FOURMILE CANYON CREEK AND WONDERLAND CREEK MAJOR DRAINAGEWAY PLANNING

FINAL PLAN

May 2011

UPDATED February 2017
NOTE: updates were not made to implementation plan or costs.

CITY OF BOULDER

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

FOURMILE CANYON CREEK AND WONDERLAND CREEK
MAJOR DRAINAGEWAY PLANNING
FINAL PLAN

March 2011

UPDATED February 2017

Prepared by:

City of Boulder
Department of Public Works
Utilities Division

Based on:

Fourmile Canyon Creek and Wonderland Creek Major Drainageway Planning
Phase A Report Alternatives Analysis May 2007
Prepared by Belt Collins West

EXECUTIVE SUMMARY

Fourmile Canyon Creek begins in the foothills west of Boulder, has a tributary watershed area of just over ten square miles and flows for approximately 11 miles before discharging to Boulder Creek. The majority of the western half of the Fourmile Canyon Creek study reach is located within city limits with the exception of private property within unincorporated Boulder County located between 19th Street and 26th Street. The eastern half of the study reach is located predominantly outside city limits in Boulder County. The Fourmile Canyon Creek study reach is predominately residential development with some commercial properties located near Broadway.

Wonderland Creek begins at Wonderland Lake and has a tributary watershed area of approximately two square miles. The creek flows southeast through the city to a discharge point into Goose Creek near Pearl Street. The majority of the Wonderland Creek study reach is located within city limits. The exception is the subdivision of Githens Acres that is located in unincorporated Boulder County between 26th Street and 19th Street. The creek flows through primarily residential development, with many of dwelling units multi-family in the eastern portion of the study area.

Fourmile Canyon Creek and Wonderland Creek have been extensively studied beginning with major drainageway planning studies developed in the 1980's. Subsequent studies were prepared in the late 1990's and again in 2002. The city commissioned a Letter of Map Revision (LOMR) for both creeks in 2006. The LOMR was submitted to FEMA in March 2006 and approved by FEMA in November 2006. The new floodplains became regulatory following the appeal period in late March 2007.

The LOMR submittal for these two creeks identified a major flood flow spill from Fourmile Canyon Creek during large rainfall events. The spill, located approximately between Broadway and 19th Street, effectively doubles the peak 100-year event flows in Wonderland Creek. As a result of the significant changes to the recognized stream hydrology, the city with the Urban Drainage and Flood Control District (UDFCD) commissioned a Phase A major drainageway planning study for both creeks. The Phase A Study was completed in 2007 and has undergone an extensive public process. The public process resulted in numerous changes to the Phase A Study recommendations. The Phase A Study with staff modifications was accepted by City Council in November 2009.

This Final Plan report documents the recommendations accepted by Council and presents a summary overview of the hydrologic and hydraulic modeling efforts, damage analysis, development and evaluation of alternatives and other planning processes used to develop the Phase A Study. Readers are encouraged to reference the 2007 Phase A Study for a detailed description of each of these topics.

The Final Plan is meant only to provide a long-range plan for future flood mitigation projects along Fourmile Canyon Creek and Wonderland Creek. Each proposed flood mitigation projects will be evaluated and refined through the city's Community and Environmental Assessment Process (CEAP) and Capital Improvement Program (CIP) processes.

The following table presents a summary of the Final Plan recommendations for Fourmile Canyon Creek and Wonderland Creek along with total estimated concept-level public costs excluding maintenance. The city has developed a recommended implementation plan. The recommended implementation plan

Recommendations revised, please see Section 10.1 for detailed information.

Final Plan Recommendations Fourmile Canyon Creek and Wonderland Creek

Stream Reach	Final Plan Recommendation	Estimated Public Cost[2]
Fourmile Canyon Creek		
Reach 6c: City limits to Lee Hill Drive	Maintain Existing Conditions	$0
Reach 6b: Lee Hill Drive to 7th Street	High Hazard Containment and Floodproofing[1]	$141,000
Reach 6a: 7th Street to Broadway	High Hazard Containment and Floodproofing[1]	$2,551,000
Reach 5: Broadway to Violet Avenue	High Hazard Containment and Floodproofing[1]	$120,000
Reach 4: Violet Avenue to 26th Street	High Hazard Containment and Floodproofing[1] with Safe Access to Crestview Elementary School via 19th Street and Upland Avenue	$4,094,000
Reach 3: 26th Street to 28th Street	High Hazard Containment and Floodproofing[1]	$2,077,000
Reach 2b: 28th Street to 30th Street	In Boulder County, no Final Plan recommendation (Phase A Study recommends 100-year Containment)	$0
Reach 2a: 30th Street to Pleasant View Soccer Fields	In Boulder County, no Final Plan recommendation (Phase A Study recommends Maintaining Existing Conditions)	$0
Reach 1b: Pleasant View Soccer Fields to BNSF Railroad	Maintain Existing Conditions	$0
Reach 1a: BNSF Railroad to Boulder Creek	In Boulder County, no Final Plan recommendation (Phase A Study recommends High Hazard Containment with Floodproofing)	$0
	Total:	$8,983,000
Wonderland Creek		
Reach 8: Wonderland Lake to Broadway	Maintain Existing Conditions	$0
Reach 7: Broadway to 19th Street	Safe Access to Crestview Elementary School via 19th Street	$30,000
Reach 6: 19th Street to 26th Street	High Hazard Containment with Floodproofing[1]	$2,310,000
Reach 5: 26th Street to 28th Street	High Hazard Containment with Floodproofing[1] unless substantial outside funding is provided for 100-year Containment	$119,000 (HHZ), $3,620,000 (100-yr)
Reach 4: 28th Street to Diagonal Highway		$3,283,000 (HHZ), $4,252,000 (100-yr)
Reach 3: Diagonal Highway to Foothills Parkway		$5,816,000 (HHZ), $6,575,000 (100-yr)
Reach 2: Foothills Parkway to Valmont Road	Maintain Existing Conditions	$0
Reach 1: Valmont Road to Goose Creek	Maintain Existing Conditions	$0
	Total:	$11,558,000 (HHZ), $16,787,000 (100-yr)
	Total Both Creeks:	$20,541,000 (HHZ), $25,770,000 (100-yr)

[1] Recommended floodproofing is the responsibility of the property owner
[2] Includes ROW acquisition, construction costs and 40% contingency (does not include operation and maintenance costs or costs not required for flood mitigation such as trails)

segments do not always coincide with the Final Plan reach designations. It should also be noted that Fourmile Canyon Creek Final Plan reaches 6c, 2b, 2a, 1b and 1a and Wonderland Creek Final Plan reaches 1, 2, and 8 are either located in Boulder County or recommended for maintaining existing conditions and therefore are not included in the project implementation plan.

Three Final Plan recommendations are in the city's 2010-2014 Capital Improvement Program (CIP) budget. Wonderland Creek Reach 3 (Foothills Parkway to the Diagonal Highway) recommended improvements are ranked the highest priority flood CIP project. Fourmile Canyon Creek Reach 4 (Topaz to just upstream of Violet Avenue) is the second ranked priority flood project.

The following table presents the recommended implementation plan for Fourmile Canyon Creek and Wonderland Creek. There are five recommended segments for each creek. The tables identify the recommended segments in relationship to the Final Plan reach. Segment improvements along with summary costs are also presented. It should be noted that for Wonderland Creek Reaches C, D and E two sets of itemized costs are presented, one for High Hazard Containment only and one for 100-year containment improvements. Two sets are presented because City Council approved recommendation of 100-year containment if substantial outside funding could be secured.

Implementation Plan - not updated

Implementation Plan Recommendations Fourmile Canyon Creek and Wonderland Creek

Plan Segment	Segment Location	Final Plan Reach	Mitigation	Estimated Cost[1]
Fourmile Canyon Creek				
A	26th Street crossing upgrade	Upstream end of Reach 3	26th St. bridge replacement	$650,700
B	Just downstream of 19th Street to just upstream of Violet Avenue	Upper ¼ of Reach 4	Provide safe access to Crestview School	$1935000
C	Just upstream of 26th Street to just downstream of 19th Street crossing	Lower ¾ of Reach 4	HHZ Containment	$2,444,200
D	Just upstream of Violet Avenue to Broadway	Reach 5	Violet crossing upgrades	$349,800
E	Upstream of Broadway	Reach 6a and 6b	HHZ Containment	Developers responsible for costs
			Fourmile Canyon Creek Total Costs	**$5,378,000**
Wonderland Creek				
A	Foothills Parkway to 34th Street	Downstream ½ of Reach 3	100-yr Containment	$2,644,000[2]
B	34th Street to Diagonal Highway	Upstream ½ of Reach 3	100-yr Containment	$2,373,000[2]
C	Diagonal Hwy to just downstream of Kalmia	Downstream ½ of Reach 4	HHZ Containment	$1,922,800
			100-yr Containment	$2,701,100
D	Downstream side of Kalmia to upstream side of Winding Trail (28th Street crossing)	Downstream end of Reach 5, upstream ½ of Reach 4	HHZ Containment	$1,456,000
			100-yr Containment	$3,559,600
E	19th Street crossing to upstream side of Winding Trail	Reaches 5 and 6	HHZ Containment	$2,786,200
			100-yr Containment	$5,083,000
			Wonderland Creek Total HHZ Containment	**$9,977,000**
			Wonderland Creek Total 100-yr Containment	**$16,360,700**

[1] Includes flood mitigation, trails and ROW costs. It does not include estimated operation and maintenance costs or high hazard zone property acquisition costs.
[2] Costs from 2010 Wonderland Creek Foothills Parkway to the Diagonal CEAP

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1.0 INTRODUCTION

Fourmile Canyon Creek begins in the foothills west of Boulder, is approximately 11 miles long and has a tributary watershed area of just over ten square miles. Fourmile Canyon Creek discharges to Boulder Creek. Wonderland Creek begins at Wonderland Lake, has a tributary watershed area of just over two square miles and flows east to Goose Creek.

The two creeks have been extensively studied beginning with major drainageway planning studies developed in the 1980's. Subsequent studies were prepared in the late 1990's and again in 2002. The city commissioned a Letter of Map Revision (LOMR) for both creeks in 2006. The LOMR was submitted to FEMA in March 2006 and approved by FEMA in November 2006. The new floodplains became regulatory following the appeal period in late March 2007.

The LOMR submittal for these two creeks identified a major flood flow spill from Fourmile Canyon Creek during large rainfall events. The spill, located approximately between Broadway and 19th Street, effectively doubles the peak 100-year event flows in Wonderland Creek. Specifically, during the 100-year flood event, approximately 3,300 cubic feet per second (cfs) is in Fourmile Canyon Creek near the mouth of the Canyon, of this amount approximately 1,600 cfs will overtop the south bank spill and flow toward Wonderland Creek. The remaining 1,700 cfs will remain in the Fourmile Canyon Creek Channel. Likewise, the 100-year discharge in Wonderland Creek significantly increases downstream of the spill inflow. Some of the spill flows return to Fourmile Canyon Creek near 19th Street but the majority of the spill remains in the Wonderland Creek floodplain.

As a result of the significant changes to the recognized stream hydrology, the city with the Urban Drainage and Flood Control District (UDFCD) commissioned a major drainageway planning study for both Fourmile Canyon Creek and Wonderland Creek – herein after named Phase A Study. The Phase A Study was completed in 2007 and has undergone an extensive public process. The public process resulted in numerous changes to the Phase A Study recommendations. The Phase A Study with staff modifications was accepted by City Council in November 2009. This report documents the recommendations accepted by Council – herein after named Final Plan. The Final Plan is meant only to provide a long-range plan for future flood mitigation projects along Fourmile Canyon Creek and Wonderland Creek. Each proposed flood mitigation projects will be evaluated and refined through the city's Community and Environmental Assessment Process (CEAP) and Capital Improvement Program (CIP) processes.

2.0 STUDY AREA DESCRIPTION

The study area includes the Fourmile Canyon Creek floodplain from the mouth of the canyon to its confluence with Boulder Creek and the Wonderland Creek floodplain from Wonderland Lake to its confluence with Goose Creek. **Figure 2.1** presents the study reaches.

Fourmile Canyon Creek begins in the foothills west of Boulder, is approximately 11 miles long and has a tributary watershed area of just over ten square miles. Fourmile Canyon Creek has an overall channel slope of approximately 2% and discharges to Boulder Creek after dropping approximately 400 feet in elevation over the study reach. The Fourmile Canyon Creek study reach is predominately residential development with some commercial properties located near Broadway. With the exception of some in-fill and redevelopment, future land use will remain very similar to current land use conditions. As shown in **Figure 2.1**, the majority of the western half of the Fourmile Canyon Creek study reach is located within city limits with the exception of private property within unincorporated Boulder County located between 19th Street and 26th Street. The eastern half of the study reach is located predominantly outside city limits in Boulder County. The City of Boulder Parks and Recreation Department owns four separate parcels along Fourmile Canyon Creek. Foothills Community Park is located on the south bank of Fourmile Canyon Creek north of Wonderland Lake. The Violet Park site is a currently undeveloped parcel located along the south bank between Broadway and Violet Avenue. The Elk's parcel is another undeveloped park site located along the north bank of the stream between 26th and 28th Streets. A soccer field complex is located south of Fourmile Canyon Creek on the west side of 47th Street.

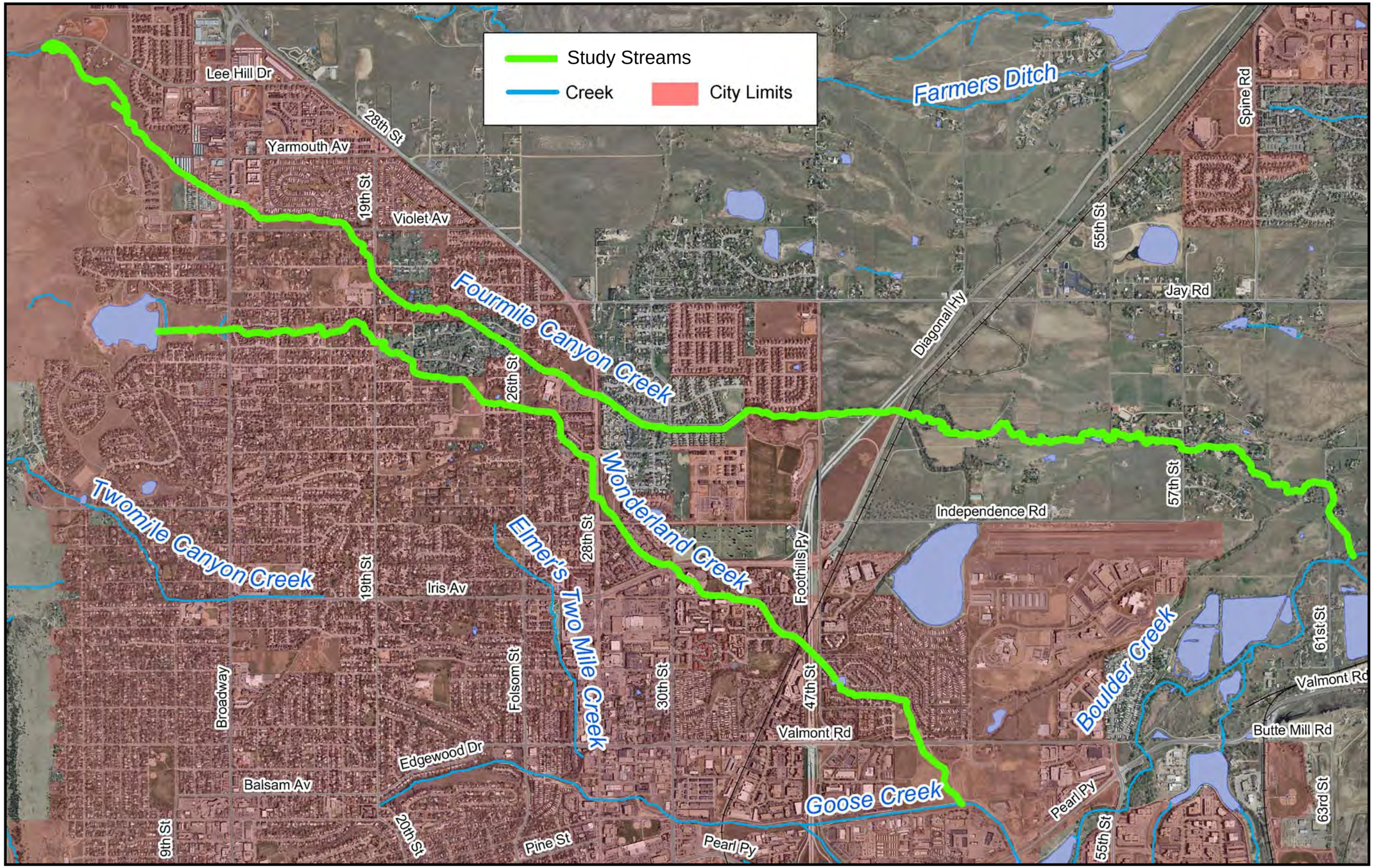
Wonderland Creek begins at Wonderland Lake and has a tributary watershed area of approximately two square miles. The creek flows southeast through the city to a discharge point into Goose Creek near Pearl Street. Most segments of the Wonderland Creek channel have been modified to provide what was once considered 100-year conveyance capacity. Wonderland Creek, however, receives flood flows from Fourmile Canyon Creek during major storm events. The spill occurs roughly between Broadway and 19th and during the 100-year event approximately 1,600 cfs overtops the south bank of Fourmile Canyon Creek and spills to Wonderland Creek. This spill effectively doubles the 100-year flow in Wonderland Creek downstream of 19th Street and the channel no longer contains 100-year event flows. Unlike Fourmile Canyon Creek, the majority of the Wonderland Creek study reach is located within city limits. The exception is the subdivision of Githens Acres that is located in unincorporated Boulder County between 26th Street and 19th Street. The creek flows through primarily residential development, with many of dwelling units multi-family in the eastern portion of the study area.

3.0 PREVIOUS STUDIES

The following lists the previous studies completed for Fourmile Canyon Creek and Wonderland Creek:

- Major Drainageway Planning, Boulder and Adjacent County Drainageways, Phase 'B', Greenhorne and O'Mara, Inc., May 1987
- Flood Insurance Study, Boulder County and Incorporated Areas, Volumes 1 through 5, Federal Emergency Management Agency, Revised June 2, 1995 and updated October 4, 2002
- Fourmile Canyon Creek Major Drainageway Planning – Phase A Report Alternatives Analysis, Love & Associates, Inc., June, 2000
- Technical Memorandum Alternative Analysis Fourmile Canyon Creek Major Drainageway Planning SH 119 to Boulder Creek Confluence, Love & Associates, Inc., January, 2002
- Floodplain Mitigation Alternatives Report for Wonderland Creek (Foothills Parkway to Wonderland Lake), Boyle Engineering Corporation, February, 2002
- Hydrology Report for Wonderland Creek, Love & Associates, Inc., April, 2005
- Wonderland Creek Damage Analysis, Love & Associates, Inc., February, 2006
- Fourmile Canyon Creek and Wonderland Creek Floodproofing Analysis, Love & Associates, Inc., February, 2006
- Fourmile Canyon Creek and Wonderland Creek Floodplain Study and Letter of Map Revision, Love & Associates, Inc., March, 2006
- Fourmile Canyon Creek and Wonderland Creek Major Drainageway Planning Phase A Report Alternatives Analysis, Love and Associates, Inc., May 2007

Figure 2.1: Study Streams



4.0 HYDROLOGY

A hydrologic analysis was completed for the entire Fourmile Canyon Creek and Wonderland Creek watersheds for the Phase A Study. The Fourmile Canyon Creek watershed is approximately 10.2 square miles in size. The Fourmile Canyon Creek watershed was delineated into seven subcatchments ranging in size from approximately one third of a square mile to just under four square miles. The Wonderland Creek watershed is approximately 2.1 square miles in size. The Wonderland Creek watershed was delineated into ten subcatchments ranging in size from just over 50 acres to just over 300 acres. The hydrologic programs CUHP and UDSWM were used to simulate the 2-, 5-, 10-, 50- and 100-year storm events. Five hundred year discharges were developed by extrapolation from the 50- and 100-year discharges. The models were created based on future land use conditions as presented in the City of Boulder North Boulder Sub-Community Plan, Boulder County zoning maps, and the City of Boulder GIS data. **Figure 4.1** shows the watersheds for both creeks.

Fourmile Canyon Creek from approximately Lee Hill Drive to 19th Street is perched within an alluvial floodplain. This condition results in flood waters spilling to the south into Wonderland Creek. The spill flow does not return to Fourmile Canyon Creek except at one location. Crestview Elementary School causes a portion of the spills to flow north around the school and re-enter Fourmile Canyon Creek. Diversion elements in UDSWM95 were used to simulate the Fourmile Canyon Creek spill. Rating curves were developed for the spills based on HEC-2 models. Two separate HEC-2 models were run iteratively until model parameters resulted in balanced energy grade lines at common cross sections. This spill condition results in reduced flows in downstream reaches of Fourmile Canyon Creek and increased flows in Wonderland Creek. Flood waters begin to spill west of Broadway at approximately the 10-year rainfall event and between Broadway and 19th Street at approximately the 2-year event. The spill was previously unrecognized. **Table 4.1** presents a summary of the flow split around Crestview Elementary School. **Table 4.2** presents a summary of the entire Fourmile Canyon Creek spill. **Figure 4.2** shows the spill under 100-year event conditions.

Table 4.1 Crestview Elementary School Split Flow Condition

Storm Frequency	Spill Flows Between Broadway and 19th (cfs)	Spill that returns to Fourmile		Spill to Wonderland	
		(cfs)	(%)	(cfs)	(%)
10-year	151	23	15	128	85
50-year	780	156	20	624	80
100-year	840	176	21	664	79
500-year	1,468	352	24	1,116	76

Table 4.2 Fourmile Canyon Creek Spill Summary

Storm Frequency	Total Flow Fourmile Canyon (cfs)	Net Spill to Wonderland Creek (cfs)
	West of Broadway	
10-year	794	0
50-year	2,686	844
100-year	3,590	1,623
500-year	7,500	5,476
	Broadway to 19th	
<10-year	295	0
10-year	815	128
50-year	1,800	624
100-year	1,885	664
500-year	2,716	1,116

The Phase A Study hydrology modeling has been reviewed, approved and adopted by all floodplain regulatory agencies including City of Boulder, County of Boulder, Urban Drainage and Flood Control District, Colorado Water Conservation Board and the Federal Emergency Management Agency. The Acceptance of the Phase A Study hydrology has resulted in new adopted floodplains for both streams including the spills. A more detailed summary of the hydrologic analysis used to develop study flows can be found in the Phase A Study. **Table 4.3** presents a summary of peak flows for both Fourmile Canyon Creek and Wonderland Creek. **Figure 4.3** presents 100-year peak flows at select points along both creeks.

Table 4.3 Summary of Peak Flows

Location	Tributary Area (mi^2)	Peak Flow by Rainfall Event (cfs)					
		2-yr	5-yr	10-yr	50-yr	100-yr	500-yr
Fourmile Canyon Creek							
Lee Hill Drive	7.4	36	287	715	2,461	3,296	6,000
North Broadway	8.1	58	316	794	1,842	1,967	2,350
19th Street	8.5	155	331	697	1,194	1,277	1,450
28th Street	8.9	172	360	732	1,260	1,451	2,000
SH 119 (Diagonal)	9.2	189	433	782	1,458	1,757	2,500
Boulder Creek	10.2	195	500	738	1,485	1,737	2,500
Wonderland Creek							
Wonderland Lake	0.5	50	155	220	445	570	860
North Broadway	0.8	65	150	205	415	530	1,600
19th Street	1.1*	95	205	280	1,520	2,285	6,670
26th Street	1.3*	120	275	370	1,500	2,240	5,980
28th Street	1.4*	130	300	405	1,495	2,245	5,930
Iris	1.5*	125	285	385	1,460	2,190	5,330
47th Street	1.9*	225	430	565	1,450	2,160	4,730
Goose Creek	2.1*	240	460	610	1,420	2,110	4,620

* Direct tributary area only, does not include Fourmile Canyon Creek spill area

Figure 4.1 Fourmile Canyon Creek and Wonderland Creek Watersheds

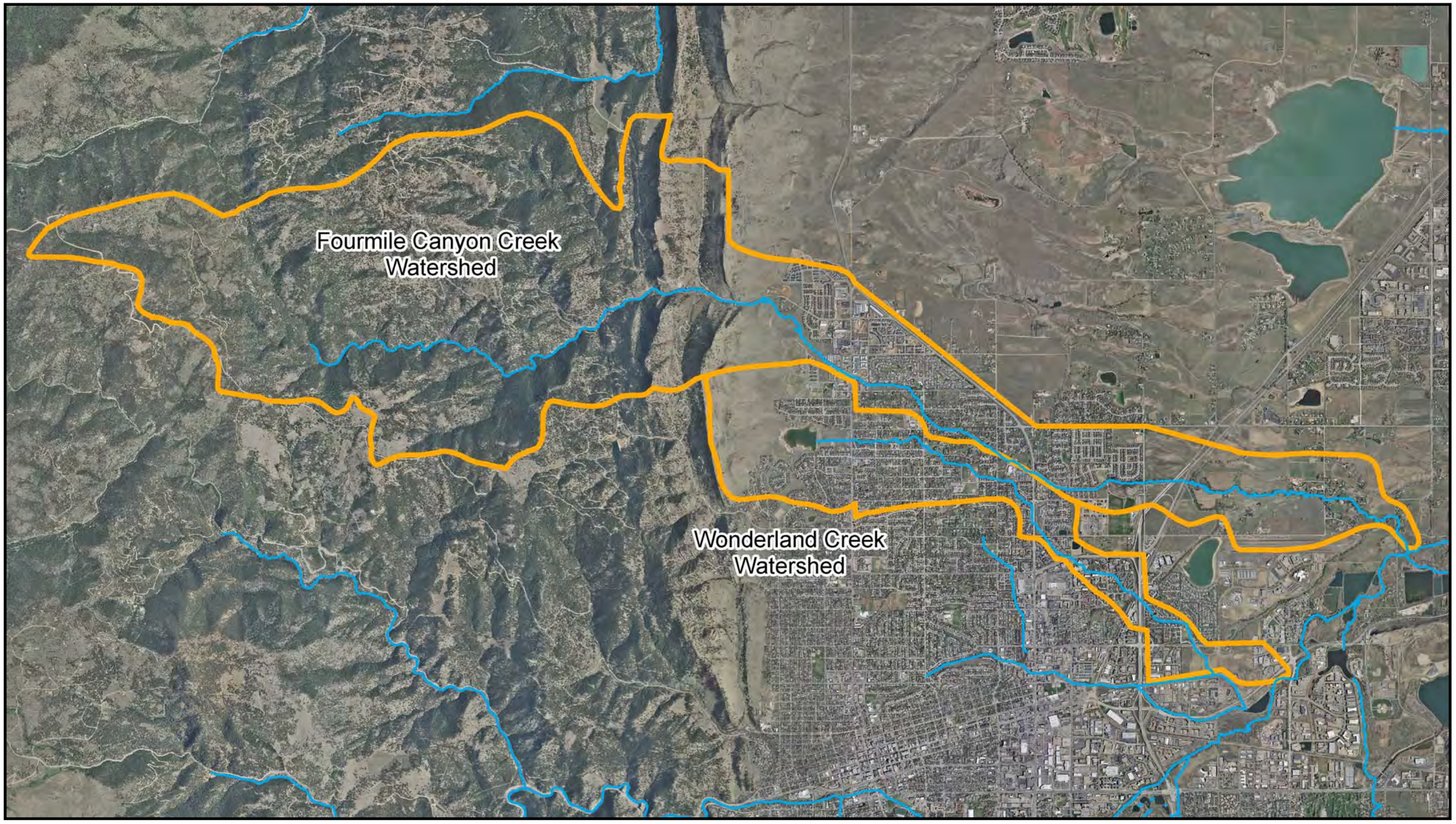
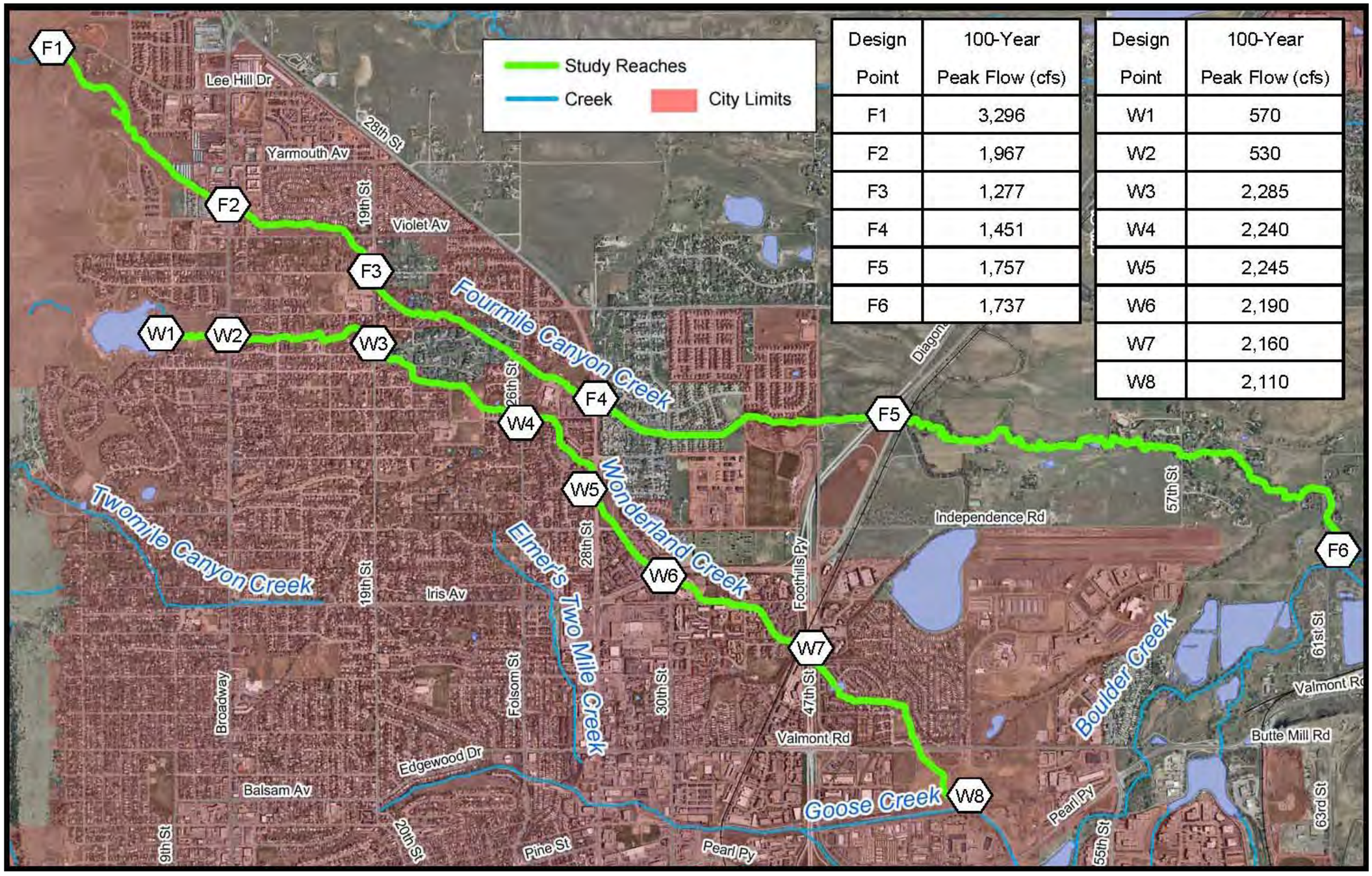


Figure 4.2 100-Year Event Fourmile Canyon Creek Spill to Wonderland Creek

Figure 4.3 100-Year Peak Flow Summary



Design Point	100-Year Peak Flow (cfs)
F1	3,296
F2	1,967
F3	1,277
F4	1,451
F5	1,757
F6	1,737

Design Point	100-Year Peak Flow (cfs)
W1	570
W2	530
W3	2,285
W4	2,240
W5	2,245
W6	2,190
W7	2,160
W8	2,110

5.0 HYDRAULICS

The Phase A Study presents hydraulic conditions under both existing conditions and those resulting from proposed mitigation measures. Existing hydraulic conditions were defined in a separate Letter of Map Revision (LOMR) study for both Fourmile Canyon Creek and Wonderland Creek. A LOMR was required because new one-foot topographic mapping (2003) and survey information was available and to correctly define the Fourmile Canyon Creek spill to Wonderland Creek. The LOMR was approved by the Federal Emergency Management Agency (FEMA) in 2006. A hydraulic analysis was conducted during development of the Phase A Study to simulate the affects of each of the proposed mitigation measures on the existing floodplain limits.

The US Army Corps of Engineers hydraulic model HEC-RAS (Version 3.1.1 2003) was used to define flood elevations and floodplains for both the Phase A Study and the 2006 LOMR. Peak flows were defined in the HEC-RAS model based on the combined Fourmile Canyon Creek and Wonderland Creek hydrologic analysis. The HEC-RAS model was used to define the Fourmile Canyon Creek spill to Wonderland Creek as well as a spill located along Wonderland Creek just upstream of Foothills Parkway. Under existing conditions, rainfall events of 50-years or greater result in a spill that sheet flows to the south. The spill results in shallow flooding that follows ditches, roads, and parking lots to the south, entering Goose Creek slightly upstream of its confluence with Wonderland Creek. The spill is confined topographically by railroad tracks to the west and Foothills Parkway to the east. Under existing conditions the spill flows does not re-enter Wonderland Creek.

There are 14 road crossings of Fourmile Canyon Creek and 16 road crossings of Wonderland Creek within the study area. The crossings range in size from small culverts to bridges. Transport of debris is common during flood events. To simulate the reduced capacity of crossing caused by the debris in the HEC-RAS model, the low chord of the upstream cross section of the opening was lowered. **Table 5.1** presents the percent of blockage that was simulated in the Phase A study for crossings along both creeks. Small path crossings were assumed to be fully obstructed.

