time.

IDENTIFICATION OF NEEDS AND OPPORTUNITIES

FLOODING NEEDS AND OPPORTUNITIES

As demonstrated in the above sections of this chapter, there is a significant existing flooding problem within the Onion and Williamson Creek Watersheds. As shown in Tables 3-6 and 3-7, 1,385 structures would experience first floor flooding from a 1% ACE event. Not only is this a very large economic burden when such an event occurs, there is public heath and safety concern since there is very little warning before flood events in the Texas hill country. According to the future without project conditions, these conditions will likely continue if not worsen in the future. Therefore, there is definitely a need to reduce these flood damages in Onion and Williamson Creeks as well as reduce the risk of loss of life from flood events.

ECOSYSTEM NEEDS AND OPPORTUNITIES

Ecosystem Needs

Since the riparian woodlands of Williamson and Onion Creeks have been degraded due to residential development and urbanization, there is a need to restore this riparian woodland habitat to improve the overall aquatic habitat of both creeks. Furthermore, since the existing riparian habitat is being even further degraded by proliferation of invasive species such as ligustrum, Chinese tallow, and chinaberry, there is a need to remove these invasive species to the extent practical. Finally, with water quality being the main reason factor in the species decline of the

Barton Springs and Austin blind salamanders, there is a need to improve water quality in both of these creeks.

Ecosystem Restoration Opportunities

There are multiple ecosystem restoration opportunities in the Onion and Williamson Creek watersheds. They range from riparian ecosystem restoration to endangered species habitat improvement. It was decided that proposed restoration opportunities for Williamson Creek should be concentrated on lands along Williamson Creek that connect other city owned lands to provide connectivity for an extensive riparian corridor or greenbelt. Due to cost constraints, the assumption was made for both creeks that houses would not be bought specifically for restoration purposes. However, if a proposed non-structural alternative is a preferred alternative as part of the Federal plan, then the excess land could be utilized as restoration areas to provide a wider riparian corridor. Currently the existing houses are a limiting factor for restoration opportunities since they extend well into the 4% ACE floodplain and most of the time homeowners maintain the existing riparian corridor as lawn all the way to the creek. Ecosystem Restoration Opportunities are provided below.

- Restore riparian woodland habitat along Onion Creek and Williamson Creek on public property where it has been completely lost

- Purchase lands adjacent to the creeks and perform riparian woodland habitat restoration to improve the aquatic habitat in the creek

- Restore habitat for the Barton Springs and Austin blind salamanders and well as other karst species by increasing water quantity and restoring water quality being recharged into the aquifer

Hazardous, Toxic and Radioactive Wastes

Based on the ESA report findings and field observations there are no real HTRW concerns that need to be addressed.

RECREATIONAL NEEDS AND OPPORTUNITIES

Development of recreation facilities in not a main Corps mission and therefore cannot be a stand alone project purpose. However, there is an opportunity with this Interim Feasibility Study to investigate the construction of recreation facilities in association with other project related purposes such as flood damage reduction and ecosystem restoration.

As mentioned earlier, results of the recreation survey show that there is latent demand for several types of recreation, meaning not enough of these types of facilities exist to support the demand. The results show that trail based recreation is by far the most in demand. It accounts for more than half the annual recreation demand calculated from the survey results. The total demand for all types of recreation in the Yarrabee Bend and Timber Creek areas alone is 15.6 million annually. Of that, some 8 million trips (52%) would be trail based if the facilities were available.

Picnicking activities, outdoor cultural activities, and playground use shared a total of 36% of the demand for recreation along with open field sports like baseball and basketball. Sports courts activities made up the remaining 11% of recreation demand.

DEVELOPMENT OF PROBLEM STATEMENT

Based on an analysis of the water resource problems, needs, and opportunities as identified during the initial phases of the study, a problem statement was developed for the Onion Creek Watershed.

The environmental and water resource related problems within the Onion Creek watershed are:

1. Over 1385 structures would receive first floor damages during a 1% ACE event on Onion and Williamson Creeks. The health, safety, and welfare of a significant number of Travis County residents are at risk.

2. Expected Annual Damages flood damages are estimated at 6.4 million dollars annually.

3. The environment has been degraded from historical urbanization and development pressures. The creeks are generally stable from a hydrological and hydraulic standpoint, and this is not expected to change significantly in the future; however, there has been a substantial direct loss of riparian habitat within the Onion and Williamson Creek Watersheds.

4. Riparian habitat has been degraded from the proliferation of invasive species such as ligustrum, Chinese tallow, and chinaberry, which has resulted in less diversity within the Onion and Williamson Creek Watersheds.

5. There is a lack of sufficient passive recreation facilities to meet the demands of the growing population.