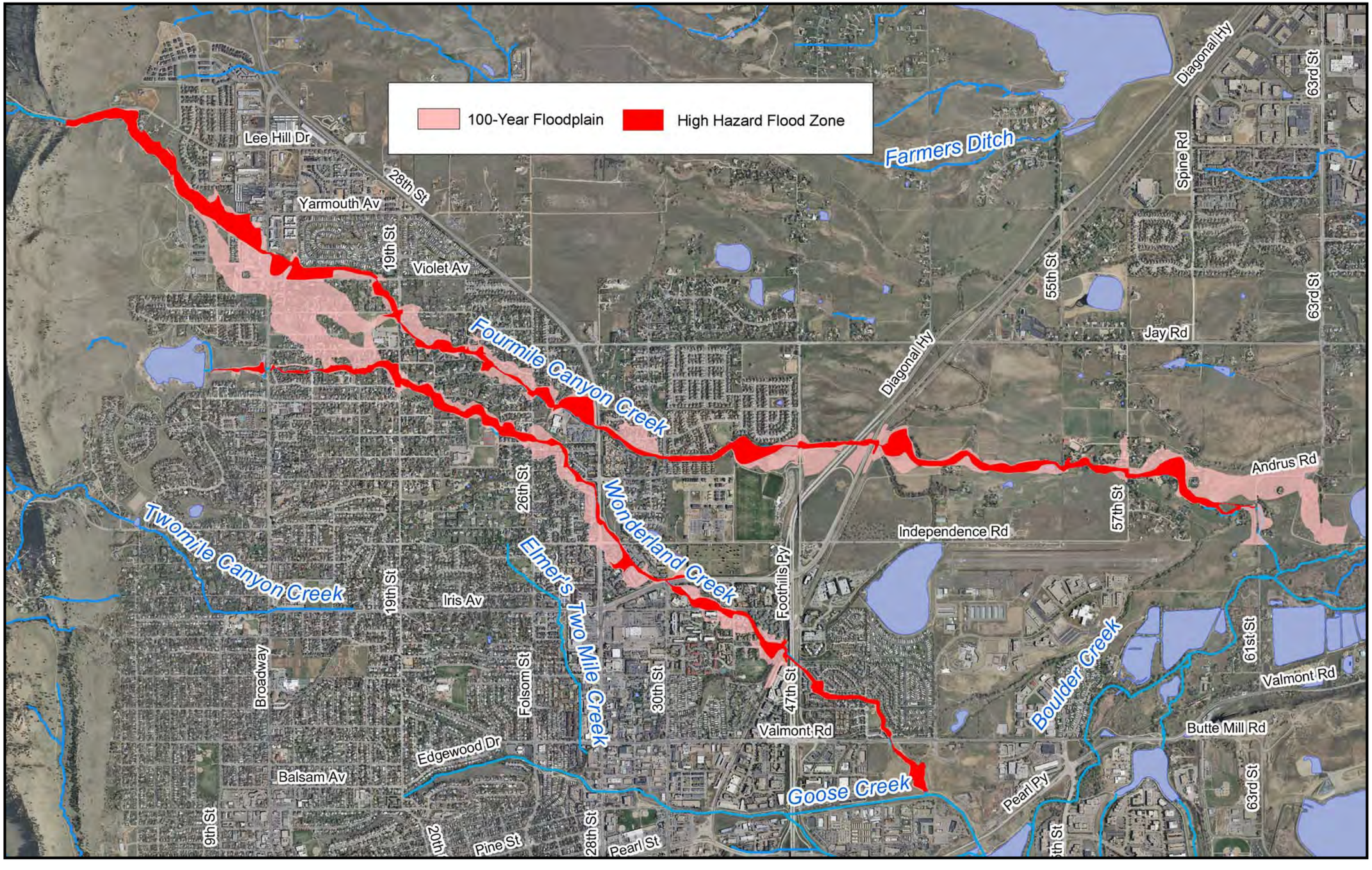
Fourmile Canyon Creek and Wonderland Creek are bisected by a number of irrigation structures. Following procedures recommended by Urban Drainage and Flood Control District, the irrigation ditches were assumed to flow full and the top of bank of the ditch is coded when the ditch crosses the channel.

Figure 5.1 presents the existing conditions 100-year floodplain limits and High Hazard Zone as defined by the 2006 Letter of Map Revision. The High Hazard Zone is defined by the City as the product number of velocity times flow depth that equals or exceeds four or where flow depths equal or exceed four feet. The vertical datum used for all mapping is NAVD 1988. A more detailed summary of the hydraulic modeling effort can be found in the Phase A Study.

Table 5.1 Percent Blockage for Crossings

Crossing	Blockage (%)	Type
Fourmile Canyon Creek		
Broadway	0	Bridge
Violet Avenue	40	Bridge
Upland Avenue	50	Bridge
19th Street	10	Bridge
Sumac Avenue	30	Bridge
Topaz Drive	30	Twin 5’ x 3’ elliptical culverts
Folsom Avenue / 26th Street	20	Bridge
Elks Club Bridge	40	Bridge
28th Street	0	Bridge
30th Street	0	Bridge
47th Street	100	4’ x 3’ elliptical CMP
Diagonal Highway (119)	0	Bridges
57th Street	100	42” CMP
61st Street	100	64” x 42” CMP arch
Wonderland Creek		
Broadway	0	14’ x 8’ RCB
Riverside Avenue	0	5’ RCB
15th Street	0	Twin 8’ x 6’ RCB
19th Street	100	36” RCP
Folsom Avenue / 26th Street	0	Twin 7’ x 4’ RCB
Winding Trail Drive	0	Triple 11’ x 4’ RCB
28th Street	0	10’ x 6’ RCB
Kalmia Avenue	0	Twin 11’ x 6’ RCB and 14’ x 6’ RCB
Fire Access	50	Twin 11’ x 3.5’ and 14’ x 3.5’ RCB
Diagonal Highway (119)	100	36” x 57” CMPA
Parking Access Bridge	0	Bridge
34th Street	0	Twin 9’ x 4’ RCB and 12’ x 4’ RCB
Spring Creek Place	0	Twin 11’ x 5’ RCB and 14’ x 5’ RCB
Foothills Parkway	0	Triple 18.4’ x 5’ RCB
Kings Ridge Boulevard	0	Four 8.5’ x 4’ RCB, Twin 2’ x 13.5’ RCB, and 16.7’ x 4’ RCB
Valmont Road	0	18’ x 7.5’ RCB

Figure 5.1 Existing Floodplain and High Hazard Zone Limits



6.0 DAMAGE ANALYSIS

A damage analysis was conducted as part of the Phase A Study. The analysis estimated annual damage under existing floodplain conditions. The damage analysis was calculated as recommended in the Urban Drainage and Flood Control District's Methodology for Evaluation of Feasibility: Multi-jurisdictional Urban Drainage and Flood Control Projects. Flood damages were estimated for structures and contents, land, and infrastructure as follows:

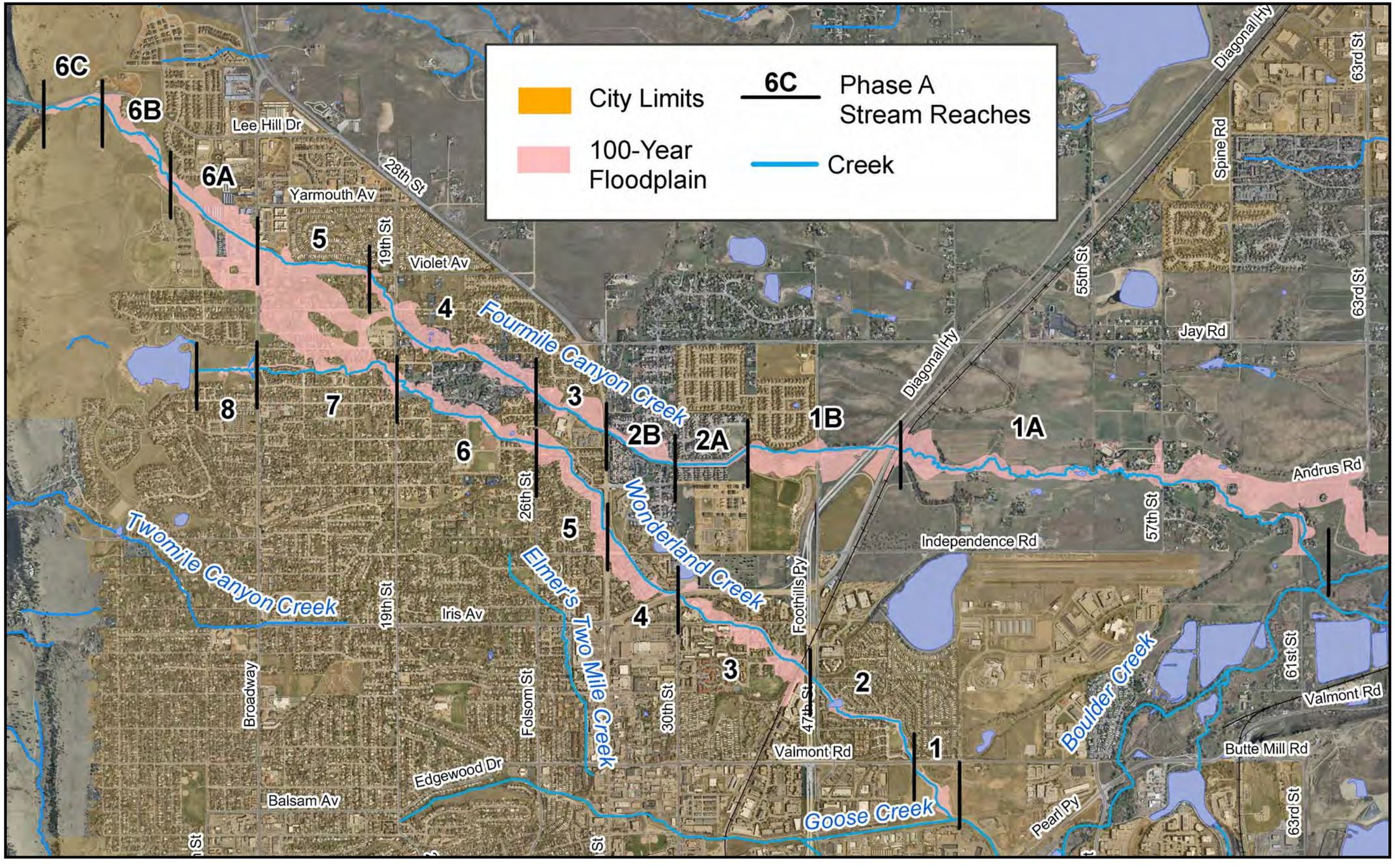
- An inventory was conducted of all developed and undeveloped property within the 500-year floodplains of both creeks to identify land value, structure value, and type of structure, construction materials, parcel value, and per acre repair costs for flood damages on undeveloped parcels.
- An inventory was conducted of all infrastructures within the 500-year floodplains of both creeks including roadway crossings, culverts, bridges, channel improvements and irrigation facilities.
- Ground elevations adjacent to each structure within the 500-year floodplain were identified based on the city's 2003 topographic mapping. A field reconnaissance of each structure was undertaken and the first floor elevation of the structure relative to the adjacent ground elevation was estimated visually.
- Flood damages were estimated for structures based on the Letter of Map Revision flood profiles for the 2-, 5-, 10-, 50-, 100-, and 500-year storms and FEMA depth-damage curves for structures and contents.
- Flood damages were estimated for undeveloped parcels based on the LOMR flood profiles for the 2-, 5-, 10-, 50-, 100-, and 500-year storms and estimated repair costs.
- Flood damages were estimated for infrastructure based on the LOMR flood profiles for the 2-, 5-, 10-, 50-, 100-, and 500-year storms and estimated repair or replacement costs.

The Phase A Study reports a total present value average annual flood damage of over $36 million for the Fourmile Canyon Creek reaches. More than one third of the Fourmile Canyon Creek average annual damage is associated with Reach 4, located between Violet Avenue and 26th Street. This reach is located almost entirely in Boulder County. Approximately one third of the damages are associated with Reaches 5 and 6a. These Fourmile Canyon Creek reaches are located between Violet Avenue and Broadway and between Broadway and 7th Street. Flood damages associated with these reaches are the result of the Fourmile Canyon Creek spill to Wonderland Creek. The remaining damages are primarily located along Reaches 2b and 6b. The 2b costs come from flooding of the houses in the floodplain north of the creek upstream of 30th Street. Most of the 6b damage costs come from the flooding of the houses on the north side of the creek. Reach 1a has only moderate damages and damages along Reaches 1b, 3, 2a, and 6c are estimated to be relatively small. Approximately half of the annual damages for Reach 1b come from damage to the railroad bridge with limited damages to the channel at the bridges for SH 119 and the Diagonal Highway. About one third (1/3) of the Reach 1b annual damages is from content damage to the houses just upstream of 47th Street. In Reach 3, at least half of the annual damages come from damage to the buildings and/or contents upstream of the Farmers Ditch.

The Phase A Study reports a total present value average annual flood damage of over $72 million for the Wonderland Creek reaches. The Phase A Study reports that approximately one half of all estimated damages along Wonderland Creek are located along Reach 4. This reach is located between the Diagonal Highway and 28th Street and result from damages to multi-unit structures. Reported damages for Reaches 3 and 5 are also high. Reported damages for Reaches 1, 2, 6, 7, and 8 are relatively small.

Figure 6.1 shows the existing 100-year floodplain along with the Phase A study reaches. It should be noted, however, that the city is currently using the latest FEMA benefit-cost analysis software to estimate damages and associated project benefits. Initial analysis using this software indicates large differences between estimated damages and associated benefits from those reported in the Phase A Study. As a result, benefit-cost ratios for the selected plan are not presented in this Final Plan report.

Figure 6.1 Study Reaches and Existing Floodplain



7.0 ALTERNATIVE DEVELOPMENT AND EVALUATION

The Phase A Study identified a large number of alternatives to mitigate the existing floodplain damages that occur along Fourmile Canyon and Wonderland Creeks. The initial alternatives were screened and evaluated to identify alternatives for further consideration. The following initial alternatives were considered:

Maintain Existing Floodplain
This alternate maintains the existing floodplains, channel configurations and allows for continued spill flows from Fourmile Canyon Creek to Wonderland Creek. This alternative requires floodplain regulations to be strictly enforced, floodplain information and education programs to be undertaken, and flood insurance recommended to property owners within the reach. Debris cleanup and routine maintenance in the floodplain would be required at regular intervals and following flood events.

Construct Natural Waterway
Fourmile Canyon Creek and Wonderland Creek have been altered over time from their natural condition. Road crossings have been constructed, the channel has been straightened, the banks of both creeks have been filled, and development has encroached on the natural floodplain. A truly natural channel would be impossible to re-construct. This alternative would construct a channel that as closely as possible, emulates a natural channel.

Implement Structural and Channel Improvements
This alternate reduces the floodplain width at select locations. The alternative would include grade control structures, bridge and irrigation structure replacement, bank projection and erosion control, channel re-alignment, low flow protection and/or velocity controls. Maintenance access to key locations would be provided.

Detention and / or Retention Facility
This alternate would provide flood storage to reduce the peak discharge of floodwaters and related flood damages downstream of the facility. The flood storage could be designed to be a multi-purpose facility with park lands, open space, and playing fields located within it.

The Phase A Study investigated both on-line and off-line detention facilities. An off-line pond was sized upstream of Broadway on city park or open space lands. The pond included a side channel spillway crest from the Fourmile Canyon Creek floodplain and had the capacity to store the 100-year flood volume with the peak discharge downstream being 1,000 cfs. This pond required approximately 30 acres of land, a ten-foot high embankment and excavation of over one million cubic yards of earth from the pond below the embankment. An on-channel pond required significantly more storage volume due to the routing nature of the hydrograph and due to the fact the pond started filling at the start of the storm thus making the storage less efficient. The detention alternate was rejected for all of the study reaches due to the enormity of the project, extensive construction cost and the negative impacts it would have on park or open space lands.

Property Acquisition
This alternate would identify and acquire structures located in hazardous areas and structures with high flood damage potential. Acquisition of all flood prone properties was rejected because of the high cost to purchase the hundreds of flood prone structures. Acquisition of select structures is, however, included in the Final Plan.

Implement Non-Structural Methods
This alternate includes flash flood forecasting and warning systems and development of evacuation plans. Flood insurance and floodproofing of structures would also be recommended at the property owner's expense. Public information and flood hazard education programs would be undertaken. Floodplain regulations would need to be strictly enforced and post flood relief would be provided.

Floodproofing is a combination of adjustments and/or additions of physical features installed in, on or around individual structures designed to eliminate or reduce the potential for flood damage to the structure. Floodproofing consists of the techniques and approaches for preventing or minimizing flood damages to a structure and its contents in flood hazard areas. Floodproofing techniques include construction of levees and walls around a structure, installing water-tight doors and windows, and physically raising the structures elevation using fill or pilings. Floodproofing measures may be applied to new structures as well as retrofitting existing structures. Floodproofing does not eliminate all flood damages but can, if done correctly, significantly reduce damages from flooding. Floodproofing along Fourmile Canyon Creek and Wonderland Creek would be the responsibility of the individual property owner including cost of floodproofing materials, installation, and operation and/or maintenance. This Final Plan recommends all structures within the 500-year floodplain of both streams to be floodproofed to two feet above the 100-year floodplain.

Trans-Basin Diversion
The Phase A Study evaluated the feasibility of constructing a trans-basin diversion to alleviate the Fourmile Canyon Creek spill to Wonderland Creek. This alternative included an approximately four mile-long channel sized to convey approximately 1,000 cfs from Fourmile Canyon Creek to Six Mile Reservoir located to the north in a separate drainage basin. This alternate was rejected in the Phase A Study because of the excessive cost and the legal liabilities involved with a trans-basin diversion of flow.

The following alternatives were evaluated in detail for each reach of both creeks in the Phase A Study:

- Channel Modifications to provide 100-year containment (50-year containment was also evaluated for Fourmile Canyon Creek)
- Maintain Existing Floodplain Configuration
- Floodproofing (at private cost)
- Channel Modifications to contain High Hazard Zone (defined as the zone where the product of velocity and depth equal or exceed 4). This alternative would include floodproofing of individual structures

The Phase A Study developed estimated costs, identified maintenance requirements and developed residual flood damage estimates and benefit-cost ratios for each alternative along each of the creeks stream reaches. The Phase A Study then presented a recommended mitigation measure for each stream reach based on engineering judgment and discussion with project sponsors.

8.0 ENVIRONMENTAL ASSESSMENT AND OPPORTUNITIES

The Phase A Study conducted an environmental assessment for both stream corridors. The purpose of the assessment was to provide planning guidance along with information that can be used to capitalize on combining flood management objectives with the multi-purpose Greenways Program objectives. **Table 8.1** presents a summary of the existing habitat conditions along both Fourmile Canyon Creek and Wonderland Creek as reported in the City of Boulder Greenways Master Plan (2010). **Table 8.2** presents a summary ranking of greenways objectives along both Fourmile Canyon Creek and Wonderland Creek as reported in the City of Boulder Greenways Master Plan (2010). The Phase A Study should be referenced for additional information on the assessment that was conducted for the 2007 study.

Table 8.1 Existing Habitat Conditions by Stream Reach

Reach	Location	Habitat Condition							
		Vegetative Structure	Native Plant Habitat	Bird Habitat	Aquatic Habitat	Streambed	Channel Morphology	Bank Stabilization	Vegetative Bank Stability
Fourmile Canyon Creek									
1a	Boulder Creek to BNSF Railroad	G	P	VG	F	G	F	G	G
1b	BNSF Railroad to Pleasant View Soccer fields	G	P	VG	F	G	F	G	G
2a	Pleasant View Soccer fields to 30th Street	G	P-G	P-VG	F	P-G	F-G	G	G
2b	30th Street to 28th Street	G	P-G	P-VG	F	P-G	F-G	G	G
3	28th Street to 26th Street	G-VG	VP-G	P-G	F	F-G	P-F	G	F-G
4	26th Street to Violet Avenue	G-VG	VP-G	P-G	F	F-G	P-F	G	F-G
5	Violet Avenue to Broadway	G-VG	VP-G	P-G	F	F-G	P-F	G	F-G
6a	Broadway to 7th Street	P-G	G-VG	G	P	F	P	F	F-G
6b	7th Street to Lee Hill Drive	P-G	G-VG	G	P	F	P	F	F-G
6c	Lee Hill Drive to city limits	P-G	G-VG	G	P	F	P	F	F-G
Wonderland Creek									
1	Goose Creek to Valmont Road	P	P	P	P	P	P	F	P
2	Valmont Road to Foothills Parkway	P-G	P-E	VP-P	P	P	P	F	P-F
3	Foothills Parkway to Diagonal Highway	P-VG	P-E	VP-P	P-F	P-F	P	F	F-G
4	Diagonal Highway to 28th Street	P-VG	P-E	VP-P	P-F	P-F	P	F	F-G
5	28th Street to 26th Street	VP-G	P-G	VP-G	P	P	P	F	P-F
6	26th Street to 19th Street	P-G	P-G	P-G	F-VG	P-G	P-F	F-G	F-G
7	19th Street to Broadway	G	P	P	G	G	G	G	G
8	Broadway to Wonderland Lake	G	P	P	G	G	G	G	G

Table 8.2 Ranking of Greenways Objectives by Stream Reach

Reach	Location	Habitat	Water Quality	Transportation	Recreation	Flood Mitigation
Fourmile Canyon Creek						
1a	Boulder Creek to BNSF Railroad	H	H	H	H	M
1b	BNSF Railroad to Pleasant View Soccer fields	H	H	H	H	M
2a	Pleasant View Soccer fields to 30th Street	M	M	N/A	M	M
2b	30th Street to 28th Street	M	M	N/A	M	M
3	28th Street to 26th Street	M	M	H	H	H
4	26th Street to Violet Avenue	M	M	H	H	H
5	Violet Avenue to Broadway	M	M	H	H	H
6a	Broadway to 7th Street	M	M	H	H	H
6b	7th Street to Lee Hill Drive	M	M	H	H	H
6c	Lee Hill Drive to city limits	M	M	H	H	H
Wonderland Creek						
1	Goose Creek to Valmont Road	L	M	N/A	H	L
2	Valmont Road to Foothills Parkway	M	M	N/A	L	L
3	Foothills Parkway to Diagonal Highway	H	M	H	L	H
4	Diagonal Highway to 28th Street	H	M	H	L	H
5	28th Street to 26th Street	M	M	M	N/A	H
6	26th Street to 19th Street	L/M	L/M	L/M	L	H
7	19th Street to Broadway	M	H	N/A	N/A	L
8	Broadway to Wonderland Lake	M	H	N/A	N/A	L

***** H = High, M = Medium, L = Low, N/A = not applicable. It should be noted that the Greenways Master Plan reaches do not always exactly coincide with the reaches in this plan

9.0 PUBLIC PROCESS

The Fourmile Canyon Creek and Wonderland Creek Major Drainageway Phase A Planning Study has gone through an extensive public process. The following provides a summary of the public process since the completion of the study in June 2007.

- On September 19, 2007 staff presented a summary of the Phase A flood mitigation study to the Greenways Advisory Committee (GAC).

- On September 27, 2007 a public meeting was conducted to present the Phase A flood mitigation study results.

- On both October 15, 2007 and December 17, 2007 staff facilitated a Water Resources Advisory Board (WRAB) discussions of the Phase A flood mitigation study. A question was raised whether detention storage for upstream Fourmile Canyon Creek or construction of a bypass channel to Boulder Creek was feasible. Both alternatives were considered infeasible because of cost estimates exceeding $50 million for either alternative.

- In January 2008 WRAB passed a motion with a 4-0 vote to recommend approval of the Phase A plan as modified by staff with the following recommendations and guiding principles:
  1. Protect life safety by addressing structures in the high hazard zone through:
     a) Acquiring properties from willing sellers
     b) Constructing flood improvements at time of redevelopment of properties along Fourmile Canyon Creek west of Broadway and Wonderland Creek near 30th.
     c) Constructing high hazard zone containment and other improvements as funding is available, including coordinating with the county on expediting improvements located jointly in the city and county.
  2. The intent of the overall approach is to minimize disruption to private property and riparian areas. This implies that flooding during 100-year events will not be contained in a channel minimizing impacts to downstream properties. Many properties including schools will experience shallow flooding under this approach.
  3. During the next phase all potentially impacted properties and persons including students and parents should be notified of proposed approach and tradeoffs of minimizing property impacts versus the potential for flood damages.
  4. Public education of flood risks should be emphasized including signage and flood markers and response plans for impacted schools.
  5. Opportunities for facilitating and encouraging private flood proofing should be explored.
  6. Continue to maintain high level of public involvement and feedback.
  7. This non-structural approach requires active regulatory flood plain management in order to preserve flood conveyance areas.

- In March 2008 Planning Board passed a motion recommending City Council accept the proposed flood mitigation plan outlined in the March 20, 2008 staff memorandum including the following recommendations:
  1. City Council approve the staff's recommendation with prioritization, to the extent feasible from an engineering perspective, favoring city improvements over county improvements.
  2. Public education on life and safety issues as to flooding, particularly as to critical facilities, be given a high priority.
  3. Discussion with the affected property owners in the Village Center take place with the feasibility of moving forward with flood mitigation.

  The motion passed 5-1, A. Sopher opposed. The dissenting vote from Sopher was based on his request that the report contain additional physical flood protection for access and egress to Crestview Elementary and Waldorf Elementary school.

- On November 10, 2008 Council members discussed the Fourmile Canyon and Wonderland Creek Flood Mitigation Plan. Council expressed concern about moving forward on such a complex and costly project and stated the need for taking more time in making this decision. Prior to making its decision, Council requested the following:
  - A field trip to the affected properties
  - A study session that would focus on the policy level
  - That the Water Resources Advisory Board and staff review the overall spending for water utilities and provide that information for Council

- On April 28, 2009 staff presented information to City Council during a Study Session to address issues raised during the November 2008 public hearing. Council members generally expressed support for the approach to flood mitigation planning and that existing policies were appropriate, with the following comments relating to the Phase A report:
  1. The current approach to flood mitigation should continue and is mostly in the right direction.
  2. Consider doing the least amount of work necessary with the structural improvement approach to mitigate flood hazards.
  3. Flood mitigation work proposed along Fourmile Canyon Creek east of 28th should be reconsidered and possibly scaled back.
  4. Alternatives that leave drainageways in their natural state should be a priority.
  5. Mitigation measures should be kept as "green" as possible, i.e. minimize use of asphalt and concrete.
  6. The need to disturb natural areas for the benefit of a few homes was questioned.
  7. Flood mitigation to reduce the 100-year floodplain was questioned if the mitigation was only to reduce property damage. Focus removal efforts on structures in the high hazard and conveyance zone.
  8. City council members requested that proposed mitigation costs be presented to distinguish the cost of containing high hazard flood flows versus containing all 100-year flood flows.

- An open house was held at Centennial Middle School on August 5, 2009 to present the 100-year Containment and High Hazard Containment alternatives for Wonderland Creek between Foothills Parkway and 26th Street (Phase A reaches 3, 4, and 5). Letter invites were sent to all residents and property owners within the 500-year floodplains of both creeks. Seventeen attended from the public. Staff solicited public input regarding the two alternatives and nine written comments were received. Frequently heard comments included:
  - Flood insurance has been a burden and this cost should be considered
  - Questioned public's willingness to floodproof

- Staff presented to WRAB on August 17, 2009 and on September 21, 2009. During the September meeting, staff recommended WRAB approve the Fourmile Canyon Creek and Wonderland Creek Phase A Report with the staff modifications including a Modified 100-year Containment alternative for Wonderland Creek between 26th and Foothills Parkway. On September 21, 2009 WRAB passed a motion recommending City Council adopt the Phase A Report as modified by staff and subject to the condition that if a significant portion of grant funding is not awarded to construct various segments of the project, then WRAB recommends adopting only the High Hazard Containment and Floodproofing alternative for the segment of Wonderland Creek between 26th and Foothills Parkway. Motion passed by vote of 4:1 (S. Iott opposed, favors the high hazard containment option only.)

- Staff presented to City Council at a public hearing on November 10, 2009 and recommended a motion to accept the Phase A study with staff modifications. Council Member Wilson moved, seconded by Osborne to accept the Fourmile Canyon Creek and Wonderland Creek Phase A Plan as modified by staff as a long-term plan with the understanding that funding for flood mitigation improvements for each stream reach will be evaluated as part of the city's CEAP and CIP processes. Staff modifications to the Phase A study include:
  1. Wonderland Creek from 26th Street to Foothills Parkway – High Hazard Containment unless substantial outside funding can be secured for 100-year Containment
  2. Wonderland Creek from 19th Street to 26th Street – High Hazard Containment with safe access to Crestview Elementary School via 19th Street
  3. Fourmile Canyon Creek from 7th Street to 28th Street – High Hazard Containment with safe access to Crestview Elementary School via 19th Street and Upland Avenue
  4. Fourmile Canyon Creek from 28th Street to Pleasant View Soccer Fields – No recommendation (stream reach located in Boulder County)
  5. Fourmile Canyon Creek from BNSF Railroad to Boulder Creek - No recommendation (stream reach located in Boulder County)

  The motion carried unanimously 6:0; Ageton and Appelbaum absent.

Recommendations revised, please see individual Stream Reach sections (on the following pages) for detailed information.

10.0 FINAL PLAN

The public process resulted in numerous changes to the Phase A recommendations. **Table 10.1** presents a comparison between the Phase A Study recommendations and the Final Plan Recommendations. The Final Plan is meant only to provide a long-range plan for future flood mitigation projects along Fourmile Canyon Creek and Wonderland Creek. Each proposed flood mitigation projects will be evaluated and refined through the city's Community and Environmental Assessment Process (CEAP) and Capital Improvement Program (CIP) processes. **Figure 10.1** presents a map showing the Final Plan recommendations. **Table 10.2** presents a summary of estimated concept-level costs for the Final Plan recommendations. The appendices presents more detailed cost estimate information. The remainder of this section presents existing conditions and Final Plan recommendations for each of the stream reaches.

Table 10.1 Phase A Study versus Final Plan Recommendations

Stream Reach	Reach ID	Phase A Recommendation	Revised Recommendation
Fourmile Canyon Creek			
▪ City limits to Lee Hill Drive	6c	Maintain Existing	No revisions
▪ Lee Hill Drive to 7th Street	6b	HHZ Containment / Floodproofing	No revisions
▪ 7th Street to Broadway	6a	Floodproofing	HHZ Containment / Floodproofing
▪ Broadway to Violet Avenue	5	HHZ Containment / Floodproofing	No revisions
▪ Violet Avenue to 26th Street	4	100-year Containment	HHZ Containment with Floodproofing and Safe Access to Crestview Elementary School via 19th Street and Upland Avenue [2]
▪ 26th Street to 28th Street	3	HHZ Containment / Floodproofing	No revisions
▪ 28th Street to 30th Street	2b	100-year Containment	No recommendation (reach in Boulder County)
▪ 30th Street to Pleasant View Soccer Fields	2a	Maintain Existing	No recommendation (reach in Boulder County)
▪ Pleasant View Soccer Fields to BNSF Railroad	1b	Maintain Existing	No revisions
▪ BNSF Railroad to Boulder Creek	1a	HHZ Containment / Floodproofing	No recommendation (reach in Boulder County)
Wonderland Creek			
▪ Wonderland Lake to Broadway	8	Maintain Existing	No revisions
▪ Broadway to 19th Street	7	Maintain Existing	Safe Access to Crestview Elementary School via 19th Street [2]
▪ 19th Street to 26th Street	6	HHZ Containment / Floodproofing	HHZ Containment / Floodproofing[1]
▪ 26th Street to 28th Street	5	100-year Containment	HHZ Containment / Floodproofing unless substantial outside funding is provided for 100-year Containment
▪ 28th Street to Diagonal Hwy	4	100-year Containment	
▪ Diagonal Hwy to Foothills Parkway	3	HHZ Containment / Floodproofing	
▪ Foothills Parkway to Valmont Road	2	Floodproofing	No revisions
▪ Valmont to Goose Creek	1	Maintain Existing	No revisions

[1] Revised method for high hazard zone (HHZ) containment that reduces the estimated cost by approximately $600,000 from Phase A HHZ containment alternative
[2] Channel modifications at 19th Street required to provide safe access to Crestview Elementary School

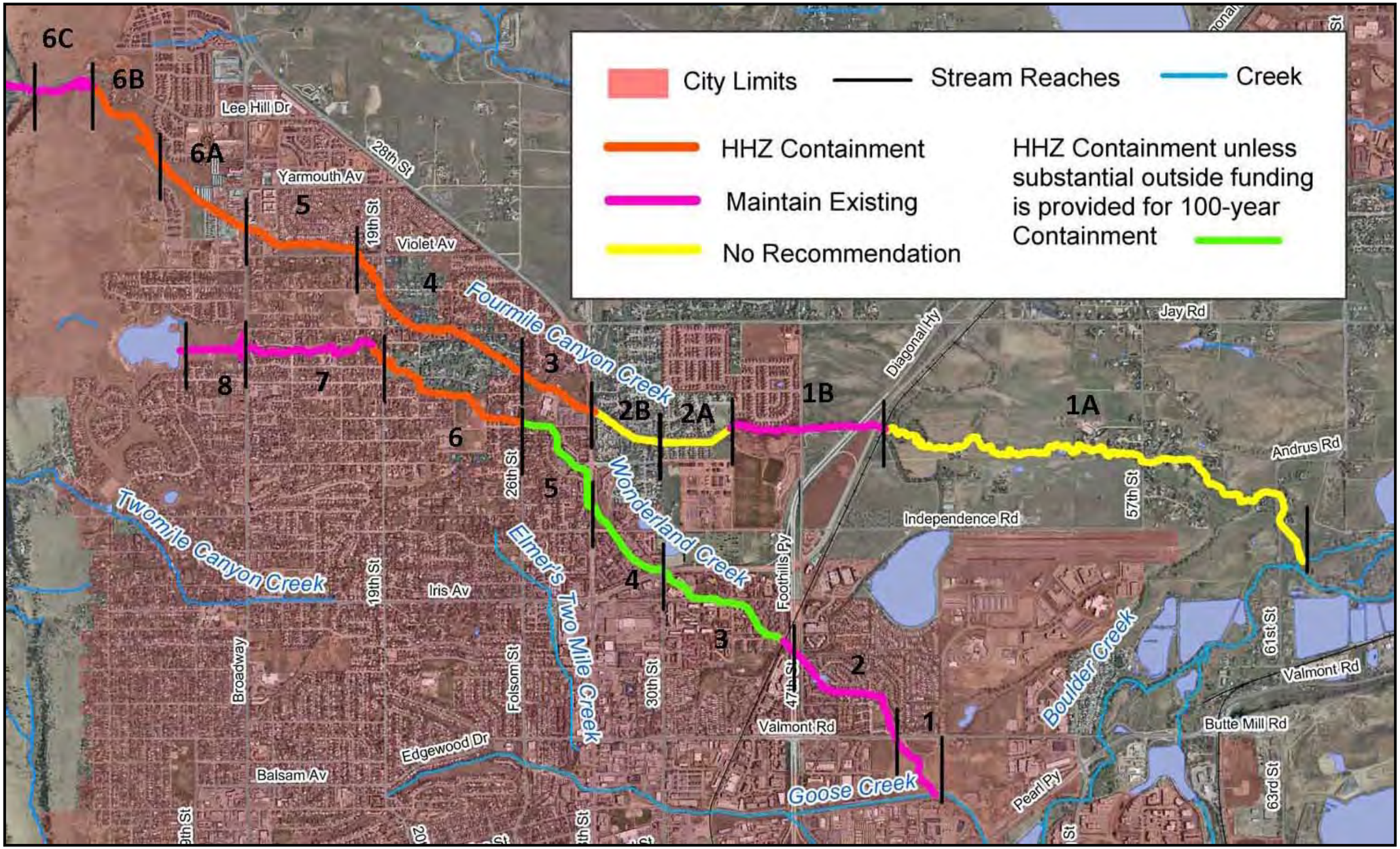
Costs have not been updated

Table 10.2 Concept-Level Cost Estimates for Final Plan Recommendations

Stream Reach	Reach ID	Final Plan Recommendation	Concept-Level Cost Estimates[4]				
			ROW	Construction	Total Public (no O&M)	O&M	Private (floodproofing)
Fourmile Canyon Creek							
▪ City limits to Lee Hill Drive	6c	Maintain Existing	$0	$0	$0	$173,000	$0
▪ Lee Hill Drive to 7th Street	6b	HHZ Containment / Floodproofing	$55,000	$86,000	$141,000	$454,000	$908,000
▪ 7th Street to Broadway	6a	HHZ Containment / Floodproofing	$0	$2,551,000	$2,551,000	$290,000	$3,131,000
▪ Broadway to Violet Avenue	5	HHZ Containment / Floodproofing	$0	$120,000	$120,000	$310,000	$726,000
▪ Violet Avenue to 26th Street	4	HHZ Containment with Safe Access to Crestview Elementary School via 19th Street and Upland Avenue [2]	$1,512,000	$2,582,000	$4,094,000	$513,000	$5,349,000
▪ 26th Street to 28th Street	3	HHZ Containment / Floodproofing	$0	$2,077,000	$2,077,000	$336,000	$495,000
▪ 28th Street to 30th Street	2b	100-year Containment	$0[3]	$0[3]	$0[3]	$0[3]	$0[3]
▪ 30th Street to Pleasant View Soccer Fields	2a	Maintain Existing	$0[3]	$0[3]	$0[3]	$0[3]	$0[3]
▪ Pleasant View Soccer Fields to BNSF Railroad	1b	Maintain Existing	$0	$0	$0	$921,000	$0
▪ BNSF Railroad to Boulder Creek	1a	HHZ Containment / Floodproofing	$0[3]	$0[3]	$0[3]	$0[3]	$0[3]
		Total:	$1,567,000	$7,416,000	$8,983,000	$2,997,000	$10,609,000
Wonderland Creek							
▪ Wonderland Lake to Broadway	8	Maintain Existing	$0	$0	$0	$289,000	$0
▪ Broadway to 19th Street	7	Safe Access to Crestview Elementary School via 19th Street [2]	$0	$30,000	$30,000	$807,000	$0
▪ 19th Street to 26th Street	6	HHZ Containment / Floodproofing[1]	$206,000	$2,104,000	$2,310,000	$253,000	$2,390,000
▪ 26th Street to 28th Street	5	HHZ Containment / Floodproofing unless substantial outside funding is provided for 100-year Containment	$0 (HHZ), $510,000 (100-yr)	$119,000 (HHZ), $3,110,000 (100-yr)	$119,000 (HHZ), $3,620,000 (100-yr)	$493,000 (HHZ), $282,000 (100-yr)	$2,528,000 (HHZ), $0 (100-yr)
▪ 28th Street to Diagonal Hwy	4		$359,000 (HHZ), $589,000 (100-yr)	$2,924,000 (HHZ), $3,663,000 (100-yr)	$3,283,000 (HHZ), $4,252,000 (100-yr)	$774,000 (HHZ), $479,000 (100-yr)	$3,117,000 (HHZ), $0 (100-yr)
▪ Diagonal Hwy to Foothills Parkway	3		$560,000 (HHZ), $742,000 (100-yr)	$5,256,000 (HHZ), $5,833,000 (100-yr)	$5,816,000 (HHZ), $6,575,000 (100-yr)	$434,000 (HHZ), $216,000 (100-yr)	$3,506,000 (HHZ), $0 (100-yr)
▪ Foothills Parkway to Valmont Road	2	Maintain Existing	$0	$0	$0	$0	$0
▪ Valmont to Goose Creek	1	Maintain Existing	$0	$0	$0	$618,000	$0
		Total:	$1,125,000 (HHZ), $2,047,000 (100-yr)	$10,433,000 (HHZ), $14,740,000 (100-yr)	$11,558,000 (HHZ), $16,787,000 (100-yr)	$3,668,000 (HHZ), $2,944,000 (100-yr)	$11,541,000 (HHZ), $2,390,000 (100-yr)
		Total both Creeks:	$2,692,000 (HHZ), $3,614,000 (100-yr)	$17,849,000 (HHZ), $22,156,000 (100-yr)	$20,541,000 (HHZ), $25,770,000 (100-yr)	$6,665,000 (HHZ), $5,941,000 (100-yr)	$22,150,000 (HHZ), $12,999,000 (100-yr)

[1] Revised method for high hazard zone (HHZ) containment that reduces the estimated cost by approximately $600,000 from Phase A HHZ containment alternative
[2] Channel modifications at 19th Street required to provide safe access to Crestview Elementary School
[3] No cost to the city, reach located within Boulder County, see appendices for cost estimates
[4] Includes 40% contingency
5 Yearly operation and maintenance costs converted to present value assuming a 3% discount rate (6% interest rate minus 3% inflation rate) and a 50-year life span.

Figure 10.1 Fourmile Canyon Creek and Wonderland Creek Final Plan Recommendations



10.1 *Fourmile Canyon Creek*

UPDATED information for this Reach. Please see the CEAP document.

Fourmile Canyon Creek Reach 6c – City Limits to Lee Hill Drive

Final Plan – Maintain Existing Condition ($0 public)

Reach 6c is the furthest upstream reach of the Fourmile Canyon Creek study reaches. The existing 100-year floodplain extends beyond the creek banks through this reach but the floodplain does not impact any structures. This reach is located entirely within city limits. Consistent with the Phase A Study, the Final Plan recommends maintaining status quo for this reach. **Figure 10.2** presents existing conditions for this reach. **Figure 10.3** presents the Final Plan recommendation.

Fourmile Canyon Creek Reach 6b – Lee Hill Drive to 7th Street Final Plan – High Hazard Zone Containment with Floodproofing ($141,000 public)

UPDATED information for this Reach. Please see the CEAP document.

Trail crossing along Reach 6b

As shown on **Figure 10.2**, the floodplain limits extend beyond the creek banks along this reach of Fourmile Canyon Creek. Consistent with the Phase A Study, the Final Plan recommends High Hazard Zone Containment and floodproofing for this reach. This alternative would maintain the existing channel configuration for the majority of the reach, excavate two feet in an area located south of the extension of 47th Street and recommend floodproofing of all structures located within the 500-year floodplain to two feet above the 100-year floodplain at private cost. Reach 6b improvements would narrow the high hazard zone so that the structure located on parcel 4854 4th Street would be located outside the high hazard zone. **Table 10.3** presents total estimated concept-level costs for proposed improvements along Reach 6b. **Figure 10.4** shows the location of the excavation, the individual structures recommended for floodproofing, and the post-project floodplain limits.

Table 10.3 Concept-Level Cost Estimates for Fourmile Canyon Creek Reach 6b

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$86,000	$55,000	$454,000	$908,000	$0	$0

Fourmile Canyon Creek Reach 6a – 7th Street to North Broadway

Final Plan – High Hazard Zone Containment with Floodproofing ($2,551,000 public)

This reach of Fourmile Canyon Creek has an extensive floodplain under existing conditions that includes the western extent of the spill to Wonderland Creek. **Figure 10.2** shows the existing floodplain limits along this reach. The High Hazard Zone limits currently extend north into existing commercial / industrial development located on the north side of Rosewood Street. This reach also contains two critical facilities; the North Broadway Silo Gas facility located on the northwest corner of the intersection of Broadway and Rosewood Street and the Shining Path Waldorf School located on the southwest corner of the intersection of Cherry Avenue and 10th Street. The location of these facilities is indicated by green dots on **Figure 10.2**.

The Phase A Study had recommended floodproofing of structures along this reach with no channel improvements. The public process resulted in changes to this recommendation to accommodate future development west of Broadway. The Final Plan now recommends High Hazard Zone Containment with Floodproofing for Reach 6a. **Figure 10.5** shows the proposed improvements that include:

- A flood interceptor channel located at the upstream end of the reach to limit flood spills to the east
- Removal and replacement of an existing trail crossing located at the western extent of Yarmouth Avenue
- Modification of approximately 1,350 feet of existing channel including 15 drop structures to contain the High Hazard Zone between the extent of Yarmouth Avenue and Broadway. The channel modifications will need to be carefully designed to not change the spill flows or distribution from Fourmile Canyon Creek south to Wonderland Creek.
- Relocation of Rosewood Avenue to provide vehicular access to the commercial / industrial land uses.
- Floodproofing of all structures located within the 500-year floodplain to two feet above the 100-year floodplain at private cost.

Reach 6a improvements would narrow the high hazard zone so that the structures located on the following parcels would be located outside the high hazard zone:

- 4501 North Broadway
- 4525 North Broadway
- 4535-4537 North Broadway
- 4545 North Broadway
- 4571 North Broadway
- 4635 North Broadway
- 1027 Rosewood Avenue
- 1025 Rosewood Avenue

Reach 6a shortly after channel improvements

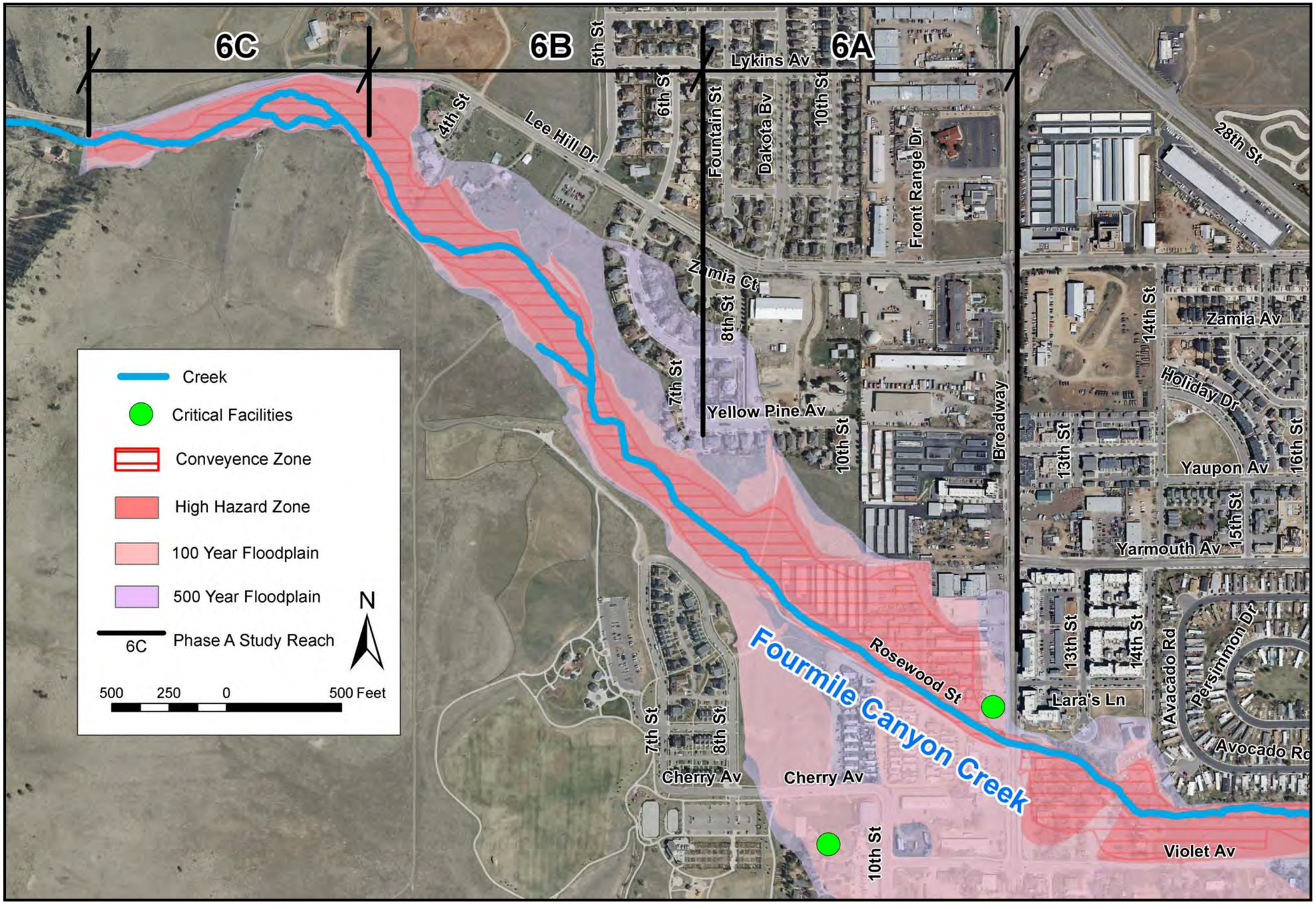
Table 10.4 presents total estimated concept-level costs for proposed improvements along Reach 6a. The resulting floodplain depths would be shallow enough to allow safe access to the Shining Path Waldorf School.

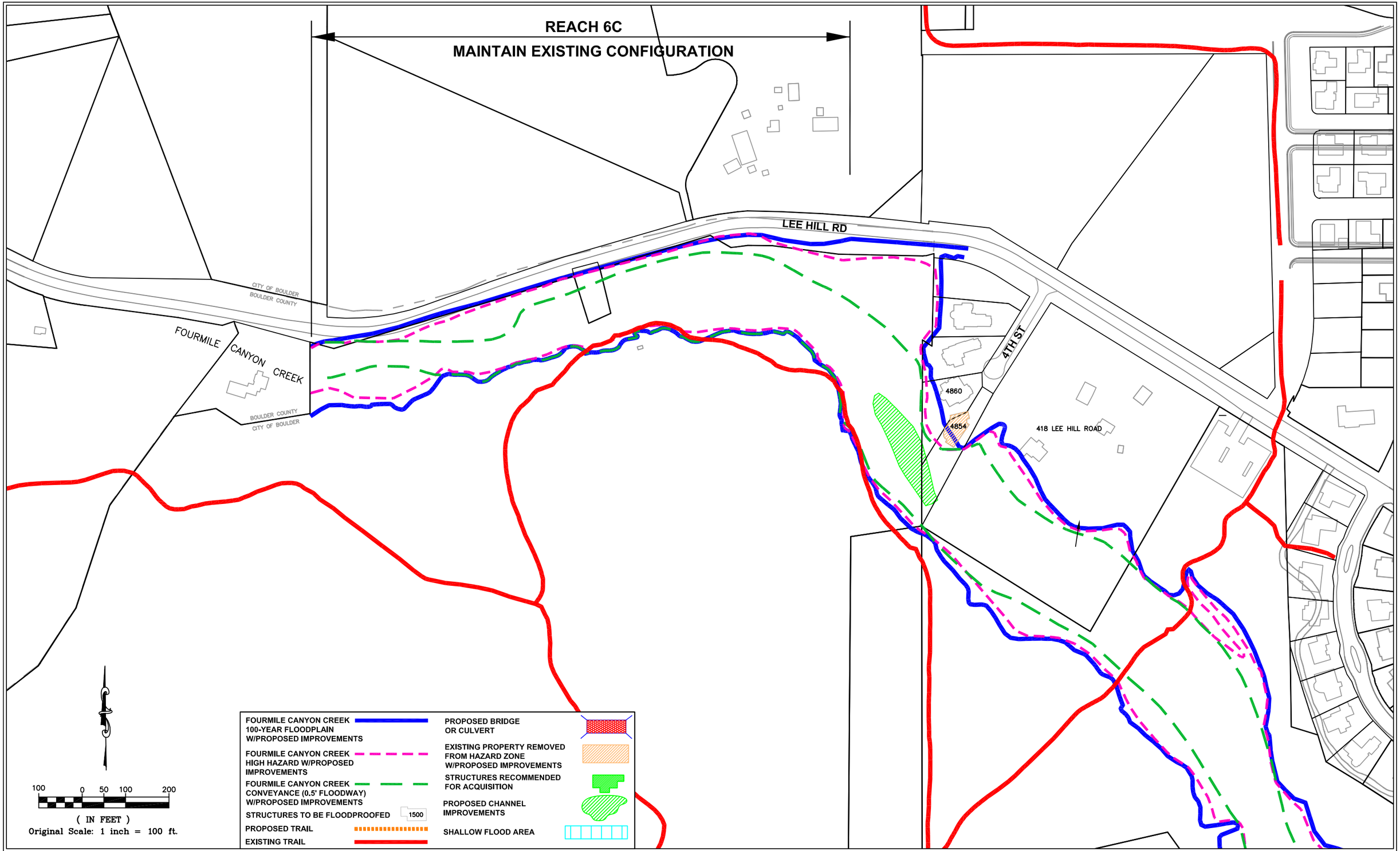
Table 10.4 Concept-Level Cost Estimates for Fourmile Canyon Creek Reach 6a

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$2,551,000	$0	$290,000	$3,131,000	$0	$0

Figure 10.2 Existing Conditions Fourmile Canyon Creek Reaches 6C, 6B, 6A

UPDATED information for this Reach.
Please see the CEAP document.





GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

PREPARED BY:
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Fax: 303-786-8026

DESIGNED:	SDL
DRAWN:	PEM
CHECKED:	DJL
DATE:	8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE REACH 6C FOURMILE CANYON CREEK

Fig 10.3

REACH 6B
HHZ CONTAINMENT/FLOODPROOFING

GUTTER FLOW

LEE HILL RD

4th ST

418 LEE HILL ROAD

4860

4854

EXCAVATE NORTH
OVERBANK 2' DEEP FOR
ADDITIONAL CHANNEL CAPACITY

YELLOW PINE

4669

4647

4700

4567

100 0 50 100 200

(IN FEET)

Original Scale: 1 inch = 100 ft.

FOURMILE CANYON CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

FOURMILE CANYON CREEK
CONVEYANCE (0.5' FLOODWAY)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
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DATE FLOWN: 2003
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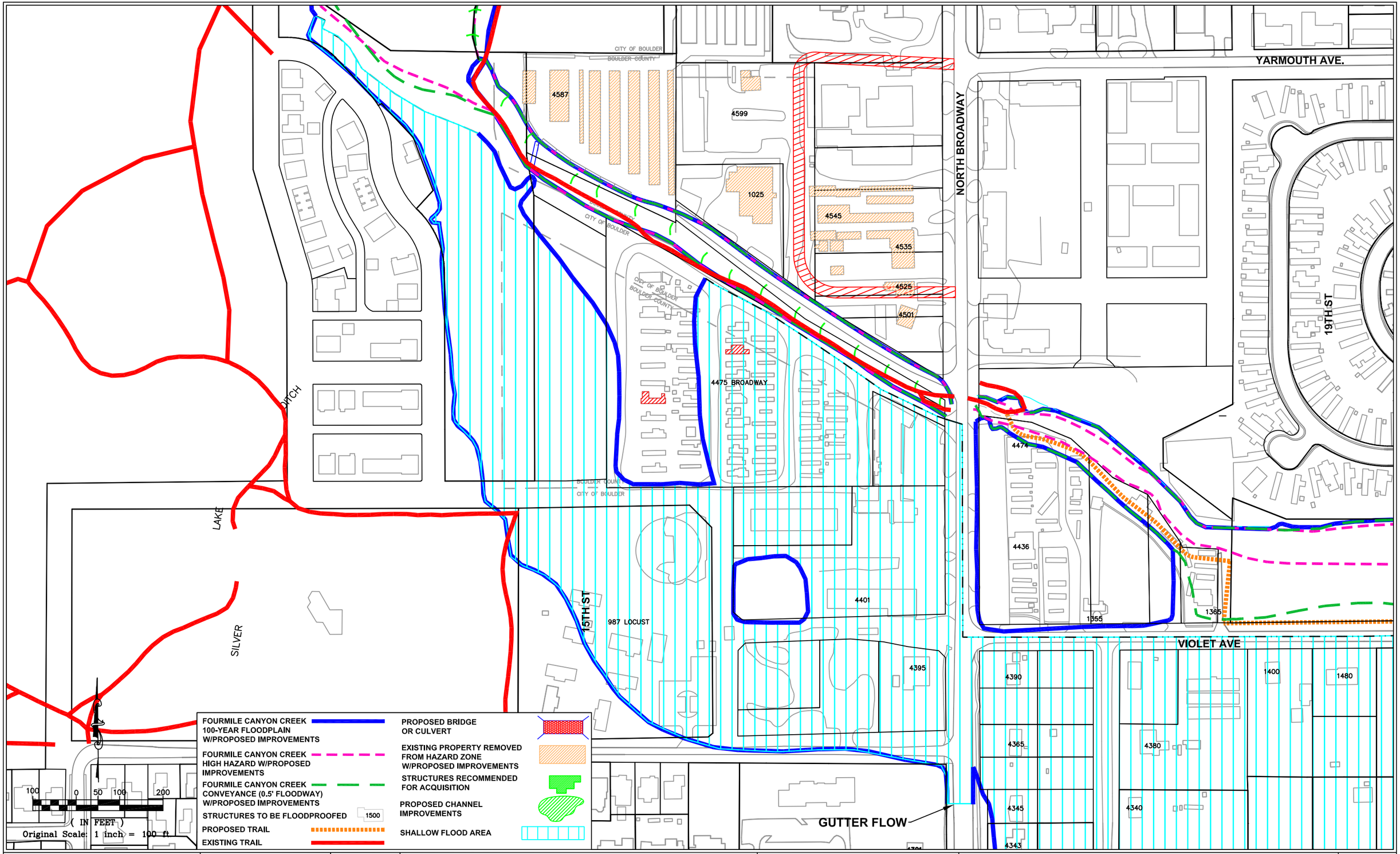
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 6B
FOURMILE CANYON CREEK

Fig
10.4



GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

REACH 6A SPILL
FOURMILE CANYON CREEK

Fig 10.5

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

VIOLET AVE
UPLAND AVE
SUMAC AVE.
TAMARACK AVE.
SUMAC AVE
NORTH BROADWAY
19TH ST
15TH ST

GUTTER FLOW
GUTTER FLOW
GUTTER FLOW
MAY REQUIRE PROPERTY PURCHASE

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS
FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS
FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS
STRUCTURES TO BE FLOODPROOFED 1500
PROPOSED TRAIL
EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT
EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS
STRUCTURES RECOMMENDED FOR ACQUISITION
PROPOSED CHANNEL IMPROVEMENTS
SHALLOW FLOOD AREA

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

REACH 6A SPILL
FOURMILE CANYON CREEK

Fig 10.5

UPDATED information for this Reach.
Please see the CEAP document.

Fourmile Canyon Creek Reach 5 – North Broadway to Violet Avenue Final Plan – High Hazard Zone Containment with Floodproofing ($120,000 public)

This reach of Fourmile Canyon Creek has an extensive floodplain under existing conditions that includes the majority of the spill to Wonderland Creek. **Figure 10.6** shows the existing floodplain limits along this reach. Several critical facilities are located near the downstream of the end of this reach but are listed in Reach 4. No changes were made to the recommended alternative for Reach 5 from the Phase A Study. Recommended work within this reach is located just upstream of Violet Avenue and would include:

Reach 5 looking west

- Construction of an approximately two feet deep drop structure to stabilize existing headcut in the stream channel
- Stabilization of approximately 250 linear feet of stream bank
- Construction of an on-stream sediment capture facility and wetland mitigation

Figure 10.7 presents the Final Plan recommendations.Reach 5 improvements would narrow the high hazard zone so that the structure located at 1750 Violet Avenue would be located outside the high hazard zone. **Table 10.4** presents total estimated concept-level costs for proposed improvements along Reach 5.

Table 10.4 Concept-Level Cost Estimates for Fourmile Canyon Creek Reach 5

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$120,000	$0	$310,000	$726,000	$169,000	$0

Fourmile Canyon Creek Reach 4 –Violet Avenue to 26th Street

Final Plan – High Hazard Zone Containment with Floodproofing with Safe Access to Crestview Elementary School via 19th Street and Upland Avenue ($4,094,000 public)

The existing conditions floodplain of Reach 4 extends well beyond the stream banks but no longer spills to Wonderland Creek as shown on **Figure 10.6**. Several critical facilities are located within the upstream end of this reach including:

- Boulder Meeting of Friends located at 1825 Upland Avenue
- Congregate Care (at-risk population) located at 1825 Upland Avenue
- Boulder Fire Station 5 located at 4365 19th Street
- Crestview Elementary School located at 1897 Sumac Avenue

The public process resulted in modification of the Phase A Study recommendation of HHZ Containment with Floodproofing to include upgraded road crossings at Upland Avenue and 19th Street to provide safe access to Crestview Elementary School. Final Plan recommendations for this reach include:

- Replacing the existing Violet Avenue bridge with a 38’ W x 8’ H RCB with multi-use underpass

UPDATED information for this Reach.
Please see the CEAP document.

Crusher fine multi-use path added between Riverside Ln. and 22nd St.

- Removing an existing culvert located approximately 250 feet upstream of the Upland Avenue and 19th Street intersection and constructing open channel
- Constructing approximately 110 linear feet of wall just upstream of Upland Avenue on parcel 1885 upland to convey flood waters to a new 38’ W x 8’ H RCB with multi-use underpass at Upland Avenue
- Excavating approximately two feet of existing channel between Upland Avenue and 19th Street to provide a flow transition for a new 20’ W x 9’ H RCB with multi-use underpass at 19th Street that includes an upstream drop
- Excavating approximately 450 linear feet of the north overbank by two feet between Sumac Avenue and Topaz Drive to increase conveyance and remove and relocate an existing driveway on parcel 2446 Sumac
- Replacing the existing culvert under Topaz Drive with twin 12’ W x 6’ H RCB with new channel transitions
- Design and construction of channel improvements (north side of channel only) between Topaz Drive and 26th Street that increase channel capacity to narrow the floodplain to the south side of Topaz Drive but save the majority of the trees in the riparian corridor
- Constructing eight two-feet high channel drop structures along the channel between Topaz Drive and 26th Street

The city has purchased properties along Fourmile Canyon Creek Reach 4 to facilitate recommended improvements including:

- 2446 Sumac Avenue
- 0 Topaz Street (just west of parcel 2435 Topaz Drive)
- 2400 Topaz Drive

Two more properties, 4097 26th Street and 2500 Topaz Drive, are recommended for acquisition.

Reach 4 looking west

Reach 4 improvements would narrow the high hazard zone so that the structures located at 2455 Sumac Avenue and 1885 Upland Avenue would be located outside the high hazard zone.

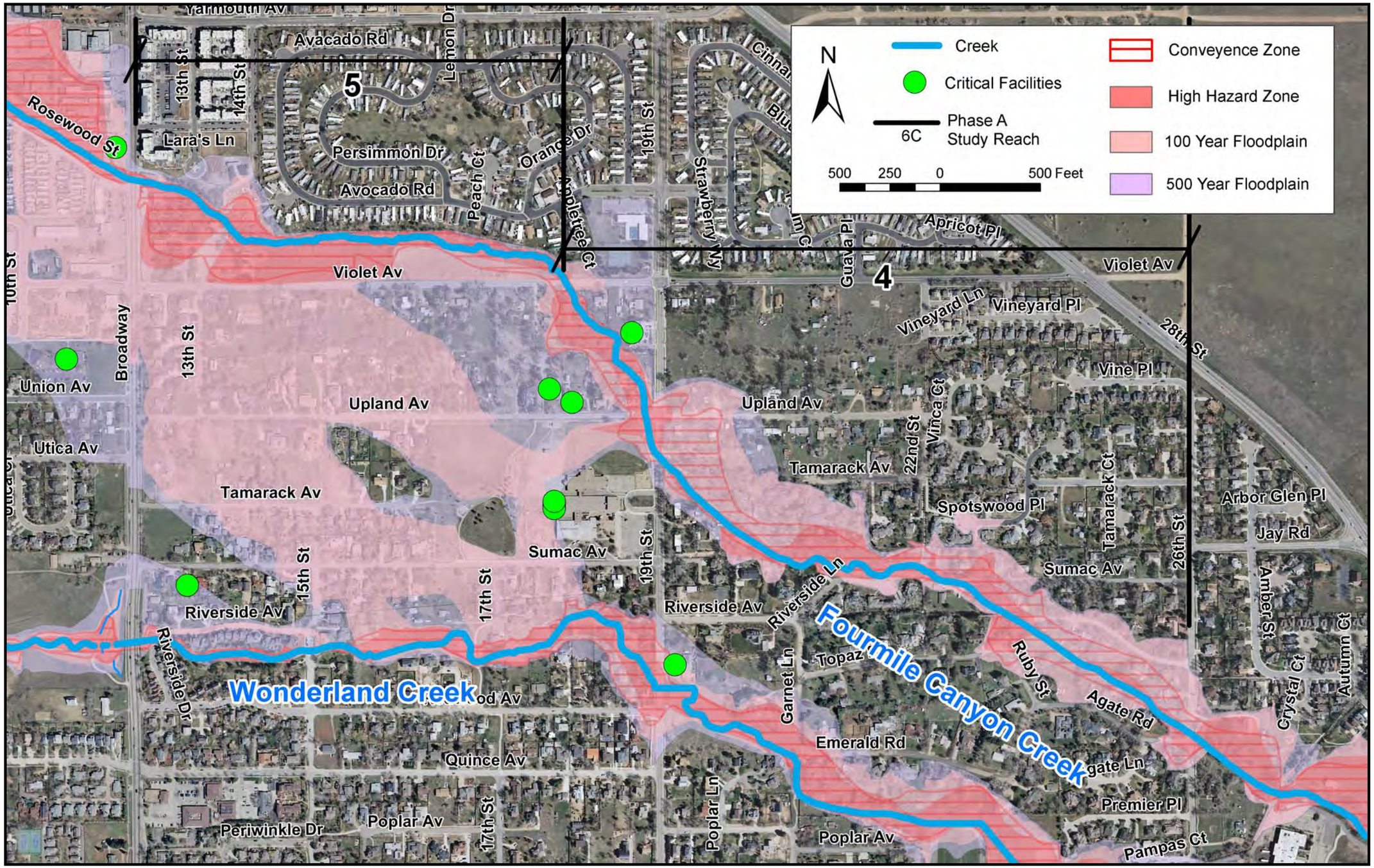
Figure 10.8 presents the Final Plan recommendations for Reach 4 including the flood hazard limits and structures that would be removed from the High Hazard Zone following implementation. **Table 10.5** presents total estimated concept-level costs for proposed improvements along Reach 4.

Table 10.5 Concept-Level Cost Estimates for Fourmile Canyon Creek Reach 4

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$2,582,000	$2,582,000	$513,000	$5,349,000	$87,000	$0

UPDATED information for this Reach.
Please see the CEAP document.

Figure 10.6 Existing Conditions Fourmile Canyon Creek Reaches 5, 4



REACH 5
HHZ CONTAINMENT/FLOODPROOFING

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

CONSTRUCT 2' DEEP DROP STRUCTURE TO STABILIZE EXISTING HEADCUT. 250± LF - STABILIZE BANKS. ON-STREAM SEDIMENT CAPTURE FACILITY AND WETLAND MITIGATION.

AVOCADO RD

SILVER LAKE DITCH

VIOLET AVE

19TH ST

NORTH BROADWAY

GUTTER FLOW

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

PREPARED BY:
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Fax: 303-786-8026

DESIGNED: SDL
DRAWN: PEM
CHECKED: DJL
DATE: 8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 5
FOURMILE CANYON CREEK

Fig 10.7

REACH 4 (Con't)
HHZ CONTAINMENT/FLOODPROOFING WITH SAFE ACCESS TO CRESTVIEW ELEMENTARY SCHOOL VIA 19TH STREET AND UPLAND

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

REPLACE VIOLET AVENUE BRIDGE 38'Wx8'H RCB WITH MULTI-USE UNDERPASS

VIOLET AVE

REMOVE EXISTING PEDESTRIAN BRIDGE

PEDESTRIAN TRAIL

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

19TH ST

REMOVE EXISTING CULVERT. CONSTRUCT OPEN CHANNEL

SIDE CHANNEL SPILL COLLECTION AREA

CONSTRUCT 110± LF WALL & CHANNEL IMPROVEMENTS

REPLACE UPLAND AVENUE BRIDGE 38'Wx8'H RCB WITH MULTI-USE UNDERPASS

GUTTER FLOW

UPLAND AVE

MAY REQUIRE PROPERTY PURCHASE

EXCAVATE 2' DEEP FOR CHANNEL TRANSITION

MATCH LINE

PEDESTRIAN TRAIL

REPLACE 19TH STREET BRIDGE 38'Wx8'H RCB MULTI-USE UNDERPASS WITH UPSTREAM DROP

GUTTER FLOW

SUMAC AVE

FOURMILE CANYON CREEK

CITY OF BOULDER
BOULDER COUNTY

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 4
FOURMILE CANYON CREEK

Fig 10.8

REACH 4 (Con't)
HHZ CONTAINMENT/FLOODPROOFING
WITH SAFE ACCESS TO
CRESTVIEW ELEMENTARY SCHOOL VIA
19TH STREET AND UPLAND

EXCAVATE NORTH
OVERBANK 450± LF x 2' DEEP
TO INCREASE CONVEYANCE

TAMARACK AVE.

DESIGN CHANNEL IMPROVEMENTS
TO SAVE MAJORITY OF TREES IN
RIPARIAN CORRIDOR

STRUCTURES HAVE BEEN
ACQUIRED BY CITY

FOURMILE CANYON CREEK

MATCH LINE

SUMAC AVE

CONSTRUCT 2'
GRADE CONTROL
DROP STRUCTURES (8)

RIVERSIDE AVE

STRUCTURES HAVE BEEN
ACQUIRED BY CITY

REMOVE EXISTING
DRIVEWAY & CULVERT.
RELOCATE DRIVEWAY

TOPAZ DR

RUBY

PROPERTY ACQUISITION
(4097 26TH ST. &
2500 TOPAZ)

REMOVE & REPLACE TOPAZ
DRIVE BOX CULVERT
WITH 2-12'Wx6'H RCB AND
CHANNEL TRANSITIONS

GARNET LN

AGATE RD

NO IMPROVEMENTS
ON SOUTH SIDE OF
CHANNEL

EMERALD RD.

26TH ST.

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

FOURMILE CANYON CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

FOURMILE CANYON CREEK
CONVEYANCE (0.5' FLOODWAY)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 4
FOURMILE CANYON CREEK

Fig
10.8

Improvements at Elk's Park include: new playground equipment, multi-use path, and replaced pedestrian bridge. No improvements were made to the drainageway.

Fourmile Canyon Creek Reach 3 – 26th Street to 28th Street

Final Plan – High Hazard Zone Containment with Floodproofing ($2,077,000 public)

The existing conditions floodplain of Reach 3 extends well beyond the stream banks, particularly on the north side of the channel as shown on **Figure 10.9**. There are no critical facilities located within Fourmile Canyon Creek Reach 3. The public process did not result in changes to the Phase A Study recommendations for this reach (**Figure 10.10**) which includes:

- Replacing the existing 26th Street bridge with a 18' W x 9' H RCB mutli-use underpass including an upstream drop
- Excavating the north bank of the existing channel two feet deep to provide a channel transition at the downstream end of the new 26th Street culvert crossing
- Provide improvements to the existing Farmers irrigation ditch crossing, construct a sediment capture facility and provide wetland mitigation at the downstream side of the ditch crossing

Reach 3 from Elks Club

- Remove and replace an existing pedestrian bridge located approximately 100 feet downstream of the Farmers ditch crossing
- Remove two existing pedestrian crossings located approximately half way along the Elk's Club Park and construct a new crossing
- Construct ten two-feet high drop structures along the stream reach between the Farmers Ditch and 28th Street

Reach 3 improvements would narrow the high hazard zone so that the structures located at 4066 N 26th Street would be located outside the high hazard zone. **Table 10.6** presents total estimated concept-level costs for proposed improvements along Reach 3.

Table 10.6 Concept-Level Cost Estimates for Fourmile Canyon Creek Reach 3

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$2,077,000	$0	$336,000	$495,000	$119,000	$0

Fourmile Canyon Creek Reach 2b – 28th Street to 30th Street

Final Plan – 100-year Containment (staff however makes no recommendations as this reach is in Boulder County) ($1,347,000 public for Boulder County)

The floodplain extends beyond the north bank of Fourmile Canyon Creek Reach 2b under existing conditions (**Figure 10.9**). No structures are currently located in the high hazard zone. The Phase A Study recommends 100-year containment. Reach 2b, however, is located entirely within Boulder County and therefore City of Boulder staff do not make any flood mitigation recommendations. The 100-year containment improvements are shown on **Figure 10.11** and would include constructing an approximately 165' wide channel with ten two-feet high drops along the entire reach. **Figure 10.11** shows the typical proposed cross section. The improvements would include removing and replacing an existing pedestrian bridge located approximately half way along Reach 2b. **Table 10.7** presents total estimated concept-level costs for proposed improvements along Reach 2b.

Table 10.7 Concept-Level Cost (Boulder County) Estimates for Fourmile Canyon Creek Reach 2b

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$1,347,000	$0	$233,000	$0	$0	$0

Reach 2b looking East

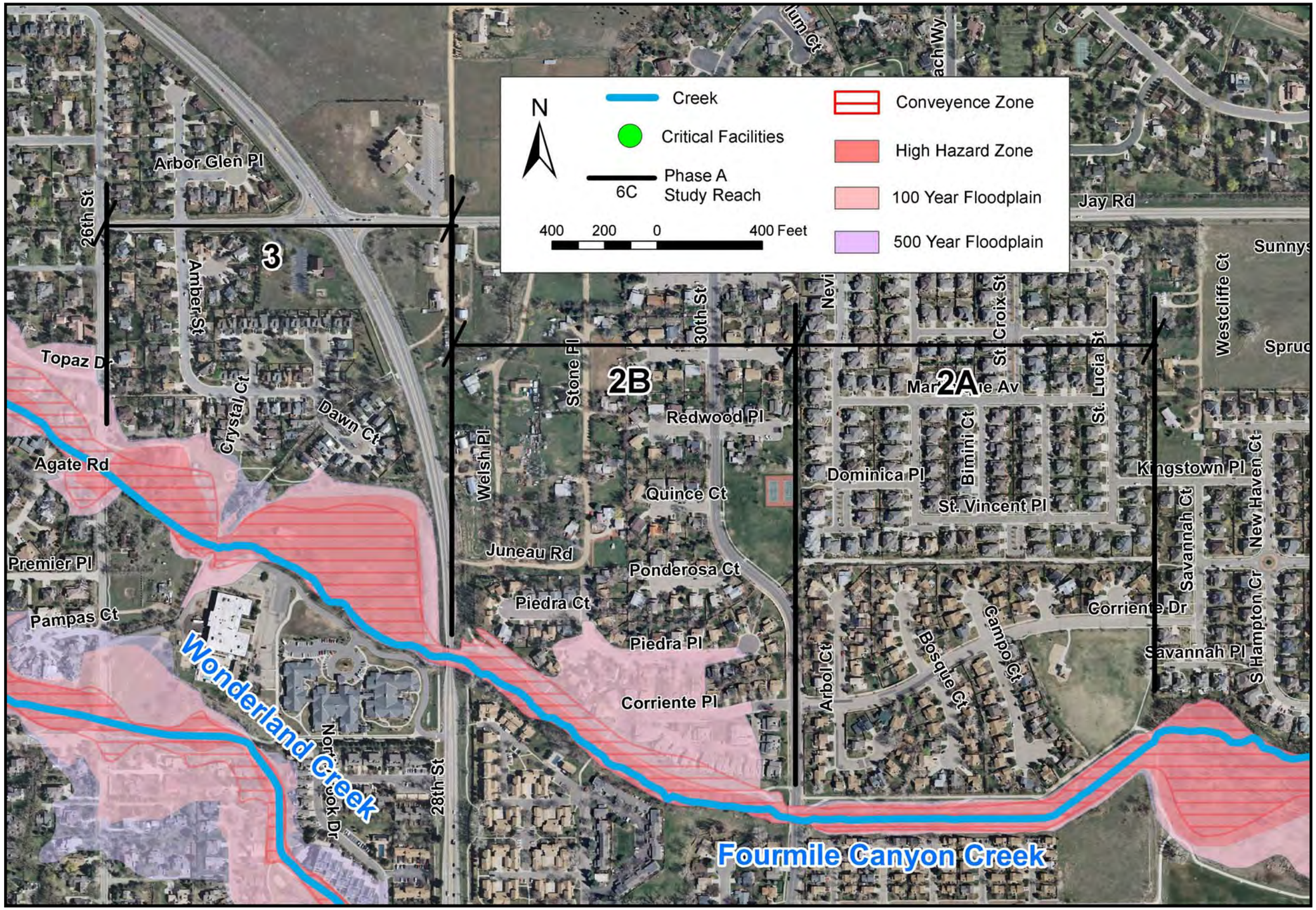
Fourmile Canyon Creek Reach 2a – 30th Street to Pleasant View Soccer Fields

Final Plan – Maintain Existing Conditions ($0 public)

Reach 2a currently fully contains the 100-year flood as shown in **Figure 10.9**. The Phase A Study recommends maintaining existing conditions. Reach 2a, however, is located entirely within Boulder County and therefore City of Boulder staff do not make any flood mitigation recommendations.

Reach 2a looking West

Figure 10.9 Existing Conditions Fourmile Canyon Creek Reaches 3, 2b, 2a



REACH 3
HHZ CONTAINMENT/FLOODPROOFING

**REPLACE 26TH STREET BRIDGE 18'Wx9'H RCB MULTI-USE UNDERPASS WITH UPSTREAM DROP

AMBER ST

**ON-STREET SEDIMENT CAPTURE FACILITY AND WETLAND MITIGATION

EXCAVATE NORTH BANK 2' DEEP FOR CHANNEL TRANSITION

REMOVE & REPLACE EXISTING BRIDGE

26TH ST

**FARMERS DITCH MODIFICATIONS

PREMIER PL.

**CONSTRUCT PEDESTRIAN CROSSING 90± LF

**REMOVE EXISTING PEDESTRIAN BRIDGES (2)

**CONSTRUCT 2' DROP STRUCTURES (10) (LOW PRIORITY)

28TH ST

NOTE: ** COSTS FOR THESE ITEMS ARE INCLUDED IN THE FOURMILE CANYON CREEK MULTI-USE PATH - 26TH TO 28TH

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

CITY OF BOULDER
BOULDER COUNTY

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS
FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS
FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS
STRUCTURES TO BE FLOODPROOFED 1500
PROPOSED TRAIL
EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT
EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS
STRUCTURES RECOMMENDED FOR ACQUISITION
PROPOSED CHANNEL IMPROVEMENTS
SHALLOW FLOOD AREA

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DATE: 8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 3
FOURMILE CANYON CREEK

Fig 10.10

REACH 2B
100-YEAR CONTAINMENT-
PHASE A RECOMMENDATION
(CITY STAFF HOWEVER MAKES NO RECOMMENDATIONS
AS THIS REACH IS IN BOULDER COUNTY)

REACH 2A
MAINTAIN EXISTING CONFIGURATION -
PHASE A RECOMMENDATION
(CITY STAFF HOWEVER MAKES NO RECOMMENDATIONS AS
THIS REACH IS IN BOULDER COUNTY)

CHANNEL TOP WIDTH AND APPROXIMATE 100-YEAR FLOODPLAIN W/CHANNEL IMPROVEMENTS. HIGH HAZARD AND CONVEYANCE ARE CONTAINED IN CHANNEL.

CORRIENTE DR.

28TH ST

30TH ST

CITY OF BOULDER
BOULDER COUNTY

CONSTRUCT 2' DEEP GRADE CONTROL DROP STRUCTURES (TYP. OF 10)

REMOVE AND REPLACE EXISTING PEDESTRIAN CROSSING

185' **

** DUE TO EXISTING STRUCTURES THE FULL WIDTH MAY NOT BE AVAILABLE IN ALL SECTIONS OF THIS REACH. CHANNEL WIDTH COULD BE NARROWED USING A MORE STRUCTURAL CHANNEL CROSS SECTION, SIMILAR TO THAT SHOWN FOR REACH 6A.

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft

REMOVE EXISTING LEVEE
EXISTING CHANNEL
LOWER EXISTING TRAIL
PROPOSED CHANNEL
6.5
3.5
4.5
2.5
2.5
2
0
2
12.5
2.5

REACH 2B
TYPICAL SECTION
NTS

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 2A AND 2B
FOURMILE CANYON CREEK

Fig
10.11

UDFCD Floodplain Mitigation Design Project (30th Street to Soccer Fields)
2016-2017 (anticipated)

Fourmile Canyon Creek Reach 1b – Pleasant View Soccer Fields to BNSF Railroad

Final Plan – Maintain Existing Conditions ($0 public)

As shown on **Figure 10.12**, no structures are impacted by the floodplain under existing conditions. The Final Plan for this reach is therefore to maintain existing conditions (**Figure 10.13).**

Fourmile Canyon Creek Reach 1a –BNSF Railroad to Boulder Creek

Final Plan – High Hazard Zone Containment with Floodproofing (staff however makes no recommendations as this reach is in Boulder County) ($817,000 public for Boulder County)

Figure 10.14 presents existing conditions for Reach 1a. As shown on this figure, the floodplain expands in width as it spills over 57th Street, causing one home to be in the high hazard zone. The Phase A Study recommends high hazard containment with floodproofing for Reach 2b. This reach is, however, located entirely within Boulder County and therefore City of Boulder staff do not make any flood mitigation recommendations. High hazard containment improvements would include:

- Constructing a 12'W x 8'H RCB for multi-use underpass at BNSF railroad just downstream of SH119
- Modifying ditch crossings including excavation of overbanks in crossings just upstream and downstream of N 57th Street
- Replacing the existing 57th Street bridge with a 16'W x 8'H RCB

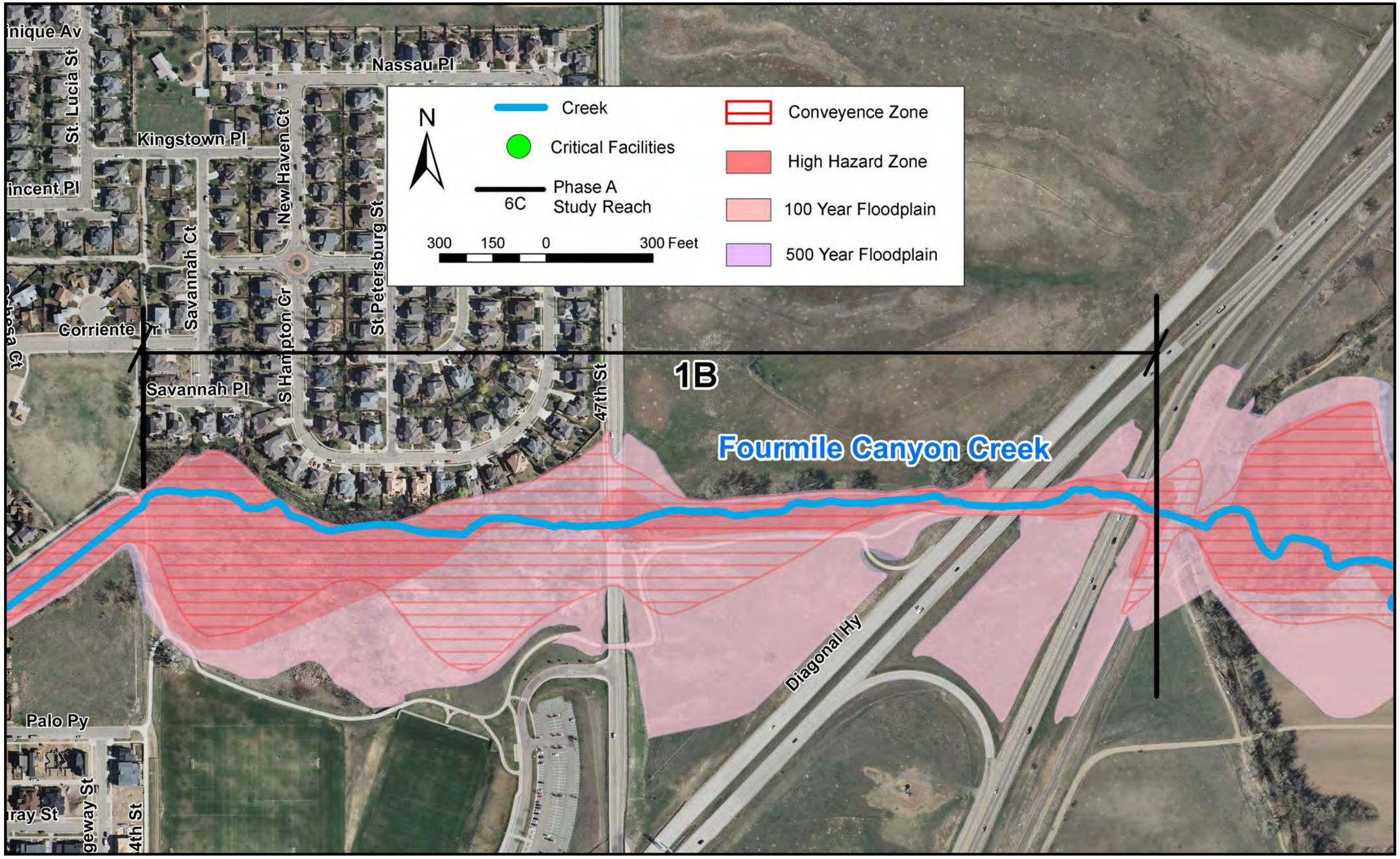
Figure 10.15 presents the Final Plan recommendations for Reach 1a. **Table 10.8** presents total estimated concept-level costs for proposed improvements along Reach 1a.

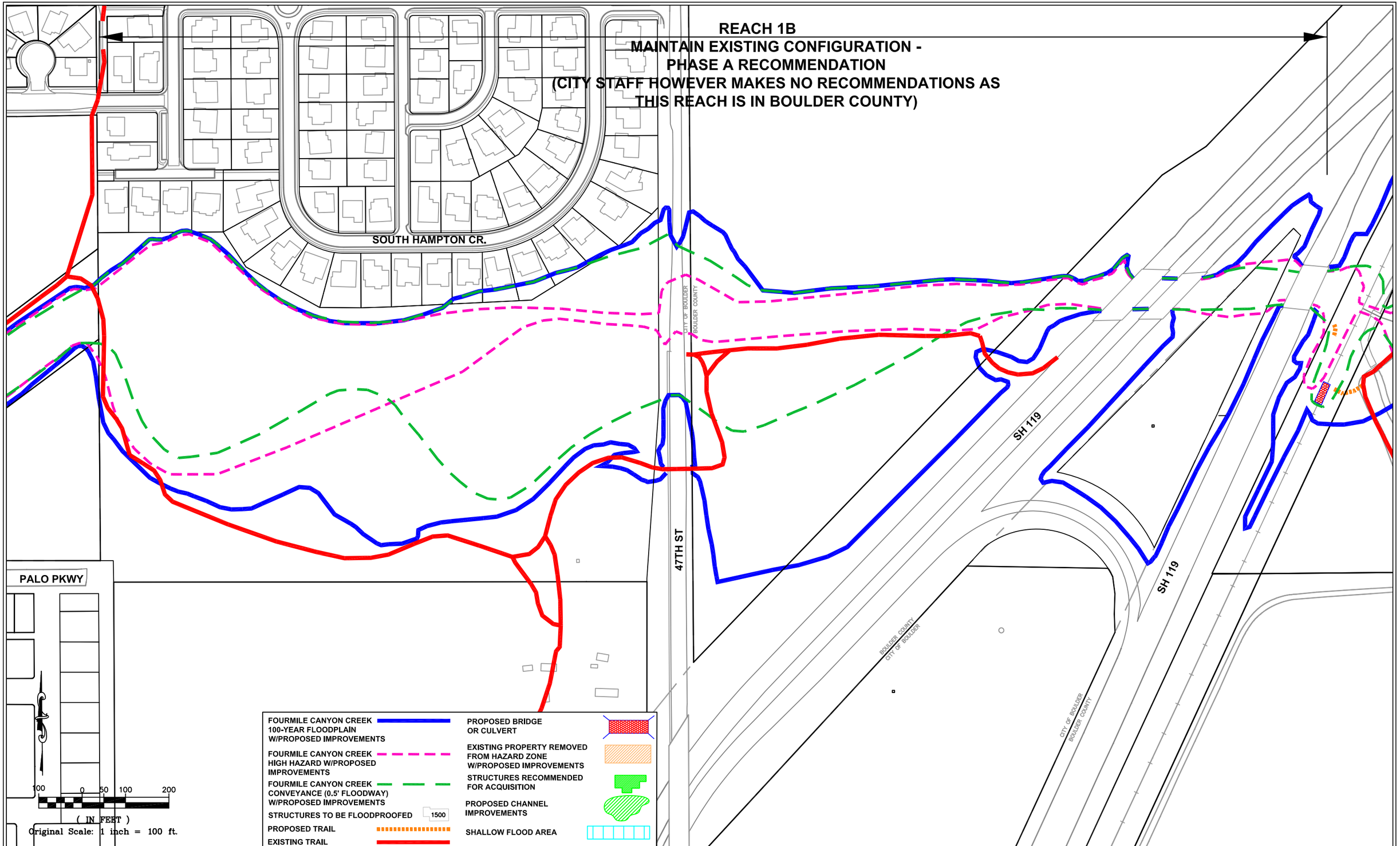
Table 10.8 Concept-Level Cost Estimates (Boulder County) for Fourmile Canyon Creek Reach 1a

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$618,000	$199,000	$267,000	$826,000	$202,000	$0

Reach 1

Figure 10.12 Existing Conditions Fourmile Canyon Creek Reach 1b





GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
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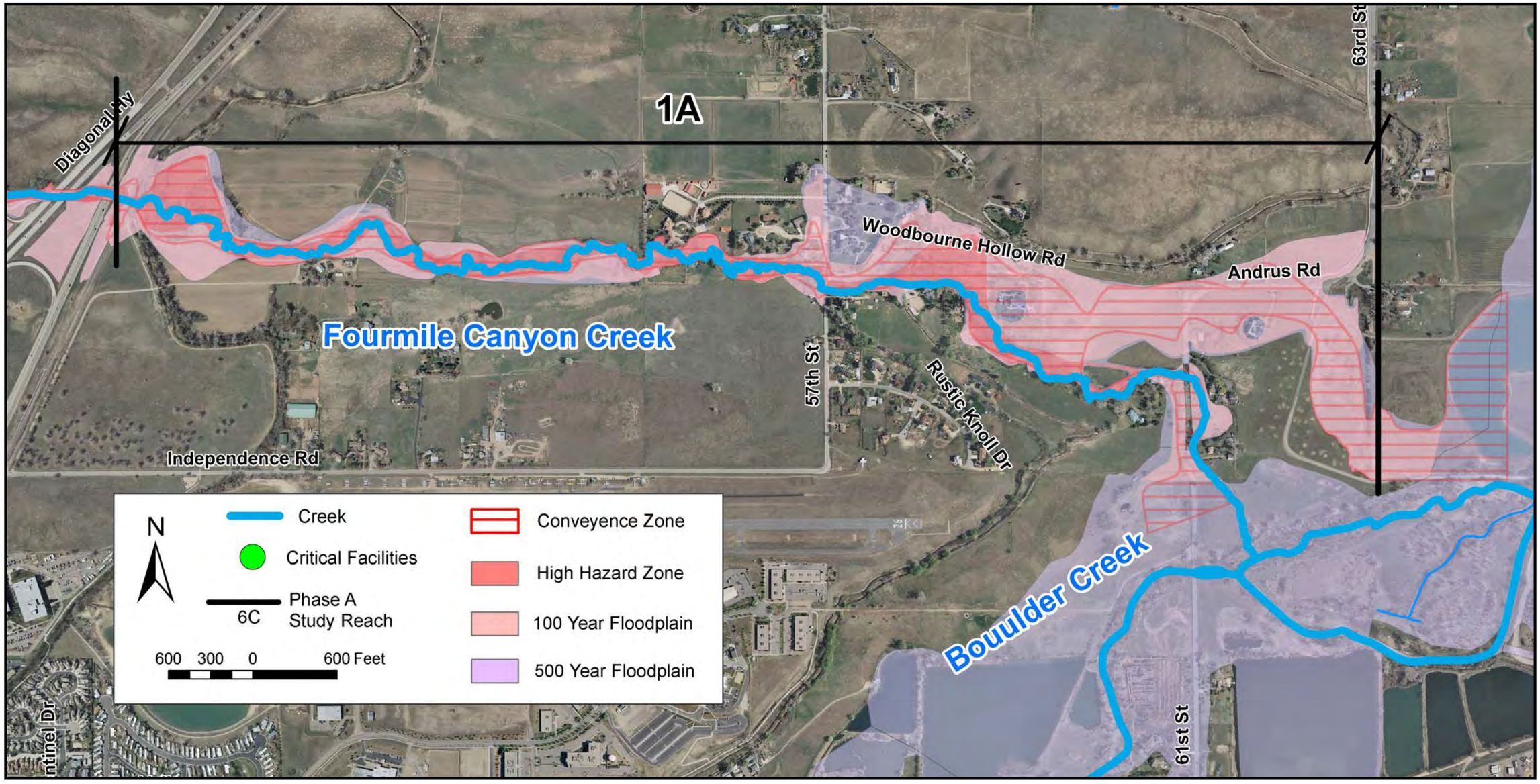
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 1B
FOURMILE CANYON CREEK

Fig
10.13

Figure 10.14 Existing Conditions Fourmile Canyon Creek Reach 1a



REACH 1A (Con't)
HIGH HAZARD CONTAINMENT/FLOODPROOFING -
PHASE A RECOMMENDATION
(CITY STAFF HOWEVER MAKES NO RECOMMENDATIONS AS THIS REACH IS IN BOULDER COUNTY)

SH 119

RAILROAD

~~CONSTRUCT NEW 12'Wx8'H~~
RCB MULTI-USE
UNDERPASS AT
RAILROAD

MATCH LINE

FOURMILE CANYON CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

FOURMILE CANYON CREEK
CONVEYANCE (0.5' FLOODWAY)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 1A
FOURMILE CANYON CREEK

Fig
10.15

REACH 1A (Con't)
HIGH HAZARD CONTAINMENT/FLOODPROOFING -
PHASE A RECOMMENDATION
(CITY STAFF HOWEVER MAKES NO RECOMMENDATIONS AS THIS REACH IS IN BOULDER COUNTY)

MATCH LINE

MODIFY DITCH
CROSSING AND EXCAVATE
IN OVERBANKS

REPLACE 57TH STREET
BRIDGE 16'W x 8'H RCB

N. 57TH ST.

NORTH BOULDER
FARMERS DITCH

MODIFY DITCH/CREEK
CROSSING AND EXCAVATE
IN OVERBANKS

BOULDER AND
LEFT HAND DITCH

MATCH LINE

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

FOURMILE CANYON CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

FOURMILE CANYON CREEK
CONVEYANCE (0.5' FLOODWAY)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 1A
FOURMILE CANYON CREEK

Fig
10.15

REACH 1A (Con't)
HIGH HAZARD CONTAINMENT/FLOODPROOFING -
PHASE A RECOMMENDATION
(CITY STAFF HOWEVER MAKES NO RECOMMENDATIONS AS THIS REACH IS IN BOULDER COUNTY)

BARN

MATCH LINE

OUT BUILDINGS
(LEAVE IN PLACE)

NORTH BOULDER FARMERS DITCH

BOULDER AND LEFT HAND DITCH

N. 61ST ST.

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 1A
FOURMILE CANYON CREEK

Fig 10.15

10.2 *Wonderland Creek*

Wonderland Creek Reach 8 – Wonderland Lake to North Broadway

Final Plan – Maintain Existing Condition ($0 public)

The floodplain extends beyond the creek banks under existing conditions but impacts only open space lands between Wonderland Lake and North Broadway. The Phase A Study and Final Plan recommends maintaining existing conditions. **Figure 10.16** shows the Wonderland Creek Reach 8 existing conditions**. Figure 10.17** presents the Final Plan for Wonderland Creek Reach 8.

Reach 8 looking east at Broadway

Wonderland Creek Reach 7 –North Broadway to 19th Street

Final Plan – Maintain Existing Condition with Safe Access to Crestview Elementary School via 19th Street ($30,000 public)

The Wonderland Creek floodplain along Reach 7 includes the extensive spill from Fourmile Canyon Creek from the north. One critical facility, a Congregate Care (at-risk population), is located along this reach of Wonderland Creek at 1286 Sumac Avenue. **Figure 10.16** shows the existing conditions floodplain limits along with the location of the critical facility.

The public process modified the Phase A Study recommendation of maintaining existing conditions to include safe access to Crestview Elementary School. Providing safe access would include constructing a two-foot deep horseshoe drop structure and constructing approximately 80 linear feet of two feet deep channel transition just upstream of the new crossing at 19th Street (the crossing at 19th Street is included in Reach 6). **Figure 10.18** presents the Final Plan recommendations for Reach 7. **Table 10.9** presents total estimated concept-level costs for proposed improvements along Reach 7.

Reach 7 at 15th Street

Table 10.9 Concept-Level Cost Estimates for Wonderland Creek Reach 7

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$30,000	$0	$807,000	$0	$0	$0

Wonderland Creek Reach 6 – 19th Street to 26th Street

Final Plan – High Hazard Containment with Flood Proofing ($2,310,000 public)

Figure 10.19 shows the extent of the existing floodplain along Wonderland Creek Reach 6. As shown on this figure, the floodplain extends well beyond the creek banks, particularly on the north side of the channel. One critical facility, a day care center located at 4072 North 19th Street just east of 19th Street is located on the study reach. The public process resulted in modifications to the HHZ containment alternative for this reach. Final Plan recommended improvements include:

- Replacing the existing 19th Street crossing with a triple 16' W x 5' H RCB
- Excavating two feet of both banks of the existing channel for approximately 160 linear feet on the downstream side of the proposed 19th Street culverts to provide increased channel capacity and channel transition
- Excavating two feet of existing channel for approximately 650 linear feet on north and south channel banks to increase channel capacity beginning approximately 400 feet upstream of Garnet Lane
- Removing and replacing pedestrian bridge with approximately 220 feet-long structure or low-water crossing with two-foot deep horseshoe drop structure directly south of Garnet Lane
- Constructing an approximately 1,100 feet long, five feet deep overflow channel beginning approximately half way along the study reach

Reach 6 upstream of 26th Street

Proposed improvements would narrow the high hazard zone so that the structures located at the following parcels would be located outside the high hazard zone:

- 4081 Garnet Lane
- 2100 Emerald Road
- 2300 Emerald Road
- 2195 Poplar Avenue
- 2155 Poplar Avenue

Reach 6 downstream of Centennial Middle School

Figure 10.20 presents the Final Plan recommendations for Reach 6. **Table 10.10** presents total estimated concept-level costs for proposed improvements along Reach 6.

Table 10.10 Concept-Level Estimates for Wonderland Creek Reach 6

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$2,104,000	$206,000	$253,000	$2,390,000	$102,000	$0

See design plan for floodplain improvements.
Design: 2014-2015 Construction 2016 - 2017 (anticipated)

Wonderland Creek Reach 5 – 26th Street to 28th Street – High Hazard Zone Containment with Floodproofing unless Substantial Outside Funding can be Secured for 100-year Containment ($3,620,000 public for 100-year containment, $119,000 public for High Hazard Zone containment)

The existing floodplain along Wonderland Creek Reach 5 extends far beyond the creek banks and includes numerous structures. There are no critical facilities located along Reach 5. **Figure 10.19** shows the existing conditions floodplain limits for Reach 5.

The Phase A Study recommended 100-year containment for Wonderland Reach 5. The public process, however, resulted in a Final Plan recommendation that high hazard containment with floodproofing be implemented unless substantial outside funding can be secured to construct 100-year containment improvements.

Figure 10.21 presents the Final Plan recommendations for 100-year containment should substantial outside funding be secured. Improvements would include:

- Replacing the existing 26th Street crossing with four 10'W x 6' H RCB
- Replacing the existing Winding Trail Drive crossing with five 12'W x 4' H RCB
- Enlarging the existing channel along the entire reach (approximately 1,700 linear feet) to 7' deep (typical channel section presented on **Figure 10.21**)
- Constructing 11 two-foot high drops along the stream reach
- Removing and replacing a trail segment located approximately 400 feet downstream of 26th Street and modify a trail crossing located approximately 400 feet upstream of Winding Trail Drive

Table 10.11 presents concept-level costs for the 100-year containment alternative.

Table 10.11 Concept-Level Cost Estimates 100-year Containment Alternative for Wonderland Creek Reach 5

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$3,110,000	$510,000	$282,000	$0	$0	$0

Figure 10.22 presents the Final Plan recommendations for high hazard containment with floodproofing. Improvements would include minor channel work and trail crossing upstream of 28th Street. The work would include excavating the existing channel bank to provide a transition for the proposed culvert under 28th Street (included in Reach 4) and constructing a trail segment approximately 200 feet long and and low-flow crossing. Reach 5 improvements would narrow the high hazard zone so that the structure located at 3755 Birchwood Drive would be located outside the high hazard zone. **Table 10.12** presents concept-level public costs for the high hazard containment with floodproofing alternative.

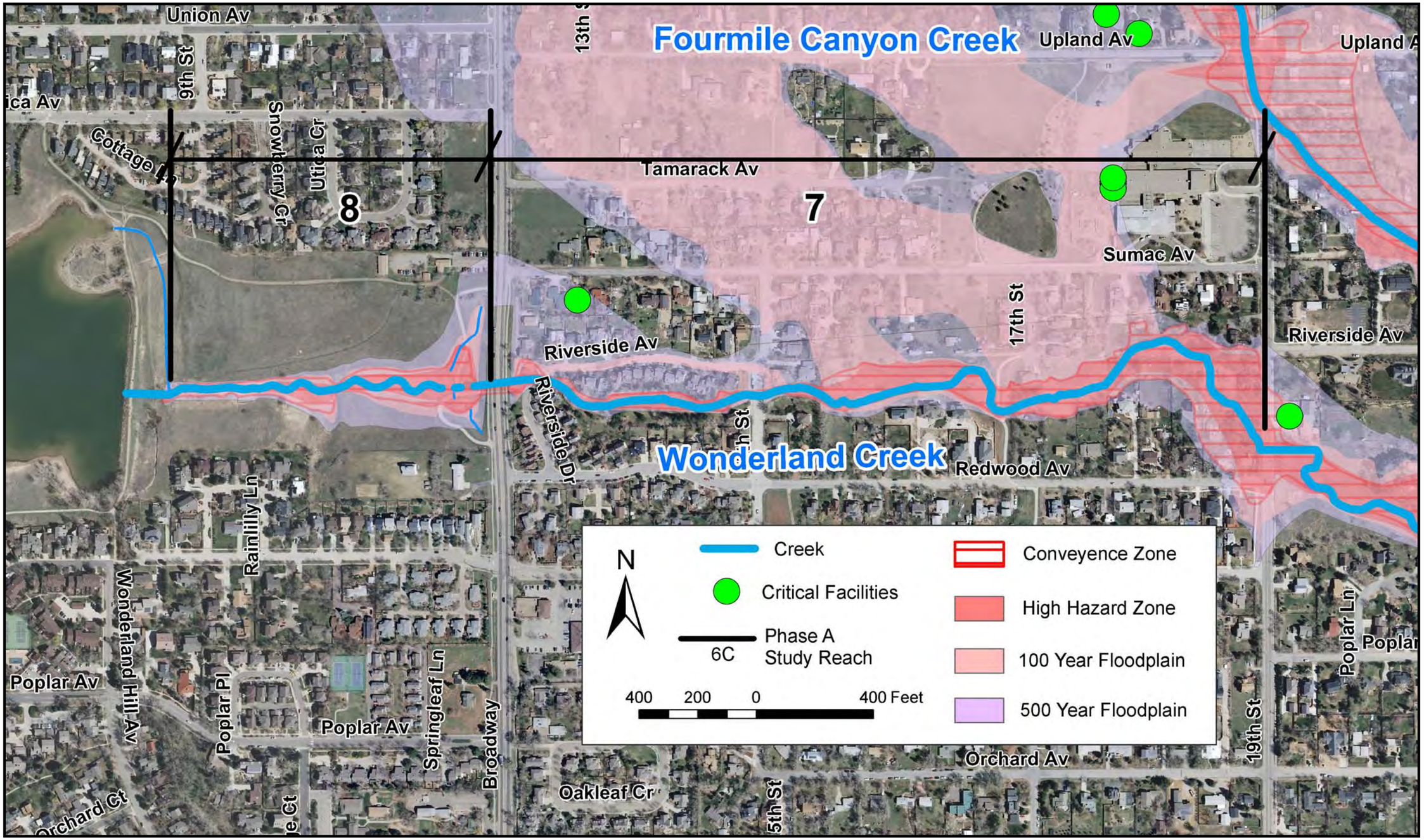
Table 10.12 Concept-Level Cost Estimates High Hazard Containment with Floodproofing Alternative for Wonderland Creek Reach 5

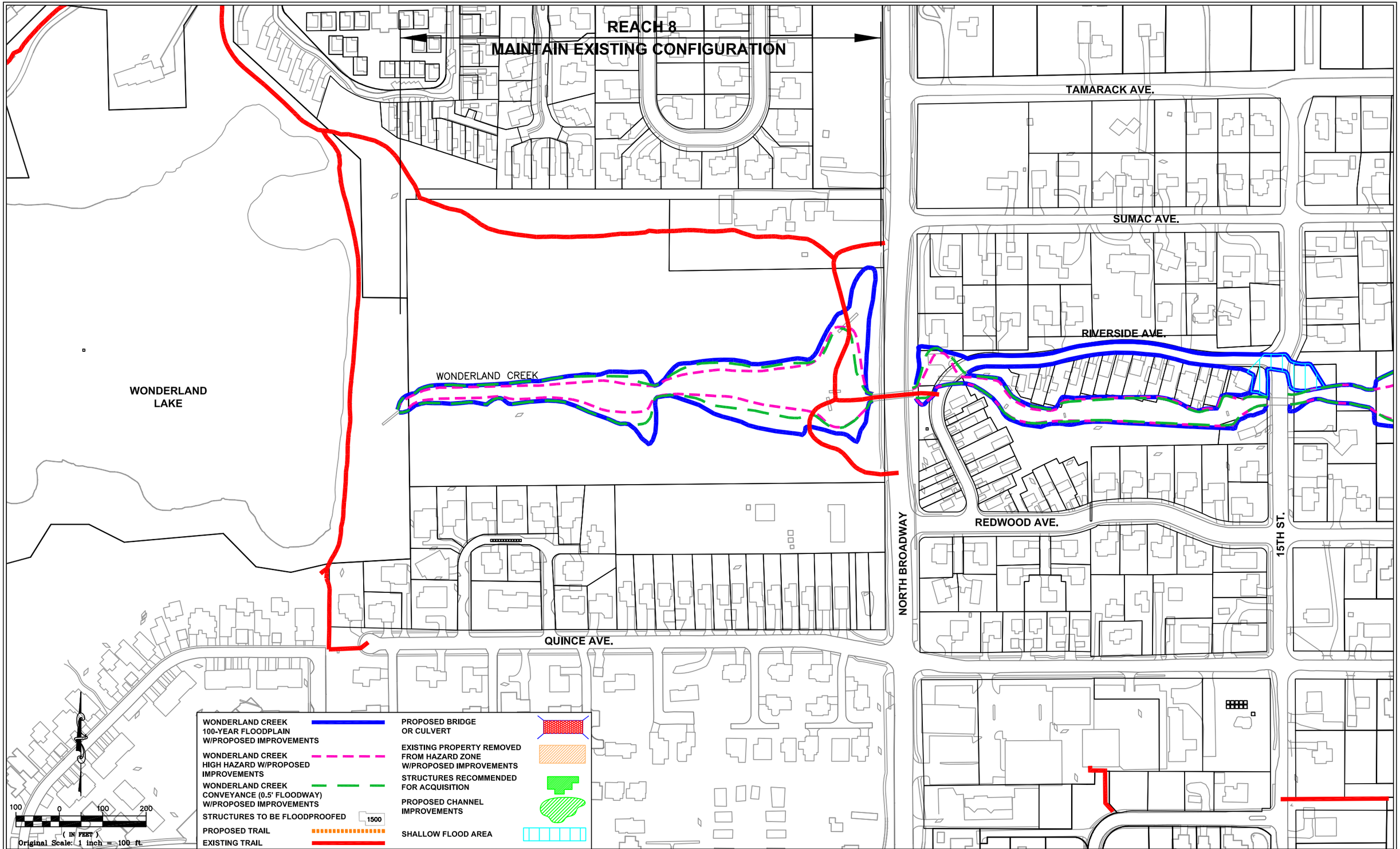
Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$119,000	$0	$493,000	$2,528,000	$49,000	$0

Trail crossing along Reach 5

Reach 5 at Winding Trail Crossing

Figure 10.16 Existing Conditions Wonderland Creek Reach 8, 7





GROUND CONTROL SURVEY BY: MERRICK & COMPANY
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PREPARED BY:

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE REACH 8 WONDERLAND CREEK

Fig 10.17

REACH 7

MAINTAIN EXISTING CONFIGURATION WITH SAFE ACCESS TO CRESTVIEW ELEMENTARY SCHOOL VIA 19TH STREET AND UPLAND

80± LF x 2' DEEP CHANNEL TRANSITION FROM EXISTING CHANNEL TO PROPOSED 100-YEAR BOX CULVERT

CONSTRUCT 2'DEEP HORSESHOE DROP STRUCTURE (1)

TAMARACK AVE.

SUMAC AVE.

RIVERSIDE AVE.

REDWOOD AVE.

QUINCE AVE.

NORTH BROADWAY

15TH ST.

19TH ST.

BOULDER COUNTY
CITY OF BOULDER

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
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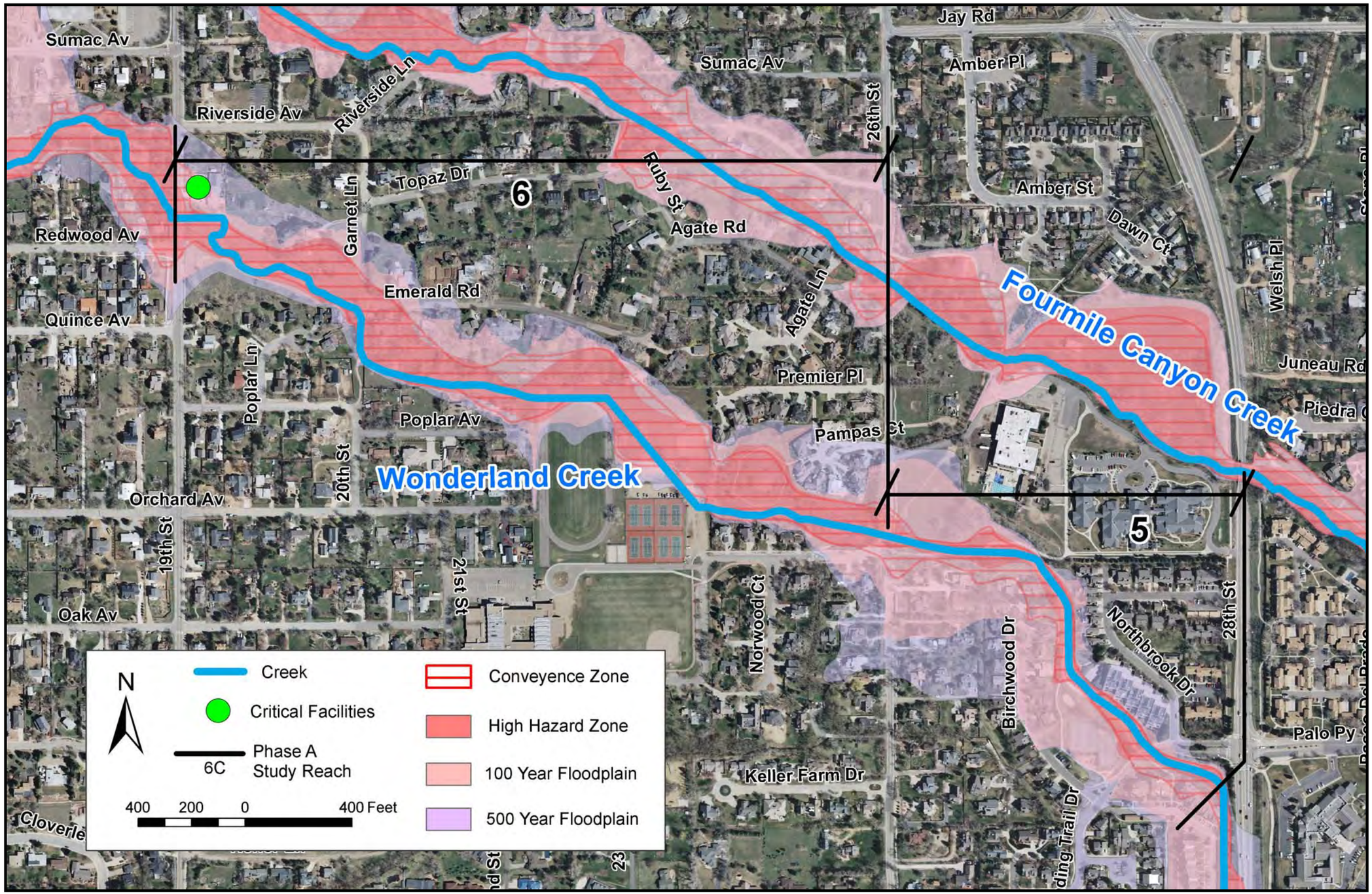
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE REACH 7 WONDERLAND CREEK

Fig 10.18

Figure 10.19 Existing Conditions Wonderland Creek Reach 6, 5



REACH 6

HHZ CONTAINMENT/FLOODPROOFING

REPLACE 19TH STREET CROSSING WITH 3-16'Wx5'H RCB

EXCAVATE 160± LF x 2' DEEP ON NORTH AND SOUTH BANK TO INCREASE CHANNEL CAPACITY. TRANSITION PROPOSED BOX CULVERT GEOMETRY TO EXISTING CHANNEL.

CONSTRUCT 1100± LF x 5' DEEP OVERFLOW CHANNEL

EXCAVATE 700 ± LF x 2' DEEP ON NORTH AND SOUTH BANK TO INCREASE CHANNEL CAPACITY

REMOVE & REPLACE PEDESTRIAN BRIDGE WITH 220± LF STRUCTURE OR LOW WATER CROSSING WITH 2' DEEP HORSESHOE DROP STRUCTURE

RIVERSIDE AVE

EMERALD RD

POPLAR AVE

NORWOOD AVE

19TH ST.

20TH ST.

26TH ST.

GARNET LN

FOURMILE CANYON CREEK

WONDERLAND CREEK

CENTENNIAL MIDDLE SCHOOL
2205 NORWOOD

BOULDER COUNTY
CITY OF BOULDER

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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CHECKED: DJL
DATE: 8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 6
WONDERLAND CREEK

Fig 10.20

REACH 5
100-YEAR CONTAINMENT

REPLACE 26TH STREET CULVERT WITH 4-10'Wx6'H RCB

ENLARGE CHANNEL 1700± LF x 7' DEEP

REMOVE AND REPLACE PEDESTRIAN TRAIL

WONDERLAND CREEK

26TH ST.

MODIFY FARMERS DITCH CROSSING TO CONSTRUCT NEW CULVERT

CONSTRUCT 2' DROP STRUCTURES (8)

MODIFY TRAIL CROSSING - 100± LF

CHANNEL TOP WIDTH AND APPROXIMATE 100-YEAR FLOODPLAIN W/CHANNEL IMPROVEMENTS. HIGH HAZARD AND CONVEYANCE CONTAINED IN CHANNEL.

REPLACE WINDING TRAIL BRIDGE WITH 5-12'Wx4'H RCB

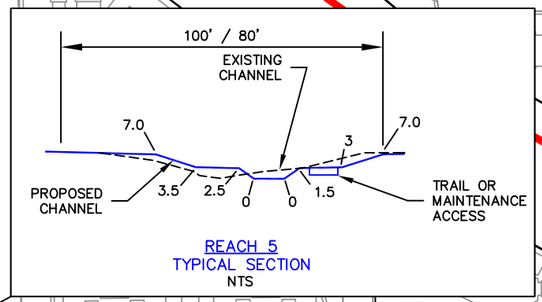
CONSTRUCT 2' DROP STRUCTURES (3)

28TH ST.

PALO PKWY

WINDING TRAIL DR

BOULDER COUNTY / CITY OF BOULDER



REACH 5
TYPICAL SECTION
NTS

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DESIGNED:	SDL
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CHECKED:	DJL
DATE:	8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 5, ALT. A
WONDERLAND CREEK

Fig 10.21

REACH 5
HHZ CONTAINMENT/FLOODPROOFING

2205 NORWOOD

NORWOOD AVE

WONDERLAND CREEK

FARMERS DITCH

26TH ST.

28TH ST.

2975 28TH
ELKS CLUB

POOL

NEW ASSISTED LIVING BUILDINGS

CONSTRUCT
PEDESTRIAN TRAIL
AND LOW FLOW CROSSING

CHANNEL TRANSITION
TO NEW CROSSING
UNDER 28TH ST.

PALO PKWY

WINDING TRAIL DR.

MANOR CARE
2800 PALO PKWY

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

WONDERLAND CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

WONDERLAND CREEK
0.5' FLOODWAY (CONVEYANCE)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 5, ALT. B
WONDERLAND CREEK

Fig
10.22

See design plan for floodplain improvements.
Design: 2014-2015 Construction 2016 - 2017 (anticipated)

Wonderland Creek Reach 4 – 28th Street to Diagonal Highway

Final Plan – High Hazard Zone Containment with Floodproofing unless Substantial Outside Funding can be Secured for 100-year Containment ($4,252,000 public for 100-year Containment, $3,283,000 public for High Hazard Zone Containment)

The existing floodplain along Wonderland Creek Reach 4 extends far beyond the creek banks, particularly on the south side of the channel, and includes numerous structures. There are no critical facilities located along Reach 4. **Figure 10.23** shows the existing conditions floodplain limits for Reach 4. The Phase A Study recommended 100-year containment for Wonderland Reach 4. The public process, however, resulted in a Final Plan recommendation that high hazard containment with floodproofing be implemented unless substantial outside funding can be secured to construct 100-year containment improvements.

Figure 10.24 presents the Final Plan recommendations for 100-year containment should substantial outside funding be secured. Improvements would include:

Reach 4 upstream of Diagonal Hwy

- Constructing a 20'W x 9'H RCB with trail underpass at 28th Street with channel transition
- Constructing a low-flow trail crossing for the underpass at the downstream side of the proposed 28th Street culvert
- Constructing an approximately 750 feet-long, nine feet deep overflow channel between 28th Street and Kalmia Avenue
- Constructing five two-foot deep drop structures in the lower half of the channel segment between 28th Street and Kalmia Avenue
- Removing, lowering and replacing approximately 200 feet of trail on the north side of the channel at Kalmia Avenue
- Adding an additional 5'W x 6'H RCB to the existing Kalmia Avenue crossing
- Constructing an approximately 1,200 feet-long, stepped boulder wall channel (typical cross section shown on **Figure 10.24**)between Kalmia Avenue and SH119 including five two-foot high drop structures
- Replacing an existing pedestrian crossing located approximately 400 feet downstream of Kalmia Avenue with a clear span bridge
- Replacing a fire access crossing located approximately 400 feet upstream of SH119 with 80 feet long twin 20'W x 9'H RCB

Table 10.13 presents concept-level costs for the 100-year containment alternative.

Table 10.13 Concept-Level Cost Estimates 100-year Containment Alternative for Wonderland Creek Reach 4

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$3,663,000	$589,000	$479,000	$0	$0	$0

Figure 10.25 presents the Final Plan recommendations for high hazard containment with floodproofing. Improvements would include:

Reach 4 downstream of 28th Street

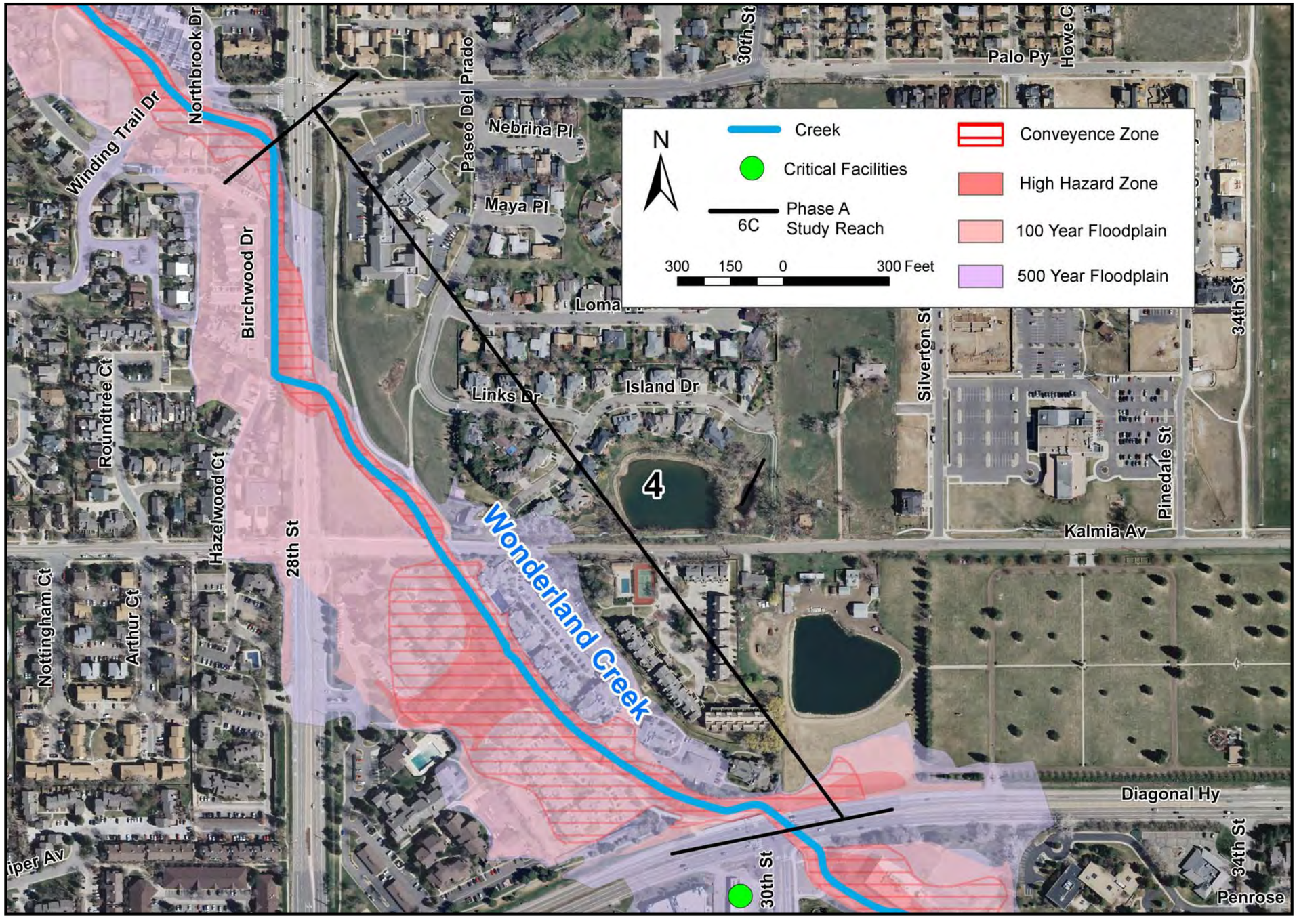
- Constructing a 20'W x 9'H RCB with trail underpass at 28th Street with channel transition
- Constructing a low-flow trail crossing for the underpass at the downstream side of the proposed 28th Street culvert
- Constructing an approximately 715 feet-long, seven feet deep overflow channel from 28th Street to the existing open channel
- Adding an additional 5'W x 6'H RCB to the existing Kalmia Avenue crossing
- Installing a 6'W x 2'H culvert on the south side of Kalmia Avenue under 28th Street to provide cross drainage from west to east under 28th Street
- Replacing an existing pedestrian crossing located approximately 400 feet downstream of Kalmia Avenue with a clear span bridge
- Replacing a fire access crossing located approximately 400 feet upstream of SH119 with 80 feet long twin 20'W x 9'H RCB
- Constructing two 2.5 feet high stepped boulder walls along the south channel bank from Kalmia Avenue to SH119 (typical cross section shown on **Figure 10.25**)

Reach 4 High Hazard Containment improvements would narrow the high hazard zone so that the structure located at 2800 Kalmia Avenue would be located outside the high hazard zone. **Table 10.14** presents concept-level costs for the high hazard containment with floodproofing alternative.

Table 10.14 Concept-Level Cost Estimates High Hazard Containment with Floodproofing Alternative for Wonderland Creek Reach 4Figure 10.23 Existing Conditions Wonderland Creek Reach 4

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$2,924,000	$359,000	$774,000	$3,117,000	$0	$0

Figure 10.23 Existing Conditions Wonderland Creek Reach 4



REACH 4
100-YEAR CONTAINMENT

CONSTRUCT 28TH STREET BRIDGE 20'Wx9'H RCB TRAIL/UNDERPASS

CONSTRUCT LOW FLOW TRAIL CROSSING

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

CONSTRUCT 715± LF x 9' DEEP OVERFLOW CHANNEL FROM UNDERPASS TO CREEK

CONSTRUCT 2' DROP STRUCTURES (5)

REMOVE, LOWER AND REPLACE PEDESTRIAN TRAIL

INCREASE CAPACITY OF KALMIA BOX. ADD 5'Wx6'H RCB

28TH ST

EXISTING 12'Wx6'H RCB

500± LF - ENLARGE CHANNEL

KALMIA AVE

REPLACE PEDESTRIAN CROSSING WITH 100± LF CLEAR SPAN BRIDGE

BOULDER COUNTY OPEN SPACE

CONSTRUCT 1200± LF x 9' HIGH STEPPED BOULDER WALL CHANNEL

1200± LF - ENLARGE CHANNEL

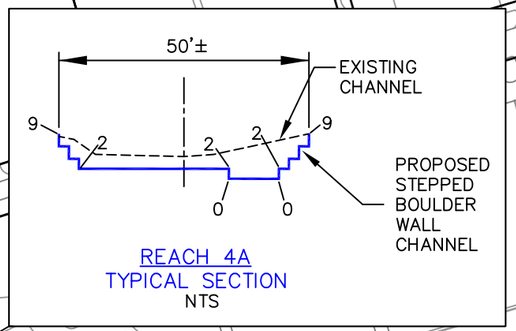
CONSTRUCT 2' DROP STRUCTURES (4)

REPLACE FIRE ACCESS CROSSING WITH 2-20'Wx9'Hx40'L BOX CULVERTS

SH 119

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

CONSTRUCT 2' DROP STRUCTURE (1)



REACH 4A
TYPICAL SECTION
NTS

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DATE: 8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 4, ALT. A
WONDERLAND CREEK

Fig 10.24

REACH 4
HHZ CONTAINMENT/FLOODPROOFING

NEW PEDESTRIAN TRAIL/UNDERPASS 20'Wx9'H WITH CHANNEL TRANSITION

CONSTRUCT LOW FLOW TRAIL CROSSING

MANOR CARE
2800 PALO PKWY

CONSTRUCT 715± LF x 7' DEEP OVERFLOW CHANNEL FROM UNDERPASS TO CREEK

INCREASE CAPACITY KALMIA BOX. ADD 5'Wx6'H RCB

EXISTING 12'Wx6'H RCB

CONSTRUCT 160± LF CROSS DRAINAGE CULVERT 6'Wx2'H RCB

28TH ST

2800 PALO PKWY

KALMIA AVE

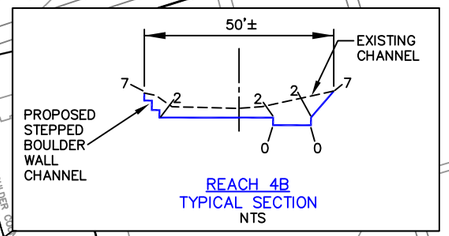
REPLACE PEDESTRIAN CROSSING WITH 100± LF CLEAR SPAN BRIDGE

REPLACE FIRE ACCESS CROSSING WITH 2-20'Wx9'Hx40'L BOX CULVERTS

SH 119

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

ADD 2-2 ½ FT STEPPED BOULDER WALLS TO SOUTHWEST BANK TO INCREASE CHANNEL CAPACITY FROM SH 119 TO KALMIA AVE.



REACH 4B
TYPICAL SECTION
NTS

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK 0.5' FLOODWAY (CONVEYANCE) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
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DESIGNED: SDL
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 4, ALT. B
WONDERLAND CREEK

Fig 10.25

See design plan for floodplain improvements.
Design: 2014-2015 Construction 2016 - 2017 (anticipated)

Wonderland Creek Reach 3 – Diagonal Highway to Foothills Parkway

Final Plan – High Hazard Zone Containment with Floodproofing unless Substantial Outside Funding can be Secured for 100-year Containment ($6,575,000 public for 100-year containment, $5,816,000 public for High Hazard Zone containment)

The existing conditions floodplain extends far beyond the creek banks along Reach 3 as shown on **Figure 10.26**. The following three critical facilities are located along this reach:

- AMOCO gas station at 2990 Diagonal Highway
- The Atrium Brookside Senior Living Center at 3350 30th Street
- Wynwood Senior Living Center at 3375 34th Street

The Phase A Study recommended 100-year containment for Wonderland Reach 3. The public process, however, resulted in a Final Plan recommendation that high hazard containment with floodproofing be implemented unless substantial outside funding can be secured to construct 100-year containment improvements. **Figure 10.27** presents the Final Plan recommendations for 100-year containment should substantial outside funding be secured. 100-year Containment Improvements would include:

- Constructing a triple 10'W x 8'H RCB with safety rack under Iris Avenue, acquiring and demolishing of a structure located at 3115 Iris Avenue and constructing a new transition channel into the box culverts
- Enlarging the existing channel between 34th Street and the Boulder and White Rock Ditch (typical cross section shown on **Figure 10.24**) including three two-foot high drop structures between 34th Street and Spring Creek Place
- Replacing the existing Spring Creek Place crossing with four 10'W x 6'H RCB
- Constructing a pedestrian trail crossing between Spring Creek Place and the Boulder and White Rock Ditch
- Separating Wonderland Creek from the Boulder and White Rock Ditch
- Replacing the existing railroad bridge with four 12'W x 5'H RCB
- Constructing a channel transition from the railroad to the existing Foothills Parkway box culverts

Reach 3 downstream from 34th Street

Table 10.15 presents concept-level costs for the 100-year containment alternative.

Table 10.15 Concept-Level Cost Estimates 100-year Containment Alternative for Wonderland Creek Reach 3

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$5,833,000	$742,000	$216,000	$0	$0	$0

Figure 10.28 presents the Final Plan recommendations for high hazard containment with floodproofing. High Hazard Containment improvements would include:

- Constructing a triple 10'W x 8'H RCB with safety rack under Iris Avenue, acquiring and demolishing a structure located at 3115 Iris Avenue and constructing a new transition channel into the box culverts
- Replacing the existing Spring Creek Place crossing with four 10'W x 6'H RCB
- Constructing a pedestrian trail crossing between Spring Creek Place and the Boulder and White Rock Ditch
- Separating Wonderland Creek from the Boulder and White Rock Ditch
- Replacing the existing railroad bridge with four 12'W x 5'H RCB
- Constructing a channel transition from the railroad to the existing Foothills Parkway box culverts

Reach 3 High Hazard Containment improvements would narrow the High Hazard Zone so that the structures located at 3375 34th Street, 3700 Hayden Place and 3690 Hayden Place would be located outside the High Hazard Zone. **Table 10.14** presents concept-level costs for the High Hazard Containment with Floodproofing alternative.

Table 10.16 Concept-Level Cost Estimates High Hazard Containment with Floodproofing Alternative for Wonderland Creek Reach 3

Flood Control Improvements			Floodproofing (Private Cost)	Non Flood Mitigation Improvements	
Construction	ROW	O&M		Construction	ROW
$5,256,000	$560,000	$434,000	$3,506,000	$0	$0

Reach 3 downstream from Spring Creek Place

Reach 3 Box Culverts under Foothills Parkway

Tree Removal Project 47th Street and Kings Ridge Road. Complete 2016.

Wonderland Creek Reach 2 – Foothills Parkway to Valmont Road

Final Plan – Maintain Existing Conditions ($0 public)

The 100-year floodplain is fully contained along the entire length of Wonderland Creek Reach 2 under existing conditions. The 500-year event is also contained under existing conditions along the entire reach with the exception of the downstream end near Valmont Road. There are no critical facilities located along this creek reach. **Figure 10.20** presents the existing conditions floodplain limits along Wonderland Reach 2. The public process did not modify this recommendation. **Figure 10.21** presents the structures identified for floodproofing along Wonderland Creek Reach 2. There are no public costs associated with the Final Plan recommendations.

Reach 2 Kings Ridge Road Crossing

Reach 2 between 47th Street and Kings Ridge Road

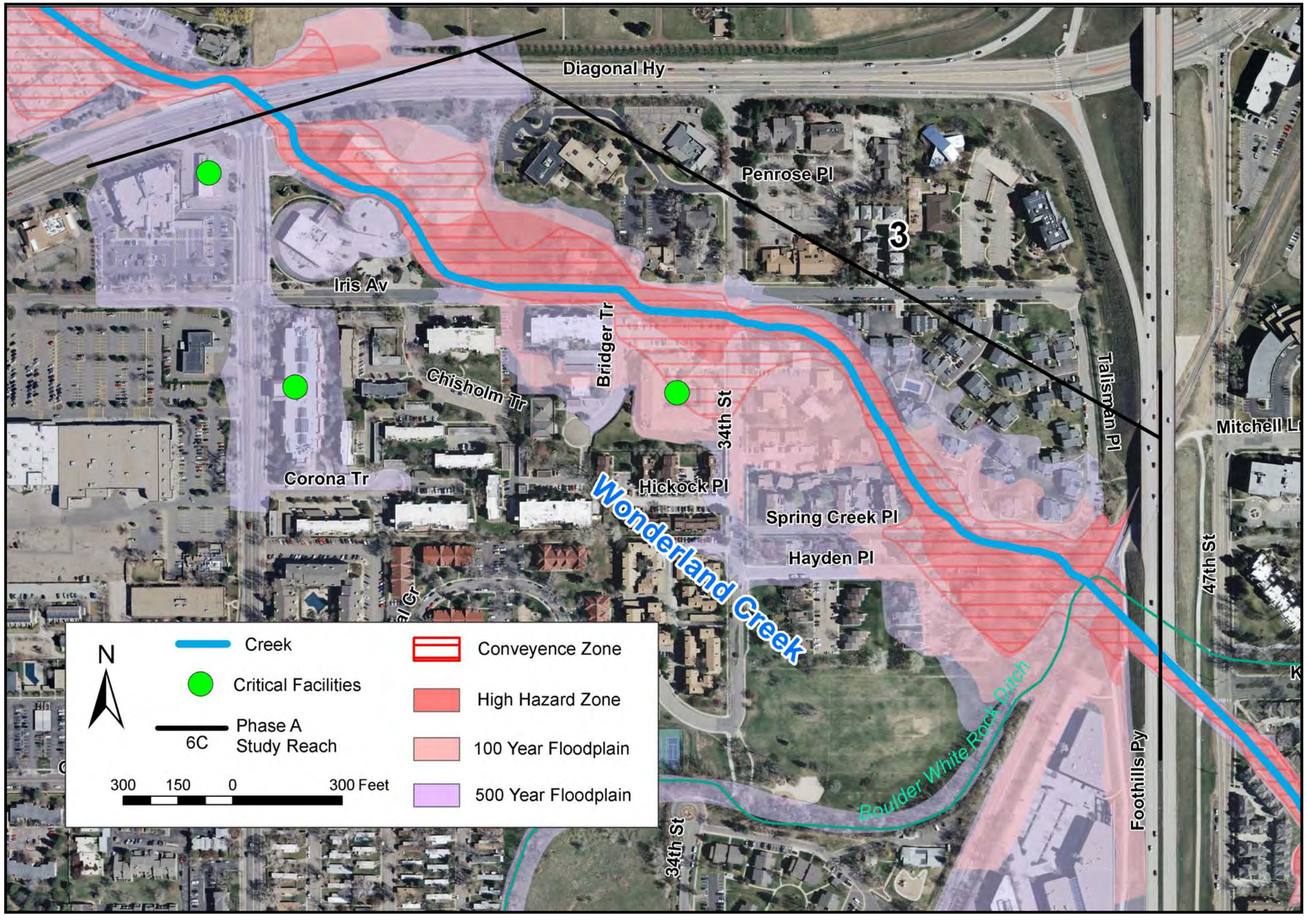
Wonderland Creek Reach 1 – Valmont Road to Goose Creek

Final Plan – Maintain Existing Conditions ($0 public)

The existing conditions floodplain impacts only city owned property in Valmont City Park (**Figure 10.20**). The Phase A Study recommends maintaining existing conditions along this reach (**Figure 10.21).** The public process did not modify this recommendation. There are no public costs associated with this recommendation.

Reach 1 looking downstream at Valmont Road

Figure 10.26 Existing Conditions Wonderland Creek Reach 3



REACH 3
100-YEAR CONTAINMENT

BOULDER COUNTY
CITY OF BOULDER

SH 119

PROPERTY ACQUISITION (3115)

REPLACE IRIS AVE. & 34TH ST. CULVERTS 3-10'Wx8'H RCB W/SAFETY RACK

WONDERLAND CREEK

IRIS AVE

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

IRIS AVE

SEPARATE BOULDER & WHITEROCK DITCH

REPLACE RAILROAD BRIDGE 4-12'Wx5'H RCB

CONSTRUCT TRANSITION FROM EXISTING CHANNEL TO NEW RCB

30TH ST

SOUTH BANK HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

34TH ST

CONSTRUCT 2' DROP STRUCTURES (3)

CONSTRUCT 100± LF PEDESTRIAN TRAIL CROSSING

ENLARGE CHANNEL

CONSTRUCT IMPROVED INLET AT FOOTHILLS PKWY/ 47TH CULVERT

SPRING CREEK PL.

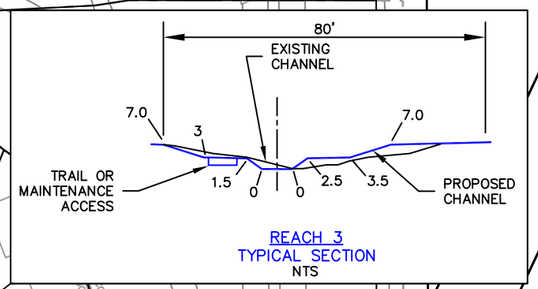
REPLACE SPRING CREEK PLACE BRIDGE WITH 4-10'Wx6'H RCB

BOULDER & WHITEROCK DITCH

RAILROAD

FOOTHILLS PKWY

47TH ST



REACH 3
TYPICAL SECTION
NTS

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 3, ALT. A
WONDERLAND CREEK

Fig 10.27

REACH 3
HHZ CONTAINMENT/FLOODPROOFING

SH 119

BOULDER COUNTY
CITY OF BOULDER

PROPERTY ACQUISITION (3115)

REPLACE IRIS AVE. & 34TH ST. CULVERTS WITH 3-10'Wx8'H RCB W/SAFETY RACK

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

IRIS AVE

WONDERLAND CREEK

CONSTRUCT TRANSITION FROM EXISTING CHANNEL TO NEW RCB

SOUTH BANK HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

30TH ST

34TH ST

REPLACE RAILROAD BRIDGE 4-12'Wx5'H RCB

CONSTRUCT 100± LF PEDESTRIAN TRAIL CROSSING

CONSTRUCT IMPROVED INLET AT FOOTHILLS PKWY/ 47TH CULVERT

47TH ST

FOOTHILLS PKWY

SPRING CREEK PL.

REPLACE SPRING CREEK PLACE BRIDGE WITH 4-10'Wx6'H RCB

EXCAVATE NORTH AND SOUTH OVERBANK 2' DEEP FOR ADDITIONAL CAPACITY

SEPARATE BOULDER & WHITEROCK DITCH

RAILROAD

ASSISTED LIVING

TENNIS

POOL

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK 0.5' FLOODWAY (CONVEYANCE) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

PREPARED BY:
BELT COLLINS WEST
water resource consultants
4999 Pearl East Circle, Suite 300
Boulder, Colorado 80301-6100
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Fax: 303-786-8028

DESIGNED: SDL
DRAWN: PEM
CHECKED: DJL
DATE: 8/27/10

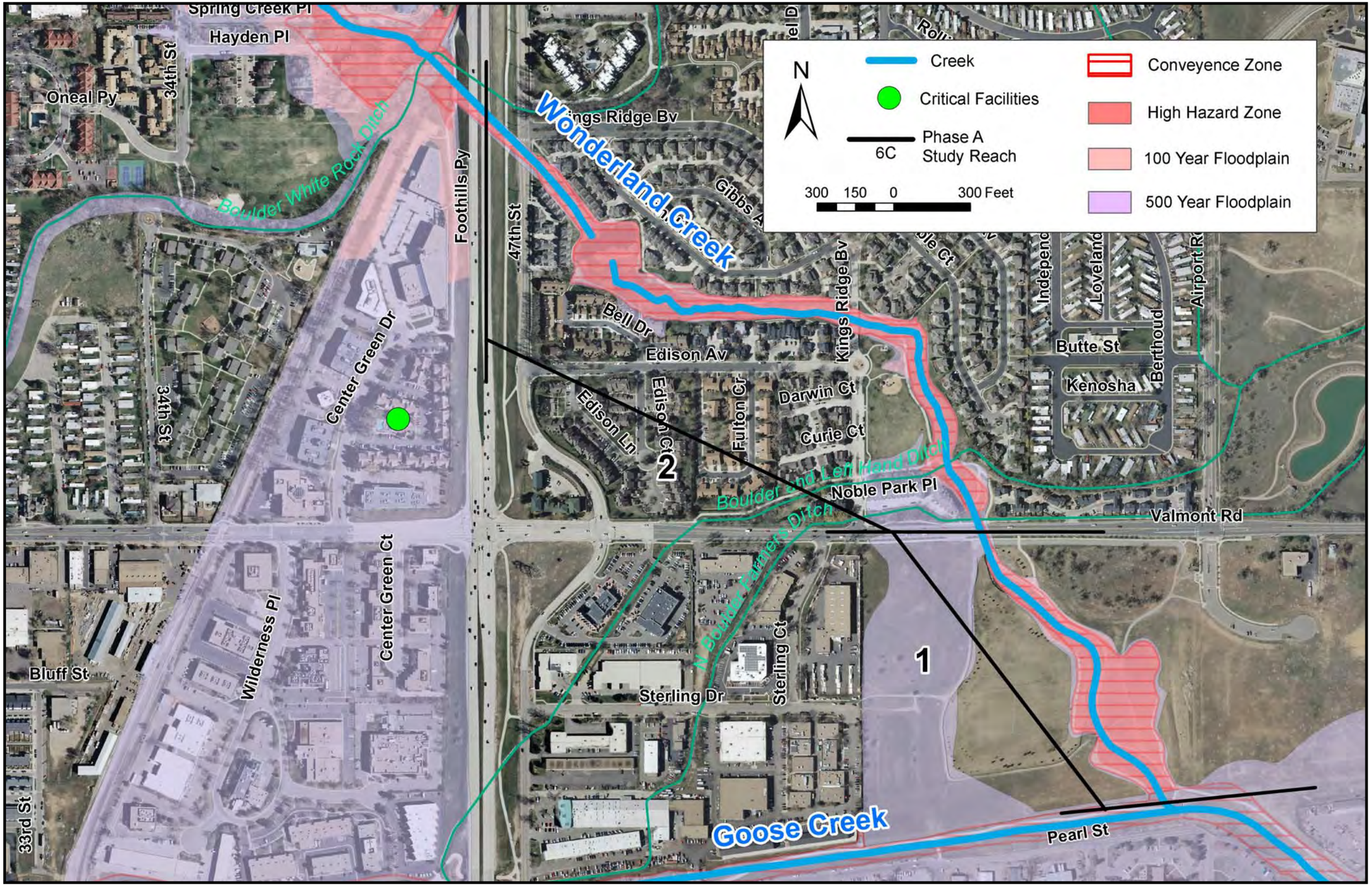
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE
REACH 3, ALT. B
WONDERLAND CREEK

Fig 10.28

Figure 10.29 Existing Conditions Wonderland Creek Reach 2, 1



REACH 2
MAINTAIN EXISTING CONFIGURATION

KING'S RIDGE BLVD

FOOTHILLS PKWY

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

EDISON AVE

KING'S RIDGE RD

VALMONT RD

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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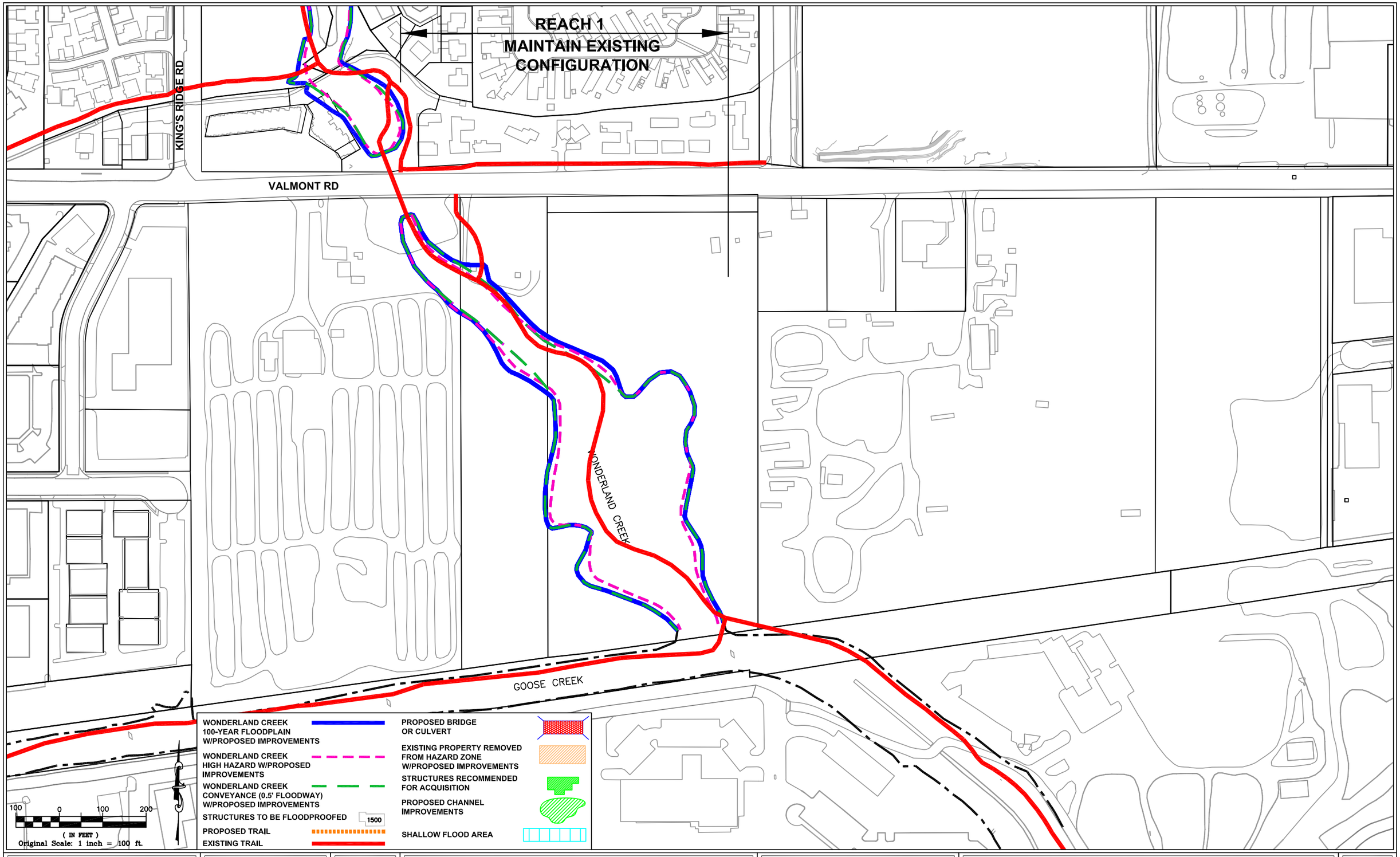
DATE:

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

RECOMMENDED ALTERNATE REACH 2 WONDERLAND CREEK

Fig 10.30



GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

RECOMMENDED ALTERNATE
REACH 1
WONDERLAND CREEK

Fig
10.31

No Changes to General Recommendations.
Implementation Plan not updated.

11.0 GENERAL RECOMMENDATIONS AND FINAL PLAN IMPLEMENTATION

This section presents general recommendations and recommended implementation of final plan elements.

General Recommendations

The drawings presented in this document are for master planning purposes and represent conceptual-level engineering only and should not be used for construction purposes. Alternatives to the recommendations will be considered during the city's Community Environmental Assessment Process (CEAP) in conjunction with the Urban Drainage and Flood Control District (UDFCD). Alternatives should, however, represent the equivalent intent of the plan, including hydraulic capacity, water quality, stream stability and natural waterway features. The alternatives must comply with the City of Boulder and UDFCD requirements and criteria. In addition, there may be State and Federal requirements that will need to be considered and met.

The City of Boulder manages and regulates all land use change, development and redevelopment activities within and adjacent to the 100-year floodplains in order to prevent, to a maximum extent possible, future flood damages to buildings and structures from the 100-year flood and to minimize damages from larger floods. The recommendations of this plan provide a set of options subscribed to by the city in carrying out their flood plain management and regulatory responsibilities and obligations. It should be noted that implementation of recommended plan elements will take many years to complete. Any major changes in the watershed such as major changes in land use will require revising the plan hydrology and hydraulic analysis.

It should also be recognized that while some of the recommended alternatives in this plan provide only High Hazard containment, one of the goals of UDFCD drainage master plans is to remove as many structures as feasible from the 100-year floodplain. The UDFCD therefore prefers 100-year containment over a lower level of flood protection.

The following items should be considered during preliminary design of recommended plan features:

- List on each plan view and profile sheet of the preliminary design, where appropriate, the recommended wetland mitigations that will be needed to implement recommended improvements, if any.
- Include on each plan sheet of the preliminary design, the following statement: "Many activities that occur or affect ditches, drainages, creeks, ponds or wetlands require a Section 404 Permit Authorization from the US Army Corps of Engineers. During preliminary design, and prior to final design or starting work, contact the Corps' Denver Regulatory Office at 303-979-4120 for appropriate permit authority to avoid compromising and delaying the completion of the project."
- Show on appropriate plan and profile sheets (and as deemed necessary) facilities to arrest the vertical degradation of the low-flow channel of natural and man-made waterways and to help rehabilitate, as much as possible their stable function and habitat.
- Recommend rehabilitating eroded and degraded banks where needed and desired to arrest the horizontal erosion along natural waterways using bio-engineered methods that combine buried soil riprap and revegetation with native species of riparian and dryland vegetation.
- Show on plan view and profile sheets the needed buttressing of critical utilities and other structures that may be endangered by stream erosion.
- Consider the various functions (as reported in the Greenways Master Plan) of all natural waterways in the study watersheds and their floodplains, including flood conveyance, riparian habitat, open space, aesthetics, recreation, urban development, water quality, utility crossings, transportation and other features.

Recommended Implementation Plan

The city has developed an implementation plan for recommended Final Plan elements. The recommended implementation plan segments do not always coincide with the Final Plan reach designations. It should also be noted that Fourmile Canyon Creek Final Plan reaches 6c, 2b, 2a, 1b and 1a and Wonderland Creek Final Plan reaches 1, 2, and 8 are either located in Boulder County or recommended for maintaining existing conditions and therefore are not included in the project implementation plan.

Three Final Plan segments are in the city's 2011-2016 Capital Improvement Program (CIP) budget. Wonderland Creek Segments A and B (Foothills Parkway to the Diagonal Highway) recommended improvements will be designed in 2011. Fourmile Canyon Creek Segment C (just upstream of 26th Street to just downstream of 19th Street) is also included in the CIP budget.

Table 11.1 presents the recommended implementation plan for Fourmile Canyon Creek. **Table 11.2** presents the recommended implementation plan for Wonderland Creek. There are five recommended segments for each creek. The tables identify the recommended segments in relationship to the Final Plan reach. Segment improvements along with summary costs are also presented. **Tables 11.3 and 11.4** present itemized costs by plan segment. It should be noted that all cost estimates include a 40% contingency were developed for the master plan. Some plan elements have been refined from the master plan cost estimates and include a 15% contingency. Refinement sources include analysis for submittal for federal Transportation Improvement Program (TIP) grant funding. It should also be noted that for Wonderland Creek Reaches C, D and E two sets of itemized costs are presented, one for High Hazard Containment only and one for 100-year containment improvements. Two sets are presented because City Council approved recommendation of 100-year containment if substantial outside funding could be secured.

Figures 11.1 through 11.5 present the Fourmile Canyon Creek recommended improvement plan segments. **Figures 11.6 through 11.15** present the Wonderland Creek recommended improvement plan segments.

Table 11.1 Fourmile Canyon Creek Implementation Plan

Plan Segment	Segment Location	Final Plan Reach	Mitigation Components	Estimated Cost				
				Flood Mitigation	Trails	ROW	Total Design, Construction and ROW (no O&M)	HHZ Property Acquisition
A	26th Street crossing upgrade	Upstream end of Reach 3	• 26th St. bridge replacement	$650,700	Connections included in underpass	$0	$650,700	$0
B	Just downstream of 19th Street to just upstream of Violet Avenue	Upper ¼ of Reach 4	Provide safe access to Crestview School: • Channel work upstream of Violet • Replace Violet crossing • Remove pedestrian bridge downstream of Violet • Construct channel wall and replace Upland crossing • Channel work between Upland and 19th • Replace 19th crossing and add channel transition • Add pedestrian trail from Violet to Topaz	$1,638,000	$217,000	$80,000	$1935000	$0
C	Just upstream of 26th Street to just downstream of 19th Street crossing	Lower ¾ of Reach 4	HHZ Containment: • Construct drops and channel work on north side of creek between 26th and Topaz • Topaz crossing replacement • North side channel work Topaz to Sumac • Move / replace drives near Sumac • Acquire two properties near 26th Street	$1,012,200	0	$1,432,000	$2,444,200	Property acquisitions included in ROW costs (no HHZ structures)
D	Just upstream of Violet Avenue to Broadway	Reach 5	• Violet crossing work	$316,600[1]	$32,200[1]	$0	$349,800[1]	$0
E	Upstream of Broadway	Reach 6a and 6b	HHZ Containment: • Channel work near 4th Street • Upstream of Broadway modify trail and ditch crossing, construct flood interceptor channel (570 ft), 1,350 ft of channel work including drops and relocation of Yarmouth / Rosewood	Developers responsible for costs				$0
			Total Costs	**$3,617,000**	**$249,000**	**$1,512,000**	**$5,378,000**	**$0**

[1] Developer responsible for half of the project costs

Note: Fourmile Canyon Creek Final Plan reaches 6c, 2b, 2a, 1b and 1a are either located in Boulder County or recommended for maintaining existing conditions and therefore are not included in the project implementation plan.

Table 11.2 Wonderland Creek Implementation Plan

Plan Segment	Segment Location	Final Plan Reach	Mitigation Components	Estimated Cost				
				Flood Mitigation	Trails	ROW	Total Design, Construction and ROW (no O&M)	HHZ Property Acquisition
A	Foothills Parkway to 34th Street	Downstream ½ of Reach 3	100-yr flood mitigation: • Separate creek from irrigation ditch • Construct new railroad bridge and below-grade trail crossing • Upgrade Spring Creek Place crossing • Extend trail along Wonderland Creek	$1,541,000[1]	$732,000[1]	$371,000[1]	$2,644,000[1]	$0
B	34th Street to Diagonal Highway	Upstream ½ of Reach 3	100-yr flood mitigation: • Construct low and high flow pipe crossing of Iris Avenue • Construct at-grade trail crossing at Bridge Trail • Construct trail along north side of Iris Avenue to 30th Street	$1,434,000[1]	$348,000[1]	$591,000[1]	$2,373,000[1]	$650,000
C	Diagonal Highway to just downstream of Kalmia	Downstream ½ of Reach 4	HHZ flood mitigation[2]: • Construct stepped boulder wall along south creek bank • Construct pedestrian bridge • Replace fire access bridge	$1,738,800	$0	$184,000	$1,922,800	$0
D	Downstream side of Kalmia to upstream side of Winding Trail (28th Street crossing)	Downstream end of Reach 5, upstream ½ of Reach 4	HHZ flood mitigation[2]: • Construct culvert at Winding Trail • Construct pedestrian underpass at 28th with trail segment • Construct low flow trail crossings • Construct overflow channel • Construct culvert at Kalmia	$1,134,000	$147,000	$175,000	$1,456,000	$0
E	19th Street crossing to upstream side of Winding Trail	Reaches 5 and 6	HHZ flood mitigation[2]: • Replace 19th Street crossing • Channel work 19th Street to Garnet • Construct 1,100 ft overflow channel along Centennial School • Replace Garnet pedestrian bridge • Construct 1,200 ft of pedestrian trail	$2,496,200	$84,000	$206,000	$2,786,200	$0
			Total Costs	**$7,436,000**	**$1,234,000**	**$1,307,000**	**$9,977,000**	**$650,000**

[1] Costs from 2010 Wonderland Creek CEAP
[2] See Table 11.4 for 100-year containment alternative costs
Note: Wonderland Creek Final Plan reaches 1, 2 and 8 are either located in Boulder County or recommended for maintaining existing conditions and therefore are not included in the project implementation plan.

Table 11.3 Fourmile Canyon Creek Plan Segment Itemized Cost Estimates

Segment A- 26th Street Crossing Upgrade

	Item	Cost
1	26th Street bridge replacement and trail connection	$550,000
	Contingency (15%)	$82,500
2	North bank channel work just downstream of 26th Street	$13,000
	Contingency (40%)	$5,200
	Total Project	**$650,700**

Segment B -Topaz Drive to Just Upstream of Violet Avenue
(100-yr crossings for safe access to Crestview School)

	Item	Cost
1	Channel work upstream of Violet Avenue	$11,000
2	Drop structure upstream of Violet Avenue	$10,000
3	Sediment capture facility upstream of Violet Avenue	$50,000
4	Wetland mitigation upstream of Violet Avenue	$15,000
5	Violet Avenue bridge replacement	$320,000
6	Remove pedestrian bridge downstream of Violet Avenue	$1,500
7	Remove culvert downstream of Violet Avenue	$1,500
8	Construct channel upstream of Upland Avenue	$9,000
9	Construct channel wall upstream of Upland Avenue	$60,000
10	Replace Upland Avenue crosssing	$320,000
11	Channel work between Upland Avenue and 19th Street	$21,000
12	Replace 19th Street bridge	$320,000
13	Channel work just downstream of 19th Street	$16,000
14	Drop structure downstream of 19th Street	$15,000
	Subtotal	$1,170,000
	Contingency (40%)	$468,000
	Total for Flood Mitigation Construction	$1,638,000
15	Right-of-way acquisition (1885 Upland)	$80,000
16	Construct 2,000 ft of pedestrian trail Topaz to 19th Street	$100,000
17	Construct 1,100 ft of pedestrian trail 19th Street to Violet Avenue	$55,000
	Contingency (40%)	$62,000
	Trail Totals	$217,000
	Total Project (excluding property acquisition)	**$1,935,000**[1]

[1] See Centennial Engineering cost estimates following this page

Segment C – Just Upstream of 26th Street to Just Downstream of 19th Street

	Item	Cost
1	Drop structures (8) between 26th Street and Topaz Drive	$120,000
2	North side channel improvements 26th Street to Topaz Drive	$120,000
3	Replace Topaz crossing	$227,000
4	North channel overbank work Topaz Drive to Sumac Avenue	$68,000
5	Remove and relocate drives near Sumac Avenue	$16,000
6	Wetland mitigation	$172,000
	Subtotal	$723,000
	Contingency (40%)	$289,200
	Total for Flood Mitigation Construction	$1,012,200
7	Acquire 4097 26th Street parcel	$614,000
8	Acquire 2500 Topaz Drive parcel	$818,000
	Total for Property Acquisitions	$1,432,000
	Total Project	**$2,444,200**[1]

Segment D – Just Upstream of Violet Avenue to Broadway

	Item	Cost	City Responsibility
1	SWPPP items	$4900	
2	Adjustment of manhole rims	$4400	
3	Channel work	$180000	
4	Planting, seeding and irrigation	$86000	
	Subtotal	$275300	
	Contingency (15%)	$41300	
	Total for Flood Mitigation Construction	$316600	$158,300 (developer to pay ½)
5	Trail construction	$28,000	
	Contingency (15%)	$4,200	
	Total Trail Construction	$32,200	$16,100 (developer to pay ½)
	Total Project	**$349,800**	**$174,400** (developer to pay ½)

Segment E – Upstream of Broadway

	Item	Cost	City Responsibility
1	Excavate north overbank channel near 4th Street	$35,000	
2	Wetland mitigation at 4th Street	$26,000	
3	Construct interceptor channel (570 ft) south of Yellow Pine	$80,700	
4	Interceptor channel drops (6)	$42,900	
5	Channel work between Yarmouth and Broadway (1,350 ft) including drops, ditch crossing and Yarmouth and Rosewood access road improvements	$1,698,600	
	Subtotal	$1,883,100	
	Contingency (40%)	$753,300	
	Total for Flood Mitigation Construction	$2,636,400	$0 (developers responsibility)
6	Right-of-way acquisition at 4th Street	$55,000	
	Total Project	**$2,691,400**	$0 (developers responsibility)

Fourmile Canyon Creek (19th street to Riverside Lane - Centennial Engineering 7/26/2010

CDOT Item	ITEM	UNIT	QTY	UNIT COST	COST
202	Removals and clearing (exist. Structures, pavement, curb, trees, concrete,)	LS	1	$40,000	$40,000
203	Unclassified excavation (channel grading)	CY	4,750	$10	$47,500
203	Structure excavation (box culvert)	CY	50	$24	$1,200
208	Erosion control	LS	1	$30,000	$30,000
208	Sediment removal and disposal	LS	1	$12,000	$12,000
214	Wetland mitigation and planting	LS	1	$18,000	$18,000
215	Landscape restoration (new plantings, transplants, irrigation)	LS	1	$26,000	$26,000
403	Hot mix asphalt	TON	396	$130	$51,480
504	Concrete drop structure	SF	1	$22,000	$22,000
504	Concrete divider wall	SF	755	$45	$33,975
504	Boulder channel wall	SF	1,400	$32	$44,800
514	Pedestrian railing	LF	100	$130	$13,000
603	38X8 CAST IN PLACE SLAB BRIDGE (19th STREET)	LF	80	$2,800	$224,000
603	Storm sewer (conc. Pipe, inlets, manholes, end sections)	LS	1	$18,000	$18,000
606	Bridge railing	LF	80	$110	$8,800
608	Concrete sidewalk (6 inch)	SY	167	$35	$5,845.00
608	Concrete bikeway (6 inch)	SY	1,666	$45	$74,970
609	Curb and gutter	LF	250	$18	$4,500
613	Underpass lighting	LS	1	$24,000	$24,000
614	Utility relocations (water, sewer, fiber)	LS	1	$35,000	$35,000
625	Mobilization, construction surveying, field office	LS	1	$70,000	$70,000
630	Traffic control (detour signage, single lane closures, portable vms)	DAY	25	$900	$22,500
	No ROW costs included, assumes ROW granted on 2020 Upland at annexation				$0
	SUBTOTAL:			$827,570.00	
	DESIGN ENGINEERING, MATERIALS TESTING AND PERMITTING	LS	1	8%	$66,000
	Construction Services	LS	1	4%	$33,103
	CLOMR/LOMR	LS	1	$40,000	$40,000
	CONSTRUCTION SUBTOTAL:				$966,673
	CONTINGENCIES	LS	1	25%	$ 242,000.00

ESTIMATED TOTAL PROJECT COSTS : $ 1,210,000.00

PROJECT NOTES:

1. Total estimated project cost does not include utility work other than those specified above.

Table 11.4 Wonderland Creek Plan Segment Itemized Cost Estimates

Item		Cost
Segment A - Foothills Parkway to 34th Street (100-yr containment)		
1	Split flow flood mitigation	$1,541,000
2	Below-grade trail crossing	$66,000
3	Wonderland Creek trail alignment	$638,000
4	Spring Creek Place trail connector	$28,000
5	Rights-of-way acquisition	$371,000
	Total Project (includes 25% contingency)	**$2,644,000**[1]

[1] Costs from 2010 Wonderland CEAP

Item		Cost
Segment B – 34th Street to Diagonal Highway (100-year containment)		
1	Low and high flow Iris culvert	$1,434,000
2	At-grade Bridger Trail crossing	$166,000
3	Iris Avenue trail alignment	$182,000
4	Rights-of-way acquisition	$591,000
5	Property acquisition (3115 Iris Avenue)	$650,000
	Total Project (includes 25% contingency)	**$3,023,000**[1]

[1] Costs from 2010 Wonderland CEAP

Item		Cost
Segment C - Diagonal Highway to Just Downstream of Kalmia Avenue (HHZ containment)		
1	Construct pedestrian bridge downstream of Kalmia Avenue	$150,000
2	Fire access	$271,000
3	Kalmia cross drainage culvert	$151,000
4	Wetland mitigation	$141,000
5	Channel improvements	$169,000
6	Boulder step walls in channel	$360,000
	Subtotal	$1,242,000
	Contingency (40%)	$496,800
	Total for Flood Mitigation Construction	$1,738,800
7	Rights-of-way acquisition	$184,000
	Total Project	**$1,922,800**

Item		Cost
Segment C - Diagonal Highway to Just Downstream of Kalmia Avenue (100-yr containment)		
1	Construct pedestrian bridge downstream of Kalmia Avenue	$150,000
2	Fire access	$271,000
3	Kalmia cross drainage culvert	$151,000
4	Wetland mitigation	$141,000
5	Channel with boulder wall (1,200 ft)	$1,009,200
6	Drop structures (5)	$50,000
	Subtotal	$1,772,200
	Contingency (40%)	$708,900
	Total for Flood Mitigation Construction	$2,481,100
7	Rights-of-way acquisition	$220,000
	Total Project	**$2,701,100**

Item		Cost
Segment D - Downstream Side of Kalmia Avenue to Upstream Side of Winding Trail (HHZ containment)		
1	Additional culvert at Kalmia Avenue	$78,000
2	Construct overflow channel downstream of 28th Street (715 ft)	$238,000
3	28th Street pedestrian underpass (20’ W x 9’ H)	$407,000
4	Wetland mitigation	$87,000
	Subtotal	$810,000
	Contingency (40%)	$324,000
	Total Construction for Flood Mitigation	$1,134,000
5	Rights-of-way acquisition	$175,000
6	Low-flow pedestrian crossing downstream of 28th Street	$20,000
7	Pedestrian trail 28th Street to Kalmia Avenue	$65,000
8	Trail and low-flow pedestrian crossing upstream of 28th Street	$20,000
	Subtotal Trails	$105,000
	Contingency (40%)	$42,000
	Total for Trails	$147,000
	Total Project	**$1,456,000**

Item		Cost
Segment D - Downstream Side of Kalmia Avenue to Upstream Side of Winding Trail (100-yr containment)		
1	Additional culvert at Kalmia Avenue	$78,000
2	Enlarge channel (500 ft) upstream of Kalmia Avenue	$167,000
3	Drop structures (5) upstream of Kalmia Avenue	$50,000
4	Construct overflow channel downstream of 28th Street (715 ft)	$238,000
5	28th Street pedestrian underpass (20’ W x 9’ H)	$407,000
6	Channel work Winding Trail to 28th Street	$107,000
7	Drop structures (3) Winding Trail to 28th Street	$30,000
8	Replace Winding Trail bridge	$561,000
9	Overflow channel on east side of 28th Street	$238,000
10	Wetland mitigation	$255,000
	Subtotal	$2,131,000
	Contingency (40%)	$852,400
	Total Construction for Flood Mitigation	$2,983,400
11	Rights-of-way acquisition for channel enlargement (500 ft)	$150,000
12	Rights-of-way acquisition for overflow channel (715 ft)	$219,000
13	Rights-of-way acquisition Winding Trail to 28th Street	$84,000
	Total Rights-of-Way Acquisition	$453,000
14	Pedestrian trail 28th Street to Kalmia Avenue	$65,000
15	Pedestrian trail upstream of 28th Street	$13,000
16	Low-flow pedestrian trail crossing downstream of Winding Trail	$10,000
	Subtotal	$88,000
	Contingency (40%)	$35,200
	Total Construction for Trails	$123,200
	Project Total	**$3,559,600**

Wonderland Creek Winding Trail to Kalmia - Centennial Engineering 7/26/2010

CDOT Item	Item	Unit	Qty	Unit Cost	Cost
202	Removals and clearing (exist. Structures, pavement, curb, trees, concrete,)	LS	1	$55,000	$55,000
203	Unclassified excavation (channel grading)	CY	5,500	$10	$55,000
203	Structure excavation (box culvert)	CY	240	$22	$5,280
208	Erosion control	LS	1	$25,000	$25,000
214	Wetland mitigation and planting	LS	1	$56,000	$56,000
215	Landscape restoration (new plantings, transplants, irrigation)	LS	1	$32,000	$32,000
403	Hot mix asphalt	TON	650	$130	$84,500
504	Concrete drop structure	EA	8	$18,000	$144,000
504	Concrete divider wall	SF	600	$45	$27,000
514	Pedestrian railing	LF	200	$130	$26,000
603	20x9 foot cast in place slab bridge (28th st.)	LF	140	$1,500	$210,000
603	40x8 foot concrete box culvert (four cell) (kalmia ave.)	LF	62	$2,800	$173,600
603	60x4 foot concrete box culvert (five cell) (winding trail)	LF	62	$4,000	$248,000
603	Storm sewer (conc. Pipe, inlets, manholes, end sections)	LS	1	$18,000	$18,000
603-2	Misc. Concrete items (low water crossing, ditch paving, curb walls)	LS	1	$10,000	$10,000
606	Bridge railing	LF	200	$110	$22,000
608	Concrete sidewalk (6 inch)	SY	150	$35	$5,250
608	Concrete bikeway (6 inch)	SY	1,651	$45	$74,295
609	Curb and gutter	LF	450	$18	$8,100
613	Underpass lighting	LS	1	$35,000	$35,000
614	Utility relocations	LS	1	$80,000	$80,000
625	Mobilization, construction surveying, field office	LS	1	$90,000	$90,000
630	Traffic control (detour signage, single lane closures, portable vms)	DAY	60	$900	$54,000
	No ROW required based on GIS	LS	1		
	Design engineering, materials testing and permitting	LS	1	8%	$123,000
	Construction Services	LS	1	4%	$61,521
	CLOMR/LOMR	LS	1	$80,000	$80,000
	CONSTRUCTION SUBTOTAL:				$1,802,546
	contingencies	LS	1	25%	$451,000
	ESTIMATED TOTAL PROJECT COSTS :				**$2,250,000**

PROJECT NOTES:

1. Total estimated project cost does not include utility work other than those specified above.

Table 11.4 Wonderland Creek Plan Segment Itemized Cost Estimates Continued

	Item	Cost
Segment E – 19th Street Crossing to Just Upstream of Winding Trail (HHZ containment)		
1	19th Street crossing replacement	$294,000
2	Channel transitions upstream of 19th Street with drop structure	$30,000
3	Channel transitions downstream of 19th Street	$21,000
4	Channel excavation work 19th Street to Garnet Lane	$99,000
5	Garnet Lane pedestrian bridge	$330,000
6	Wetland mitigation	$75,000
7	Construct overflow channel at Centennial School (1,100 ft)	$934,000
	Subtotal	$1,783,000
	Contingency (40%)	$713,200
	Total for Flood Mitigation Construction	$2,496,200
8	Rights-of-way acquisition	$206,000
9	1,200 ft of pedestrian trail	$60,000
	Contingency (40%)	$24,000
	Total Trails	$84,000
	Total Project	**$2,786,200**

	Item	Cost
Segment E – 19th Street Crossing to Just Upstream of Winding Trail (100-year containment)		
1	19th Street crossing replacement	$294,000
2	Channel transitions upstream of 19th Street with drop structure	$30,000
3	Channel transitions downstream of 19th Street	$21,000
4	Channel excavation 19th Street to Garnet Lane	$99,000
5	Garnet Lane pedestrian bridge	$330,000
6	Wetland Mitigation	$75,000
7	Construct overflow channel at Centennial School (1,100 ft)	$934,000
8	Replace 26th Street culvert with four 10’W x 6’H RCB	$748,000
9	Enlarge channel 26th Street to Winding Trail (1,700 ft)	$544,000
10	Channel drop structures (2)	$20,000
11	Modify trail crossing upstream of Winding Trail	$10,000
	Subtotal	$3,105,000
	Contingency (40%)	$1,242,000
	Total Flood Mitigation Construction	$4,347,000
12	Rights-of-way acquisition 19th Street to 26th Street	$206,000
13	Rights-of-way acquisition 26th Street to Winding Trail	$425,000
	Total ROW	$631,000
14	Pedestrian trail 19th Street to 26th Street (1,200 ft)	$60,000
15	Remove and replace pedestrian trail downstream of 26th Street	$15,000
	Subtotal	$75,000
	Contingency (40%)	$30,000
	Total Trails	$105,000
	Total Project	**$5,083,000**

IMPLEMENTATION PLAN SEMENT A

HHZ CONTAINMENT FLOODPROOFING

**REPLACE 26TH STREET BRIDGE 18'Wx9'H RCB MULTI-USE UNDERPASS WITH UPSTREAM DROP

AMBER ST

EXCAVATE NORTH BANK 2' DEEP FOR CHANNEL TRANSITION

PREMIER PL.

26TH ST

28TH ST

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

NOTE: ** COSTS FOR THESE ITEMS ARE INCLUDED IN THE FOURMILE CANYON CREEK MULTI-USE PATH - 26TH TO 28TH

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 50 100 200

(IN FEET)

Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DESIGNED:	SDL
DRAWN:	PEM
CHECKED:	DJL
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT A
FOURMILE CANYON CREEK

Fig 11.1

IMPLEMENTATION PLAN SEGMENT B
FHZ CONTAINMENT/FLOODPROOFING WITH SAFE ACCESS TO CRESTVIEW ELEMENTARY SCHOOL VIA 19TH STREET AND UPLAND

100 0 50 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

REPLACE VIOLET AVENUE BRIDGE 38'Wx8'H RCB WITH MULTI-USE UNDERPASS

VIOLET AVE

REMOVE EXISTING PEDESTRIAN BRIDGE

PEDESTRIAN TRAIL

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

19TH ST

REMOVE EXISTING CULVERT. CONSTRUCT OPEN CHANNEL

SIDE CHANNEL SPILL COLLECTION AREA

CONSTRUCT 110± LF WALL & CHANNEL IMPROVEMENTS

REPLACE UPLAND AVENUE BRIDGE 38'Wx8'H RCB WITH MULTI-USE UNDERPASS

GUTTER FLOW

UPLAND AVE

MAY REQUIRE PROPERTY PURCHASE

EXCAVATE 2' DEEP FOR CHANNEL TRANSITION

PEDESTRIAN TRAIL

REPLACE 19TH STREET BRIDGE 38'Wx8'H RCB MULTI-USE UNDERPASS WITH UPSTREAM DROP

GUTTER FLOW

SUMAC AVE

FOURMILE CANYON CREEK

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT B
FOURMILE CANYON CREEK

Fig 11.2

IMPLEMENTATION PLAN SEGMENT C
HHZ CONTAINMENT/FLOODPROOFING WITH SAFE ACCESS TO CRESTVIEW ELEMENTARY SCHOOL VIA 19TH STREET AND UPLAND

EXCAVATE NORTH OVERBANK 450± LF x 2' DEEP TO INCREASE CONVEYANCE

DESIGN CHANNEL IMPROVEMENTS TO SAVE MAJORITY OF TREES IN RIPARIAN CORRIDOR

STRUCTURES HAVE BEEN ACQUIRED BY CITY

STRUCTURES HAVE BEEN ACQUIRED BY CITY

REMOVE EXISTING DRIVEWAY & CULVERT. RELOCATE DRIVEWAY

REMOVE & REPLACE TOPAZ DRIVE BOX CULVERT WITH 2-12'Wx6'H RCB AND CHANNEL TRANSITIONS

CONSTRUCT 2' GRADE CONTROL DROP STRUCTURES (8)

PROPERTY ACQUISITION (4097 26TH ST. & 2500 TOPAZ)

NO IMPROVEMENTS ON SOUTH SIDE OF CHANNEL

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

FOURMILE CANYON CREEK

TAMARACK AVE.

SUMAC AVE

AGATE RD

TOPAZ DR

EMERALD RD.

RIVERSIDE AVE

19TH ST

GARNET LN

RUBY

26TH ST.

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 50 100 200

(IN FEET)

Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT C
FOURMILE CANYON CREEK

Fig 11.3

IMPLEMENTATION PLAN SEGMENT D
HHZ CONTAINMENT FLOODPROOFING

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

CONSTRUCT 2' DEEP DROP STRUCTURE TO STABILIZE EXISTING HEADCUT. 250± LF - STABILIZE BANKS. ON-STREAM SEDIMENT CAPTURE FACILITY AND WETLAND MITIGATION.

AVOCADO RD

SILVER LAKE DITC

VIOLET AVE

19TH ST

NORTH BROADWAY

GUTTER FLOW

FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 50 100 200

(IN FEET)

Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT D
FOURMILE CANYON CREEK

Fig 11.4

IMPLEMENTATION PLAN SEGMENT E
HHZ CONTAINMENT/FLOODPROOFING

GUTTER FLOW

LEE HILL RD

4th ST

418 LEE HILL ROAD

4860

4854

MATCH LINE

YELLOW PINE

4669

4647

4700

4587

EXCAVATE NORTH
OVERBANK 2' DEEP FOR
ADDITIONAL CHANNEL CAPACITY

100 0 50 100 200

(IN FEET)

Original Scale: 1 inch = 100 ft.

FOURMILE CANYON CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

FOURMILE CANYON CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

FOURMILE CANYON CREEK
CONVEYANCE (0.5' FLOODWAY)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT E
FOURMILE CANYON CREEK

Fig
11.5

IMPLEMENTATION PLAN SEGMENT E (CON'T)
HHZ CONTAINMENT/FLOODPROOFING

MATCH LINE

YELLOW PINE

4669

4647

700

CONSTRUCT FLOOD INTERCEPTOR CHANNEL w/6 DROP STRUCTURES. LOCATION TO BE NEGOTIATED BETWEEN CITY OF BOULDER DEPARTMENTS

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

**REMOVE & REPLACE TRAIL 100± LF CROSSING

**MODIFY SILVER LAKE DITCH CROSSING (LENGTHEN SPAN)

FLOODPROOFING (APPROX. 70 UNITS TYPICAL)

4587

4599

11TH STREET

**1400± LONG CHANNEL TOP WIDTH = 70' SEE REACH 6A TYP. SECTION

1025

4545

4535

4525

4501

4475 BROADWAY

NORTH BROADWAY

**CONSTRUCT 2' DROP STRUCTURES (TYP OF 15)

**YARMOUTH AVE. EXTENSION AND RELOCATED ROSEWOOD AVE. EXACT LOCATION AND REQUIRED RIGHT-OF-WAY AND LAND ACQUISITIONS TO BE DETERMINED BY FUTURE STUDY.

REMOVE ROSEWOOD AVENUE ROADWAY

ROCKWALL (TYP BOTH SIDES)

70'

EXISTING CHANNEL

LOWER EXISTING TRAIL

PROPOSED CHANNEL

REACH 6A TYPICAL SECTION NTS

YARMOUTH AVE

AVOCADO RD

4474

4436

NOTE: **COSTS FOR THESE ITEMS ARE FROM MEMO DATED JAN. 23, 2008. COLLECTION/REDISTRIBUTION U/S OF BROADWAY.

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

NOTE: SEE APPENDIX XX FOR SHALLOW FLOOD AREA DRAWING.

CHANNEL RECONSTRUCTION CANNOT CHANGE SPILL FLOWS OR DISTRIBUTION FROM FOURMILE CANYON CREEK

LAKE DITCH

100 0 50 100 200

(IN FEET)

Original Scale: 1 inch = 100 ft.

- FOURMILE CANYON CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS
- FOURMILE CANYON CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS
- FOURMILE CANYON CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS
- STRUCTURES TO BE FLOODPROOFED (1500)
- PROPOSED TRAIL
- EXISTING TRAIL
- PROPOSED BRIDGE OR CULVERT
- EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS
- STRUCTURES RECOMMENDED FOR ACQUISITION
- PROPOSED CHANNEL IMPROVEMENTS
- SHALLOW FLOOD AREA

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DATE: 8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT E (CON'T)
FOURMILE CANYON CREEK

Fig 11.5

IMPLEMENTATION PLAN SEGMENT A
100-YEAR CONTAINMENT

BOULDER COUNTY
CITY OF BOULDER

SH 119

WONDERLAND CREEK

IRIS AVE

30TH ST

34TH ST

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

CONSTRUCT 2' DROP STRUCTURES (3)

CONSTRUCT 100± LF PEDESTRIAN TRAIL CROSSING

ENLARGE CHANNEL

SEPARATE BOULDER & WHITEROCK DITCH

REPLACE RAILROAD BRIDGE 4-12'Wx5'H RCB

CONSTRUCT IMPROVED INLET AT FOOTHILLS PKWY/ 47TH CULVERT

SPRING CREEK PL.

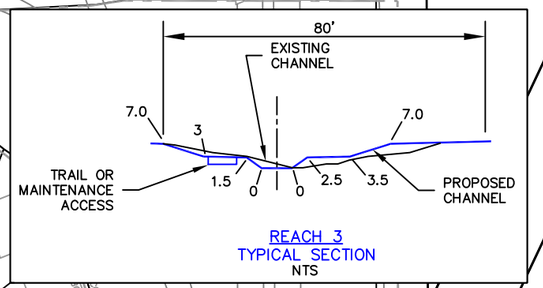
REPLACE SPRING CREEK PLACE BRIDGE WITH 4-10'Wx6'H RCB

BOULDER & WHITEROCK DITCH

RAILROAD

FOOTHILLS PKWY

47TH ST



REACH 3
TYPICAL SECTION
NTS

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT A, ALT A
WONDERLAND CREEK

Fig 11.6

IMPLEMENTAION PLAN SEGMENT A
HHZ CONTAINMENT/FLOODPROOFING

BOULDER COUNTY
CITY OF BOULDER

SH 119

WONDERLAND CREEK

IRIS AVE

30TH ST

34TH ST

47TH ST

SPRING CREEK PL.

FOOTHILLS PKWY

RAILROAD

ASSISTED LIVING

TENNIS

POOL

REC

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

REPLACE RAILROAD BRIDGE 4-12'Wx5'H RCB

CONSTRUCT 100± LF PEDESTRIAN TRAIL CROSSING

CONSTRUCT IMPROVED INLET AT FOOTHILLS PKWY/ 47TH CULVERT

REPLACE SPRING CREEK PLACE BRIDGE WITH 4-10'Wx6'H RCB

EXCAVATE NORTH AND SOUTH OVERBANK 2' DEEP FOR ADDITIONAL CAPACITY

SEPARATE BOULDER & WHITEROCK DITCH

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK 0.5' FLOODWAY (CONVEYANCE) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT A, ALT B
WONDERLAND CREEK

Fig 11.7

IMPLEMENTATION PLAN SEGMENT B
100-YEAR CONTAINMENT

BOULDER COUNTY
CITY OF BOULDER

SH 119

PROPERTY ACQUISITION (3115)

REPLACE IRIS AVE. & 34TH ST. CULVERTS 3-10'W x8'H RCB W/SAFETY RACK

WONDERLAND CREEK

IRIS AVE

IRIS AVE

CONSTRUCT TRANSITION FROM EXISTING CHANNEL TO NEW RCB

30TH ST

34TH ST

SOUTH BANK HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

SPRING CREEK PL.

BOULDER & WHITEROCK DITCH

RAILROAD

FOOTHILLS PKWY

47TH ST

BOULDER COUNTY
CITY OF BOULDER

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DESIGNED:	SDL
DRAWN:	PEM
CHECKED:	DJL
DATE:	8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT B, ALT A
WONDERLAND CREEK

Fig 11.8

IMPLEMENTATION PLAN SEGMENT B
HHZ CONTAINMENT/FLOODPROOFING

BOULDER COUNTY
CITY OF BOULDER

SH 119

PROPERTY ACQUISITION (3115)

REPLACE IRIS AVE. & 34TH ST. CULVERTS 3-10'W x 8'H RCB W/SAFETY RACK

WONDERLAND CREEK

IRIS AVE

IRIS AVE

CONSTRUCT TRANSITION FROM EXISTING CHANNEL TO NEW RCB

30TH ST

34TH ST

SOUTH BANK HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

SPRING CREEK PL.

RAILROAD

FOOTHILLS PKWY

47TH ST

BOULDER COUNTY
CITY OF BOULDER

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DESIGNED: SDL
DRAWN: PEM
CHECKED: DJL
DATE: 8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT B, ALT B
WONDERLAND CREEK

Fig 11.9

IMPLEMENTATION PLAN SEGMENT C
100-YEAR CONTAINMENT

28TH ST

KALMIA AVE

SH 119

BOULDER COUNTY
CITY OF BOULDER

BOULDER COUNTY
CITY OF BOULDER

CONSTRUCT
1200± LF x 9' HIGH
STEPPED BOULDER
WALL CHANNEL

1200± LF -
ENLARGE
CHANNEL

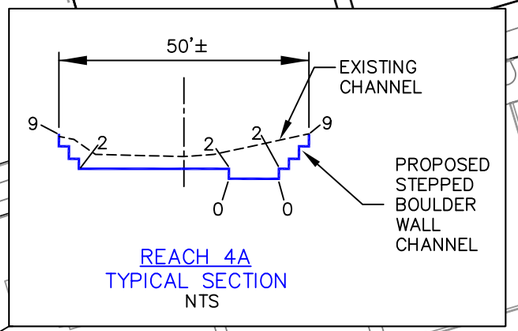
REPLACE PEDESTRIAN
CROSSING WITH 100± LF
CLEAR SPAN BRIDGE

CONSTRUCT 2' DROP
STRUCTURES (4)

REPLACE FIRE ACCESS
CROSSING WITH
2-20'Wx9'Hx40'L BOX CULVERTS

HIGH HAZARD AND
CONVEYANCE ARE
CONTAINED WITHIN
THE CHANNEL

CONSTRUCT 2' DROP
STRUCTURE (1)



REACH 4A
TYPICAL SECTION
NTS

WONDERLAND CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

WONDERLAND CREEK
CONVEYANCE (0.5' FLOODWAY)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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DATE: 8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT C, ALTA
WONDERLAND CREEK

Fig
11.10

IMPLEMENTATION PLAN SEGMENT C
HHZ CONTAINMENT/FLOODPROOFING

MANOR CARE
2800 PALO PKWY

28TH ST

KALMIA AVE

2800 PALO PKWY

SH 119

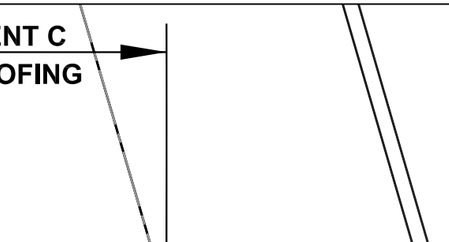
BOULDER COUNTY
CITY OF BOULDER

REPLACE PEDESTRIAN CROSSING WITH 100± LF CLEAR SPAN BRIDGE

REPLACE FIRE ACCESS CROSSING WITH 2-20'Wx9'Hx40'L BOX CULVERTS

ADD 2-2 ½ FT STEPPED BOULDER WALLS TO SOUTHWEST BANK TO INCREASE CHANNEL CAPACITY FROM SH119 TO KALMIA AVE.

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.



REACH 4B
TYPICAL SECTION
NTS

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK 0.5' FLOODWAY (CONVEYANCE) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT C, ALT B
WONDERLAND CREEK

Fig 11.11

IMPLEMENTATION PLAN SEGMENT D
100-YEAR CONTAINMENT

CONSTRUCT 28TH STREET BRIDGE 20'WX9'H RCB TRAIL/UNDERPASS

CONSTRUCT LOW FLOW TRAIL CROSSING

HIGH HAZARD AND CONVEYANCE ARE CONTAINED WITHIN THE CHANNEL

REPLACE WINDING TRAIL BRIDGE WITH 5-12'WX4'HRCB

CONSTRUCT 715 ± LF X 9' DEEP OVERFLOW CHANNEL FROM UNDERPASS TO CREEK

CONSTRUCT 2' DROP STRUCTURES (5)

REMOVE, LOWER AND REPLACE PEDESTRIAN TRAIL

INCREASE CAPACITY OF KALMIA BOX. ADD 5'WX6'H RCB

28TH ST

KALMIA AVE

BOULDER COUNTY
CITY OF BOULDER

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT D, ALT A
WONDERLAND CREEK

Fig 11.12

IMPLEMENTATION PLAN SEGMENT D
HHZ CONTAINMENT/FLOODPROOFING

CONSTRUCT 71± LF X 7' DEEP OVERFLOW CHANNEL FROM UNDERPASS TO CREEK

NEW PEDESTRIAN TRAIL UNDERPASS 20'WX9'H WITH CHANNEL TRANSITION

CONSTRUCT LOW FLOW TRAIL CROSSING

EXISTING 12'WX6'H RCB

INCREASE CAPACITY KALMIA BOX ADD 5'WX6'H RCB

CONSTRUCT 160± LF CROSS DRAINAGE CULVERT 6'WX2'H RCB

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

KALMIA AVE

28TH ST

2800 PALO PKWY

MANORCARE 2800 PALO PKWY

BOULDER COUNTY CITY OF BOULDER

BOULDER COUNTY PUBLIC LIBRARY

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK 0.5' FLOODWAY (CONVEYANCE) W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE OR CULVERT

EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED FOR ACQUISITION

PROPOSED CHANNEL IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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Fax: 303-786-8026

DESIGNED:	SDL
DRAWN:	PEM
CHECKED:	DJL
DATE:	8/27/10

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT D, ALT B
WONDERLAND CREEK

Fig 11.13

IMPLEMENTATION PLAN SEGMENT E
HHZ CONTAINMENT/FLOODPROOFING

REPLACE 19TH STREET CROSSING WITH 3-16'Wx5'H RCB

EXCAVATE 160± LF x 2' DEEP ON NORTH AND SOUTH BANK TO INCREASE CHANNEL CAPACITY. TRANSITION PROPOSED BOX CULVERT GEOMETRY TO EXISTING CHANNEL.

CONSTRUCT 1100± LF x 5' DEEP OVERFLOW CHANNEL

EXCAVATE 700 ± LF x 2' DEEP ON NORTH AND SOUTH BANK TO INCREASE CHANNEL CAPACITY

REMOVE & REPLACE PEDESTRIAN BRIDGE WITH 220± LF STRUCTURE OR LOW WATER CROSSING WITH 2' DEEP HORSESHOE DROP STRUCTURE

RIVERSIDE AVE
GARNET LN
EMERALD RD
POPLAR AVE
19TH ST.
20TH ST.
26TH ST.
NORWOOD AVE
FOURMILE CANYON CREEK
WONDERLAND CREEK
MATCH LINE
CENTENNIAL MIDDLE SCHOOL
2205 NORWOOD
BOULDER COUNTY
CITY OF BOULDER

WONDERLAND CREEK 100-YEAR FLOODPLAIN W/PROPOSED IMPROVEMENTS
WONDERLAND CREEK HIGH HAZARD W/PROPOSED IMPROVEMENTS
WONDERLAND CREEK CONVEYANCE (0.5' FLOODWAY) W/PROPOSED IMPROVEMENTS
STRUCTURES TO BE FLOODPROOFED
PROPOSED TRAIL
EXISTING TRAIL
PROPOSED BRIDGE OR CULVERT
EXISTING PROPERTY REMOVED FROM HAZARD ZONE W/PROPOSED IMPROVEMENTS
STRUCTURES RECOMMENDED FOR ACQUISITION
PROPOSED CHANNEL IMPROVEMENTS
SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT E
WONDERLAND CREEK

Fig 11.14

IMPLEMENTATION PLAN SEGMENT E (CON'T)
HHZ CONTAINMENT/FLOODPROOFING

WONDERLAND CREEK

MATCH LINE

NORWOOD AVE

FARMERS DITCH

26TH ST.

WINDING TRAIL DR

PALO PKWY

2205 NORWOOD

2975 28TH
ELKS CLUB

POOL

NEW ASSISTED LIVING BUILDINGS

MANOR CARE
2800 PALO PKWY

BOULDER COUNTY
CITY OF BOULDER

WONDERLAND CREEK
100-YEAR FLOODPLAIN
W/PROPOSED IMPROVEMENTS

WONDERLAND CREEK
HIGH HAZARD W/PROPOSED
IMPROVEMENTS

WONDERLAND CREEK
0.5' FLOODWAY (CONVEYANCE)
W/PROPOSED IMPROVEMENTS

STRUCTURES TO BE FLOODPROOFED 1500

PROPOSED TRAIL

EXISTING TRAIL

PROPOSED BRIDGE
OR CULVERT

EXISTING PROPERTY REMOVED
FROM HAZARD ZONE
W/PROPOSED IMPROVEMENTS

STRUCTURES RECOMMENDED
FOR ACQUISITION

PROPOSED CHANNEL
IMPROVEMENTS

SHALLOW FLOOD AREA

100 0 100 200
(IN FEET)
Original Scale: 1 inch = 100 ft.

NOTE: IT IS THE RESPONSIBILITY OF THE INDIVIDUAL PROPERTY OWNERS TO FLOODPROOF THEIR PROPERTIES TO PROTECT AGAINST FLOOD DAMAGES.

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AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK
AND WONDERLAND CREEK
MASTER PLAN

IMPLEMENTATION PLAN
SEGMENT E (CON'T)
WONDERLAND CREEK

Fig
11.14

12.0 PUBLIC PROPERTIES/EASEMENTS

The Final Plan for flood mitigation along Fourmile Canyon Creek and Wonderland Creek requires public ownership of lands or easements to implement. The city has worked to secure land and easements over the years in preparation for flood improvements along these creeks. This section presents a summary of the properties currently owned by the city and those requiring purchase.

Fourmile Canyon Creek

Table 12.1 presents a summary of the properties recently purchased by the City of Boulder along Fourmile Canyon Creek. **Table 12.2** presents a summary of the lands or easements still needing to be secured. **Figure 12.1** presents this information in map format.

Table 12.1 Recently Purchased Properties or Easements along Fourmile Canyon Creek

Site	Description
1800 Violet Avenue	Purchased by City of Boulder 3/2/2000
1897 Sumac Avenue	Boulder Valley School District – Crestview Elementary School
2020 Upland Avenue	Public easement dedicated 12/2/08
2455 Sumac Avenue	Purchased by City of Boulder 1/1/97
2446 Sumac Avenue	Purchased by City of Boulder 10/00
2455 Topaz Drive	Purchased by City of Boulder 9/04
2400 Topaz Drive	Purchased by City of Boulder 8/06
2490 Topaz Drive	Purchased by City of Boulder 4/05
4018 North 26th Street	Purchased by City of Boulder 3/04

Table 12.2 Property and Easement Requirements along Fourmile Canyon Creek

Site	Description
4474-4478 North Broadway, 1355 Violet Avenue, 1391 Violet Avenue, 1365 Violet Avenue	Property rights to be granted as part of development
1840 Violet Avenue 1870 Violet Avenue	Easements required
1865 Upland Avenue	
1885 Upland Avenue 2500 Topaz Drive 4097 26th Street	Significant easement or property purchase required
4270 19th Street	Property rights to be granted as part of annexation

Wonderland Creek

Table 12.3 presents a summary of the lands or easements needing to be secured along Wonderland Creek. **Figure 12.2** presents this information in map format. In August 2010, the city purchased flood and trail easements on 2939 Iris Avenue and 3115 Iris Avenue. The single family residential structure located on 3115 Iris Avenue will be deconstructed in the fall of 2010.

Table 12.3 Property and Easement Requirements along Wonderland Creek

Site	Description
4081 Garnet Lane 2100 Emerald Road 2150 Emerald Road 2190 Emerald Road 2200 Emerald Road 2290 Emerald Road 2300 Emerald Road	Property rights to be granted as condition of annexation
1953 Poplar Lane 3440 Hayden Place	Easement required on portion of property
3115 Iris Avenue	Easement purchased by City of Boulder 8/2010
2939 Iris Avenue	Easement purchased by City of Boulder 8/2010

Figure 12.1 Publicly-Owned Properties or Requirements along Fourmile Canyon Creek

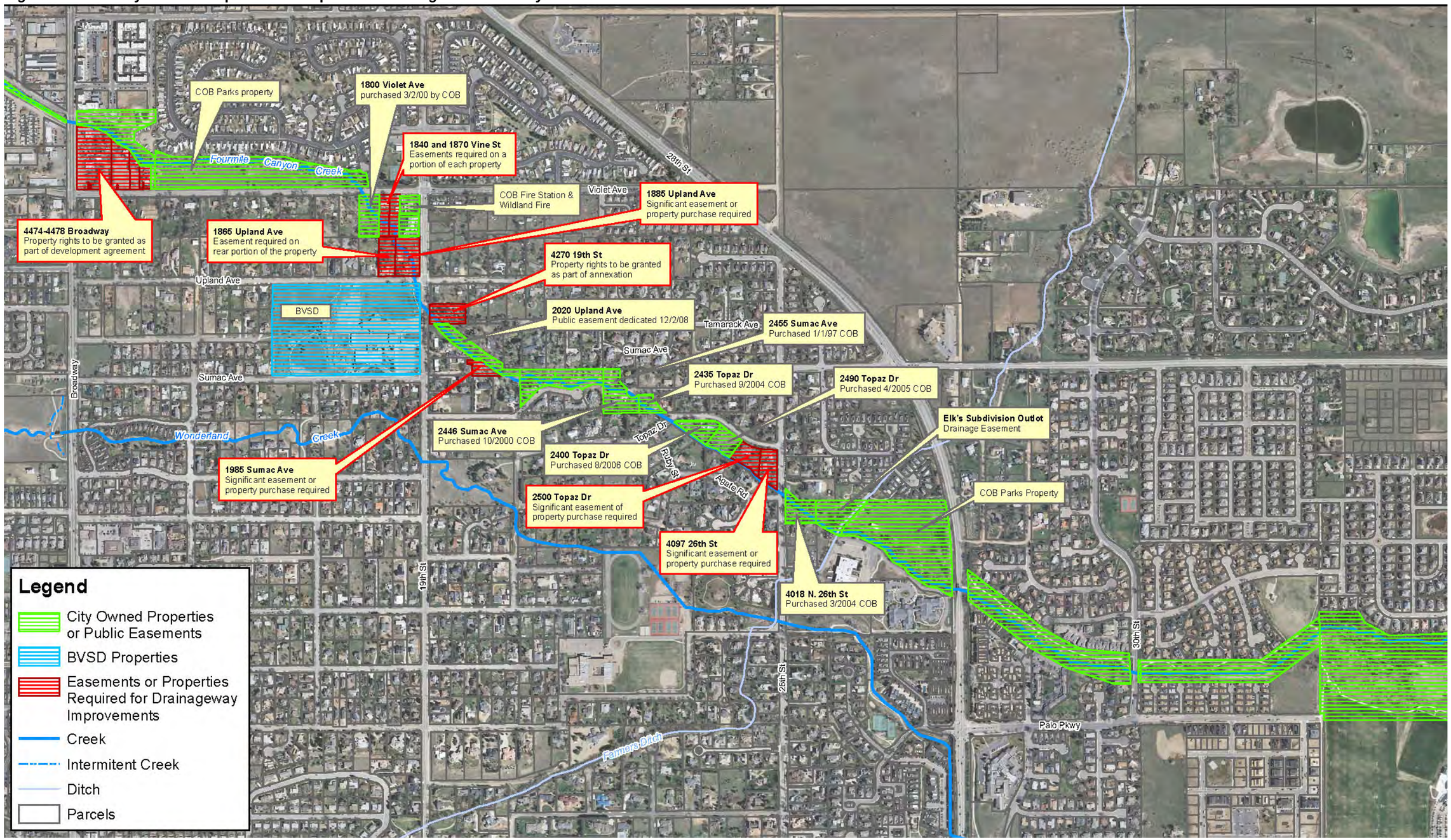
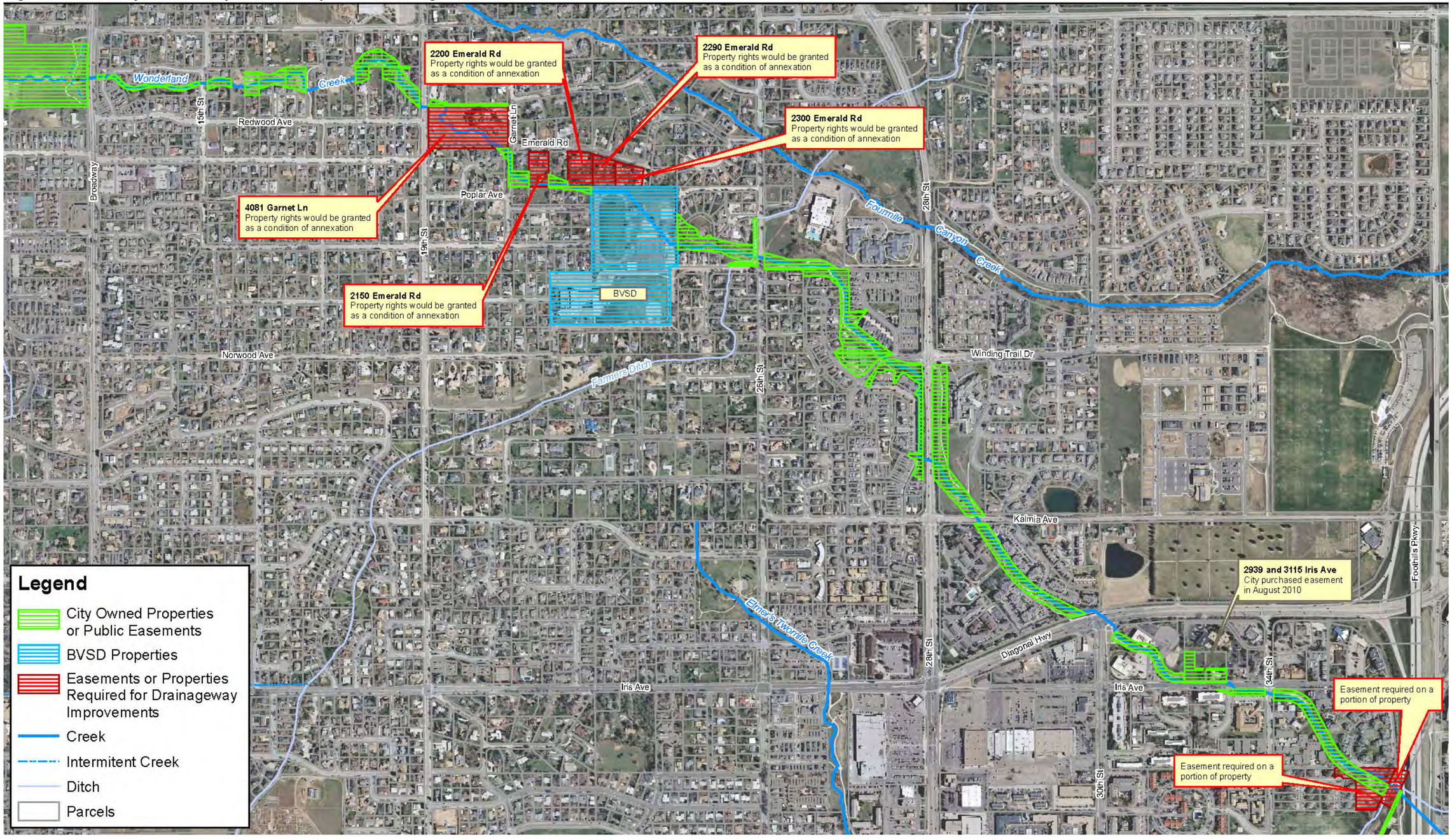


Figure 12.2 Publicly-Owned Properties or Requirements along Wonderland Creek



No updates have been made to the appendices.

APPENDICES

Cost Estimates

Technical Memorandums

Cost Estimates

Drop Structures	**Channel Section**	**Cost**		
0 - 500 cfs	A	$9,500		
500 - 1000 cfs	B and C	$15,000		
greater than 1000 cfs	D, E and F	$18,750		
Topsoil Removal & Replacement				
Topsoil Stockpiled		$ 3		
Topsoil Replaced		$ 5		
		$ 8		
Concrete Structures			CY	$750
10' Wide Concrete Sidewalk			LF	$50
Earthwork				
	Channel Excavation		CY	$15
	Pond Excavation		CY	$10
	Pond Embankment		CY	$7
Revegetation				
	Seed and Mulch		Acre	3,750
	Landscaping ($2000/100 ft)		FT	20
Construction Contingencies, Engineering, Administration and Mobilization				
	Contingencies			25%
	Engineering			5%
	Administration and Legal			5%
	Mobilization			5%
		Sub-total		40%
Land Acquisition				
	Land Value		Acre	$127,000
	Administration and Legal			5%
	Wetland Mitigation		Acre	$127,000
Roadway Restoration and Traffic Control Costs				
	% of Conduit Cost		LS	50%
Channel Costs				
Excavation				
100' TW Channel		505	SF	
53' TW Channel		165	SF	
Trickle Channel		$25	LF	
Pedestrian Crossing		$100	LF	
Pedestrian Bridge		$1,500	LF	
Ditch Crossing		$250	LF	
Remove Existing Driveway		$0.50	SF	
Install New Driveway		$3	SF	

FOURMILE CANYON CREEK - REVISED 8/27/10-REV - RECOMMENDED ALTERNATE COSTS

		Flood Control Improvements						Improvements Not Required for Flood Control Mitigation				
Reach	Alternate	Const. Costs ($)	ROW Costs ($)	Channel O & M ($)	Public-Sub-Total ($)	Private-Sub-Total ($)	TOTAL ($)	Const. Costs ($)	ROW Costs ($)	Sub-Total ($)	Location of Costs	Adjustments
Reach 1A	High Hazard Containment/Floodproofing (Boulder County)	$618,400	$199,000	$267,000	$1,084,400	$825,800	**$1,910,200**	$201,600	$0	**$201,600**	HHZ from Table 8.6 - Floodproof from Table 8.5	
Reach 1B	Maintain Existing Configuration (Boulder County)	$0	$0	$921,000	$921,000	$0	**$921,000**	$0	$0	**$0**	from Table 8.4	
Reach 2A	Maintain Existing Configuration (Boulder County)	$0	$0	$442,000	$442,000	$0	**$442,000**	$0	$0	**$0**	from Table 8.4	
Reach 2B	100-Year Containment (Boulder County)	$1,347,000	$0	$233,000	$1,580,000	$0	$1,580,000	$0	$0	$0	from ES.1	Differs from Table 8.3 of $1,580,000
Reach 2B	**Remove Sediment Capture Facility**	**-$25,400**			**-$25,400**	**$0**	**-$25,400**	**$0**	**$0**	**$0**	**from SDL Cost Estimate (0925A)**	
TOTAL Reach 2B		$1,321,600	$0	$233,000	**$1,554,600**	$0	**$1,554,600**	$0	$0	$0		
Reach 3	HHZ Containment/Floodproofing	$200,000	$0	$336,000	$536,000	$495,200	**$1,031,200**	$119,000	$0	**$119,000**	HHZ from Table 8.6 - Floodproof from Table 8.5	**Removed Public - HHZ of $741,000 - Total was $900,200**
Reach 3	**Revisions at Elks Club**	**$1,876,678**	**$0**	**$0**	**$1,876,700**	**$0**	**$1,876,700**	**$0**	**$0**	**$0**	**from SDL Cost Estimate (0925A)**	
TOTAL Reach 3		$2,076,678	$0	$336,000	$2,412,700	$495,200	**$2,907,900**	$119,000	$0	$119,000		
Reach 4	HHZ Containment/Floodproofing with Safe Access to Crestview Elementary School via 19th Street and Upland	$2,522,000	$1,512,100	$513,000	$4,547,100	$5,349,200	**$9,896,300**	$87,000	$0	**$87,000**	HHZ from Table 8.6 - Floodproof from Table 8.5	**Removed 6 Structures around 19th and Upland from Floodproofing @ $87,000 EA $4,645,200 - $522,000 = $4,123,200**
Reach 4	**Construct Wall at 1885 Upland**	**$60,000**	**$0**	**$0**	**$60,000**	**$0**	**$60,000**	**$0**	**$0**	**$0**		**See Worksheet for Revised Alternate Costs**
TOTAL Reach 4		$2,582,000	$1,512,100	$513,000	$4,607,100	$5,349,200	**$9,956,300**	$87,000	$0	$87,000		
Reach 5	HHZ Containment/Floodproofing	$119,900	$0	$310,000	$429,900	$726,400	**$1,156,300**	$169,000	$0	**$169,000**	HHZ from Table 8.6 - Floodproof from Table 8.5	
Reach 6A	HHZ Containment/Floodproofing	$0	$0	$290,000	$290,000	$3,130,600	**$3,420,600**	$0	$0	**$0**	HHZ from Table 8.6 - Floodproof from Table 8.5	
Reach 6A	**Add Flood Interceptor Channel**	**$113,300**	**$0**	**$0**	**$113,300**	**$0**	**$113,300**	**$0**	**$0**	**$0**		**See Worksheet for Revised Alternate Costs**
Reach 6A	**Add Flood Interceptor Channel Drop Structures**	**$60,000**	**$0**	**$0**	**$60,000**	**$0**	**$60,000**	**$0**	**$0**	**$0**		**See Worksheet for Revised Alternate Costs**
Reach 6A	**Revisions for Collection/Redistribution US Broadway**	**$2,378,152**	**$0**	**$0**	**$2,378,152**	**$0**	**$2,378,152**	**$0**	**$0**	**$0**		**From Memo January 23, 2008**
TOTAL Reach 6A		$2,551,452	$0	$290,000	$2,841,452	$3,130,600	**$5,972,052**	$0	$0	$0		
Reach 6B	HHZ Containment/Floodproofing	$86,000	$55,000	$454,000	$595,000	$908,000	**$1,503,000**	$0	$0	**$0**	HHZ from Table 8.6 - Floodproof from Table 8.5	
Reach 6C	Maintain Existing Configuration	$0	$0	$173,000	$173,000	$0	**$173,000**	$0	$0	**$0**	from Table 8.4	
TOTAL ALL REACHES		**$9,356,030**	**$1,766,100**	**$3,939,000**	**$15,061,152**	**$11,435,200**	**$26,496,352**	**$576,600**	**$0**	**$576,600**		
ORIGINAL PHASE A REPORT TOTALS					**$12,862,520**	**$4,130,700**	**$16,993,220**	**$576,600**	**$0**	**$576,600**		

NOTE: O & M COSTS ARE PRESENT VALUE, P = 50 years, I = 3%

FOURMILE CANYON CREEK - REVISED 4/16/10 - RECOMMENDED ALTERNATE COSTS

REACH 6C - MAINTAIN EXISTING CONFIGURATION

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$0**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$173,000**											
PUBLIC SUB-TOTAL COSTS	**$173,000**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$173,000**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											

					PED						
			DROP	SEDIMENT	TRAIL	MISC	WETLAND	SUB-	ADD	**TOTAL**	
SUB-TOTAL CONSTRUCTION COSTS	CROSSINGS	CHANNELS	STRUCT	CAPTURE	REQD	COSTS	MITIG.	TOTAL	40%		
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	

CHANNEL O&M COSTS	**$173,000**	Refer to 0217FCC_O &Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**	Refer to FLOODPROOFING COSTS-1-13-06

FOURMILE CANYON CREEK - REVISED 4/16/10 - RECOMMENDED ALTERNATE COSTS

REACH 6B - HIGH HAZARD CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$86,000**											
ROW COSTS	**$55,000**											
CHANNEL O&M COSTS	**$454,000**											
PUBLIC SUB-TOTAL COSTS	**$595,000**											
PRIVATE SUB-TOTAL COSTS	**$908,000**											
TOTAL	**$1,503,000**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											
CHANNEL	Length	Width	Depth	Excav	Low Flow	Seeding	Landscape	Sub-total				
North Overbank	300	60	2	$20,000	$7,500	$1,550	$6,000	**$35,100**				
WETLAND MITIGATION												
North Overbank	Length	Width	Acres	Cost								
	300	30	0.2	**$26,300**								
					PED							
			DROP	SEDIMENT	TRAIL	MISC	WETLAND	SUB-	ADD	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	CROSSINGS	CHANNELS	STRUCT	CAPTURE	REQD	COSTS	MITIG.	TOTAL	40%			
	$0	$35,100	$0	$0	$0	$0	$26,300	$61,400	$24,560	**$86,000**		
ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**						
	(ft)	(ft)	(acres	ROW	5%	**Costs**						
at 4th St	300	60	0.4	$52,479	$2,624	**$55,000**						
	HHZ											
CHANNEL O&M COSTS	**$454,000**											Refer to 0217FCC_O &Mrepair$FINAL Spreadsheet
FLOODPROOFING	Floodproofing	O & M	**TOTAL**									
	$167,700	$454,000	**$908,000**									Refer to FLOODPROOFING COSTS-1-13-06

FOURMILE CANYON CREEK - REVISED 4/19/10 - RECOMMENDED ALTERNATE COSTS

REACH 6A - HIGH HAZARD CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS

CONSTRUCTION COSTS	**$0**
Add Flood Interceptor Channel	**$113,300**
Add Flood Interceptor Channel Drop Structures	**$60,000**
Revisions for Collection/Redistribution U/S Broadway	**$2,378,152**
ROW COSTS	**$0**
CHANNEL O&M COSTS	**$290,000**
PUBLIC SUB-TOTAL COSTS	**$2,841,452**
PRIVATE SUB-TOTAL COSTS	**$3,130,600**
TOTAL	**$5,972,052**

IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION

CONSTRUCTION COSTS	$0
ROW COSTS	$0
TOTAL	**$0**

SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**DROP STRUCT**	**SEDIMENT CAPTURE**	**PED TRAIL REQD**	**MISC COSTS**	**WETLAND MITIG.**	**SUB-TOTAL**	**ADD 40%**	**TOTAL**
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**

	HHZ
CHANNEL O&M COSTS	**$290,000**

FLOODPROOFING	Floodproofing	O & M	**TOTAL**
	$2,840,600	$290,000	**$3,130,600**

REVISIONS

MISCELLANEOUS	LF	Height	Width	CY/LF	Unit Cost	Cost	**TOTAL**
Add Flood Interceptor Channel	570	4	30	2533	$25	$63,333	
	Length	Width	Ac.	Cost			
Wetland Mitigation	570	30	0.39	$49,900		$49,900	**$113,300**
	Each						
Add Flood Interceptor Channel Drop Structures	6				$10,000	$60,000	**$60,000**
Revisions for Collection/Redistribution U/S Broadway (1400 LF)							**$2,378,152**

Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet

Refer to FLOODPROOFING COSTS-1-13-06

From Memo dated January 23, 2008

FOURMILE CANYON CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 5 - HIGH HAZARD CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$119,900**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$310,000**											
PUBLIC SUB-TOTAL COSTS	**$429,900**											
PRIVATE SUB-TOTAL COSTS	**$726,400**											
TOTAL	**$1,156,300**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$169,000											
ROW COSTS	$0											
TOTAL	**$169,000**											
CHANNEL	Length	Width	Depth	Excav	Low Flow	Seeding	Landscape	**Sub-total**				
US of Violet	250	20	2	$5,556	$0	$430	$5,000	**$11,000**				
DROP STRUCTURES	Qty	Unit Cost	**Total**									
Drop Structures U/S Violet	1	$10,000	**$10,000**									
SEDIMENT CAPTURE FACILITY												
at Violet	1	$50,000	**$50,000**									
WETLAND MITIGATION												
	Length	Width	Acres	Cost								
	250	20	0.11	**$14,578**								
					PED							
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$0	$11,000	$10,000	$50,000	$0	$0	$14,578	$85,578	$34,231	**$119,900**		
ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**						
	(ft)	(ft)	(acres	ROW	5%	**Costs**						
	HHZ											
CHANNEL O&M COSTS	**$310,000**											Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	Floodproofing	O & M	**TOTAL**									
	$404,400	$322,000	**$726,400**									Refer to FLOODPROOFING COSTS-1-13-06
IMPROVEMENTS NOT REQUIRED	Length	Cost/LF							Subtotal	40%	**Total**	
D/S Broadway	150	$100									$15,000	
Pedestrian Trail	2200	$50							$110,000	$44,000	$154,000	
											$169,000	

FOURMILE CANYON CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 4 - HIGH HAZARD CONTAINMENT/FLOODPROOFING WITH SAFE ACCESS TO CRESTVIEW SCHOOL

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$2,522,000**											
Construct Wall at 1885 Upland	**$60,000**											
ROW COSTS	**$1,512,100**											
CHANNEL O&M COSTS	**$513,000**											
PUBLIC SUB-TOTAL COSTS	**$4,607,100**											
PRIVATE SUB-TOTAL COSTS	**$5,349,200**											
TOTAL	**$9,956,300**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$87,000											
ROW COSTS	$0											
TOTAL	**$87,000**											
								Roadway	Sub-total	Misc.	**Total**	
	Length	Width	Height	Cells	Area	RCB	RCB	Restor.	Crossing	Crossing	**Estimated**	
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**	
Violet Ave	45	38	8	1	304	153	$154,000	$74,600	$228,600	$91,440	$320,040	
Upland Ave.	45	38	8	1	304	153	$154,000	$74,600	$228,600	$91,440	$320,040	
19th Streeet	45	38	8	1	304	153	$154,000	$74,600	$228,600	$91,440	$320,040	
Topaz Drive	40	12	6	2	72	107	$107,000	$55,400	$162,400	$64,960	$227,360	
Remove Existing Pedestrian Bridge	1	EACH	$1,500								$1,500	
Remove Existing Culvert	1	EACH	$1,500								$1,500	
TOTAL											**$1,190,500**	
CHANNEL	Length	Width	Depth	Excav	Low Flow	Seeding	Landscape	Sub-total				
US of 1885-Construct Open Channel	30	20	2	$667	$0	$52	$600	$1,318				
at 1885 at Wall	85	30	2	$2,833	$0	$220	$1,700	$4,753				
Side Channel Spill - 1885	100	10	1	$556	$0	$86	$2,000	$2,642				
Between Upland and 19th	200	50	2	$11,111	$5,000	$861	$4,000	$20,972				
D/S 19th	150	50	2	$8,333	$3,750	$646	$3,000	$15,729				
US Topaz	450	50	2	$25,000	$32,500	$1,937	$9,000	$68,437				
DS Topaz	950	60	2	$63,333	$32,500	$4,907	$19,000	$119,740				
TOTAL								**$233,600**				
DROP STRUCTURES	No.	Unit Cost	Cost	**Total**								
Drop Structures - DS Topaz	8	$15,000	$120,000	**$135,000**								
Drop Structure - DS 19th	1	$15,000	$15,000									
WETLAND MITIGATION	Length	Width	Acres	Cost								
All Channels	1965	30	1.4	**$171,900**								
RELOCATE EXIST DRIVE-Misc Costs		Length	Width	Area (sf)	Cost							
Remove Old Driveway - 2446		150	12	1800	$900							
Remove Existing Culvert - 2446			20		$800							
Install New Driveway - 2446		400	12	4800	$14,400							
Remove Ex. Culvert - 1885			80		$1,200							
					$17,300							
PEDESTRIAN TRAIL REQUIRED	Length	Cost/LF				**Cost**						
Violet to Upland	800	$50				$40,000						
Upland to 19h	250	$50				$12,500						
						$52,500						
					PED							
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$1,190,500	$233,600	$135,000	$0	$52,500	$17,300	$171,900	$1,800,800	$720,320	**$2,522,000**		
ROW COSTS			Area	Sub-total	Add	**ROW**						
			(acres	ROW	5%	**Costs**						
1885 UPLAND AVE.			0.6	$76,200	$3,810	$80,010						
2500 TOPAZ AVE						$818,300						
4097 26TH STREET						$613,700						
TOTAL						**$1,512,100**						
	HHZ											
CHANNEL O&M COSTS	**$513,000**											Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	Floodproofing	O & M	**TOTAL**									
	$4,645,200	$704,000	**$5,349,200**									Refer to FLOODPROOFING COSTS-1-13-06
IMPROVEMENTS NOT REQUIRED	Length	Cost/LF							Cost	40%	**Cost**	
D/S 19th Ped Crossing	100	$100									$10,000	
Pedestrian Trail	1100	$50							$55,000	$22,000	$77,000	
											$87,000	
REVISIONS			LF	Height	Width	CY/LF	Unit Cost	Cost	**SAY**			
Construct Wall at 1885 Upland			110			0.66	$750	$54,450	**$60,000**			CY/LF from CDOT M-Standards

FOURMILE CANYON CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 3 - HIGH HAZARD CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$200,000**											
Revisions at Elks Club	**$1,876,700**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$336,000**											
PUBLIC SUB-TOTAL COSTS	**$2,412,700**											
PRIVATE SUB-TOTAL COSTS	**$495,200**											
TOTAL	**$2,907,900**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$119,000											
ROW COSTS	$0											
TOTAL	**$119,000**											
								Roadway	Sub-total	Misc.	**Total**	
	Length	Width	Height	Cells	Area	RCB	RCB	Restor.	Crossing	Crossing	**Estimated**	
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**	
Remove Existing Bridge											$2,500	
Construct New Bridge	40	25	4	1	100	86	$86,000	$5,000	$91,000	$36,400	$127,400	
											$129,900	
CHANNEL				Excav	Low Flow	Seeding	Landscape	**Sub-total**				
North Bank Channel Transition	160	50	2	$8,889		$689	$3,200	**$12,800**				
DROP STRUCTURES												
					PED							
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$129,900	$12,800	$0	$0	$0	$0	$0	$142,700	$57,080	**$200,000**		
ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**						
	(ft)	(ft)	(acres	ROW	5%	**Costs**						
	HHZ											
CHANNEL O&M COSTS	**$336,000**											Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	Floodproofing	O & M	**TOTAL**									
	$159,200	$336,000	**$495,200**									Refer to FLOODPROOFING COSTS-1-13-06
IMPROVEMENTS NOT REQUIRED	Length	Cost/LF							Sub-total	40%	**Total**	
Pedestrian Crossing D/S 26th	100	$100							$10,000	$4,000	$14,000	Note: is included in Multi-Use 26th th 28th Project
Pedestrian Trail	1500	$50							$75,000	$30,000	$105,000	Note: is included in Multi-Use 26th th 28th Project
											$119,000	
REVISIONS												
Revisions at Elks Club		**$1,876,678**										from SDL Costs Estimate (0925A)
												Fourmile Canyon Creek Multi-Use Path-26th to 28th

FOURMILE CANYON CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 2B - 100-YEAR CONTAINMENT (BOULDER COUNTY)

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$1,347,000**											
Omit On-stream sediment capture facility	**-$25,400**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$233,000**											
PUBLIC SUB-TOTAL COSTS	**$1,554,600**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$1,554,600**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											
100-YEAR CHANNEL IMPROVEMENTS	Qty	Unit	Unit Cost	Item Cost								from Fourmile const$100y.xls
Channel Excavation (471 sf x 1,440 lf)	25,120	CY	$ 10	$ 251,200								
Grade Control Structure	10	EA	$ 20,000	$ 200,000								
Sediment Capture/Wetland Mitigation Facility	1	LS	$ 20,000	$ 20,000								
Remove and Replace Pedestrian Bridge	1	EA	$ 25,000	$ 25,000								
Remove & Replace Pedestrian Trial	1,440	LF	$ 40	$ 57,600								
Revegetation (165 ft x 1,440 ft)	5.5	AC	$ 3,000	$ 16,364								
Landscaping (165 ft x 1,440 ft)	5.5	AC	$ 10,000	$ 54,545								
Wetland Mitigation (35 ft x 1,440 ft)	1.16	AC	$ 100,000	$ 115,702								
Contingency/Mobilization	25%	-	$ 740,412	$ 185,103								
Engineering/Administration	15%	-	$ 925,514	$ 138,827		x 1.27						
				$ 1,064,342	$1,060,000	**$1,347,000**						
					PED							
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**		
CHANNEL O&M COSTS	**$233,000**											Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**											Refer to FLOODPROOFING COSTS-1-13-06
IMPROVEMENTS NOT REQUIRED												
REVISIONS												
SEDIMENT CAPTURE FACILITY												
Omit On-stream sediment capture facility			**-$20,000**	**1.27**	**-$25,400**							

FOURMILE CANYON CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 2A - MAINTAIN EXISTING CONFIGURATION (BOULDER COUNTY)

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$0**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$442,000**											
PUBLIC SUB-TOTAL COSTS	**$442,000**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$442,000**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											

SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**DROP STRUCT**	**SEDIMENT CAPTURE**	**PED TRAIL REQD**	**MISC COSTS**	**WETLAND MITIG.**	**SUB-TOTAL**	**ADD 40%**	**TOTAL**	
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	

CHANNEL O&M COSTS	**$442,000**	Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**	Refer to FLOODPROOFING COSTS-1-13-06

FOURMILE CANYON CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 1B - MAINTAIN EXISTING CONFIGURATION

PHASE A RECOMMENDATION (CITY STAFF HOWEVER MAKES NO RECOMMENDATIONS AS THIS REACH IS IN BOULDER COUNTY

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$0**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$921,000**											
PUBLIC SUB-TOTAL COSTS	**$921,000**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$921,000**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											

					PED						
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**	
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**		
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	
CHANNEL O&M COSTS	**$921,000**										Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**										Refer to FLOODPROOFING COSTS-1-13-06

FOURMILE CANYON CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 1A - HIGH HAZARD CONTAINMENT/FLOODPROOFING (BOULDER COUNTY)

PHASE A RECOMMENDATION (CITY STAFF HOWEVER MAKES NO RECOMMENDATIONS AS THIS REACH IS IN BOULDER COUNTY

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$618,400**											
ROW COSTS	**$199,000**											
CHANNEL O&M COSTS	**$267,000**											
PUBLIC SUB-TOTAL COSTS	**$1,084,400**											
PRIVATE SUB-TOTAL COSTS	**$825,800**											
TOTAL	**$1,910,200**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$201,600											
ROW COSTS	$0											
TOTAL	**$201,600**											
								Roadway	Sub-total	Misc.	**Total**	
	Length	Width	Height	Cells	Area	RCB	RCB	Restor.	Crossing	Crossing	**Estimated**	
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**	
57th Street	50	16	8	1	128	89	$67,000	$33,500	$100,500	$40,200	$140,700	
						Cost\LF						
Modify Boulder & Left Hand Ditch Crossing	100					$250					$25,000	
Modify N. Boulder Farmers Ditch Crossing	100					$250					$25,000	
TOTAL											**$190,700**	
CHANNEL	Length	Width	Depth	Excav	Low Flow	Seeding	Landscape	Sub-total				
at 57th	300	100	2	$33,333	$7,500	$2,583	$6,000	$49,416				
at NBF Ditch	250	100	2	$27,778	$6,250	$2,152	$5,000	$41,180				
								$90,600				
WETLAND MITIGATION												
	Length	Width	Acres	Cost								
	550	100	1.3	**$160,400**								
					PED							
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$190,700	$90,600	$0	$0	$0	$0	$160,400	$441,700	$176,680	**$618,400**		
ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**						
	(ft)	(ft)	(acres	ROW	5%	**Costs**						
at SH119	100	100	0.2	$29,155	$1,458	$30,613						
at 57th	300	100	0.7	$87,466	$4,373	$91,839						
at NBF Ditch	250	100	0.6	$72,888	$3,644	$76,532						
						$199,000						
	HHZ											
CHANNEL O&M COSTS	**$267,000**											Refer to 0217FCC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	Floodproofing	O & M	**TOTAL**									
	$558,800	$267,000	**$825,800**									Refer to FLOODPROOFING COSTS-1-13-06
IMPROVEMENTS NOT REQUIRED	Length	Cost/LF							Costs	40%	**Total**	
Pedestrian Trail D/S 19th	1200	$50							$60,000	$24,000	$84,000	
	Cells	Length	Width	Depth	SF	CY	RCB Costs	Railroad				
BNSF Railroad by SH119	1	50	12	8	96	74	$56,000	$28,000	$84,000	$33,600	$117,600	
											$201,600	

FOURMILE CANYON CREEK
FLOODPROOFING COSTS
2/9/06

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
	AREA - 1						
700	YELLOW PINE	$ 109,700	$ 158,000	$ 267,700	house, garden level in fld pln	$ 25,600	0.23
	AVERAGE	$ 109,700		$ 267,700		$ 25,600	0.23
	MAXIMUM					$ 26,000	
4854	4TH	$ 371,400	$ 216,000	$ 587,400	house, only land in fld pln		$ 26,000
4860	4TH	$ 461,700	$ 240,000	$ 701,700	house, only land in fld pln		$ 26,000
418	LEE HILL	$ 105,000	$ 135,800	$ 240,800			$ 24,200
TOTAL	**3**	**$ 938,100**			**TOTAL FP COSTS - AREA 1**		**$ 76,200**
	AREA - 2						
700	YELLOW PINE	$ 109,700	$ 158,000	$ 267,700	house, garden level in fld pln	$ 25,600	0.23
	AVERAGE	$ 109,700		$ 267,700		$ 25,600	0.23
	MAXIMUM					$ 26,000	
700	YELLOW PINE	$ 109,700	$ 158,000	$ 267,700	house, garden level in fld pln		$ 25,600
4647	7TH	$ 477,600	$ 163,800	$ 641,400	house, garden level in fld pln		$ 26,000
4669	7TH	$ 477,600	$ 158,000	$ 635,600	house, garden level in fld pln		$ 26,000
TOTAL	**3**	**$ 1,064,900**			**TOTAL FP COSTS - AREA 2**		**$ 77,600**

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
	AREA - 3						
1025	ROSEWOOD	$ 145,300	$ 369,200	$ 514,500	commercial	$ 180,100	1.24
	AVERAGE	$ 145,300		$ 514,500		$ 180,100	1.24
	MAXIMUM				**Not for Storage Units**	$ 45,000	
		$ 103,000	$ -	$ 103,000	self storage	$ 166,600	
4481	BROADWAY	$ 221,900	$ 292,200	$ 514,100	retail complex		$ 45,000
4501	BROADWAY	$ 131,100	$ 122,900	$ 254,000	gas station		$ 45,000
4525	BROADWAY	$ 17,100	$ 143,800	$ 160,900	potters guild		$ 21,200
4535	BROADWAY	$ 16,600	$ 308,000	$ 324,600	auto sales		$ 20,600
4545	BROADWAY	$ 21,800	$ -	$ 21,800	self storage		$ 27,000
4599	BROADWAY	$ 146,600	$ 666,000	$ 812,600	commercial		$ 45,000
4599	BROADWAY	$ 146,600	$ 666,000	$ 812,600	commercial		$ 45,000
4599	BROADWAY	$ 146,600	$ 666,000	$ 812,600	commercial		$ 45,000
4599	BROADWAY	$ 146,600	$ 666,000	$ 812,600	commercial		$ 45,000
4587	BROADWAY-A	$ 103,000	$ -	$ 103,000	self storage-24 Units		$ 72,000
4587	BROADWAY-B	$ 103,000	$ -	$ 103,000	self storage - 54 Units		$ 162,000
4587	BROADWAY-C	$ 103,000	$ -	$ 103,000	self storage - 22 Units		$ 66,000
4587	BROADWAY-D	$ 103,000	$ -	$ 103,000	self storage - 48 Units		$ 144,000
4587	BROADWAY-E	$ 103,000	$ -	$ 103,000	self storage - 54 Units		$ 162,000
4587	BROADWAY-F	$ 103,000	$ -	$ 103,000	self storage - 60 Units		$ 180,000
4587	BROADWAY-G	$ 103,000	$ -	$ 103,000	self storage - 64 Units		$ 192,000
4587	BROADWAY-H	$ 103,000	$ -	$ 103,000	self storage - 38 Units		$ 114,000
4587	BROADWAY-I	$ 103,000	$ -	$ 103,000	self storage - 16 Units		$ 48,000
4295	BROADWAY	$ 103,100	$ 134,400	$ 237,500	house		$ 45,000
4395	BROADWAY	$ 153,100	$ 127,100	$ 280,200	house		$ 45,000
4401	BROADWAY	$ 380,000		$ 380,000	auto repair shop		$ 45,000
1025	ROSEWOOD	$ 145,300	$ 369,200	$ 514,500	commercial		$ 180,100
1122	UNION	$ 103,000		$ 103,000	house		$ 45,000
1126	UNION	$ 103,000		$ 103,000	house		$ 45,000

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
TOTAL	**24**	**$ 2,909,400**			**TOTAL FP COSTS - AREA 3**		**$ 1,883,900**
	AREA - 4						
4475	BROADWAY	$ 56,500	$ 804,000	$ 860,500	trailer park		
	TRAILERS (61)	$ 6,000.00			Single Wide		$ 366,000
	TRAILERS (4)	$ 9,400.00			Double Wide		$ 37,600
	BUILDING (1)	$ 22,125.00			Office		$ 22,100
TOTAL	**66**				**TOTAL FP COSTS - AREA 4**		**$ 425,700**
	AREA - 5						
4301	BROADWAY	$ 115,500	$ -	$ 115,500	school bldg, only land in fld pln		
987	LOCUST	$ 71,100	$ -	$ 71,100	school buildings	$ 296,400	
	AVERAGE	$ 93,300		$ 93,300			
	Flooproof all buildings including the Auditorium with Flood Walls and Levees						
	FLOODPROOFING FOR THE WHOLE AREA						$ 296,400
TOTAL	**2**	**$ -**			**TOTAL FP COSTS - AREA 5**		**$ 296,400**
	AREA - 6						
4474	BROADWAY	$ 33,500	$ 89,400	$ 122,900	building	$ 38,500	1.15
	AVERAGE	$ 33,500		$ 122,900		$ 38,500	1.15
	MAXIMUM					$ 39,000	
	TRAILERS (26)	$ 6,000			Single Wide		$ 156,000

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
4474	BROADWAY	$ 33,500	$ 89,400	$ 122,900	building		$ 38,500
4474	BROADWAY	$ 33,500	$ 89,400	$ 122,900	building		$ 38,500
4474	BROADWAY	$ 33,500	$ 89,400	$ 122,900	building		$ 38,500
4474	BROADWAY	$ 33,500	$ 89,400	$ 122,900	building		$ 38,500
1365	VIOLET	$ 72,200	$ 180,000	$ 252,200	house		$ 39,000
1355	VIOLET	$ 19,100	$ 12,400	$ 31,500	house		$ 22,000
TOTAL	**31**				**TOTAL FP COSTS - AREA 6**		**$ 371,000**
	AREA - 7						
1545	UPLAND	$ 85,300	$ 225,000	$ 310,300	house	$ 54,700	0.64
1500	UPLAND	$ 144,900	$ 210,000	$ 354,900	house	$ 53,000	0.37
1525	SUMAC	$ 89,600	$ 150,000	$ 239,600	house	$ 75,300	0.84
1734	SUMAC	$ 133,900	$ 180,000	$ 313,900	house	$ 37,100	0.28
1502	SUMAC	$ 55,000	$ 150,000	$ 205,000	house	$ 29,400	0.53
4140	17TH - WC	$ 313,900	$ 180,000	$ 493,900	house	$ 47,800	0.15
	AVERAGE	$ 137,100		$ 319,600		$ 49,550	0.53
	MAXIMUM					$ 50,000	
4343	13TH	$ 155,900	$ 150,000	$ 305,900	house		$ 50,000
4340	13TH	$ 10,000	$ 225,000	$ 235,000	house		$ 5,300
4380	13TH	$ 92,500	$ 247,500	$ 340,000	house		$ 49,000
4390	13TH	$ 50,000	$ 180,000	$ 230,000	house		$ 26,500
4365	13TH	$ 43,400	$ 150,000	$ 193,400	house		$ 23,000
4345	13TH	$ 67,500	$ 150,000	$ 217,500	house		$ 35,800
4365	13TH	$ 43,400	$ 150,000	$ 193,400	house		$ 23,000
4176	15TH	$ 162,900	$ 150,000	$ 312,900	house		$ 50,000
4188	15TH	$ 124,900	$ 165,000	$ 289,900	house		$ 50,000
4165	17TH	$ 95,000	$ 180,000	$ 275,000	house		$ 50,000
4140	17TH	$ 313,900	$ 180,000	$ 493,900	no bldg. In flood plain		$ 50,000
4500	19TH	$ 329,400	$ 6,008,500	$ 6,337,900	no bldg. In flood plain		$ 50,000

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
4157	19TH	$ 136,900	$ 162,000	$ 298,900	house		$ 50,000
4195	19TH	$ 228,500	$ 162,000	$ 390,500	house		$ 50,000
4390	BROADWAY	$ 22,500	$ 157,500	$ 180,000	house		$ 11,900
1845	REDWOOD	$ 151,200	$ 180,000	$ 331,200	no bldg. In flood plain		$ 50,000
1801	REDWOOD	$ 87,100		$ 87,100	no bldg. In flood plain		$ 46,200
1765	REDWOOD	$ 219,800	$ 195,000	$ 414,800	no bldg. In flood plain		$ 50,000
1721	REDWOOD	$ 95,300	$ 225,000	$ 320,300	no bldg. In flood plain		$ 50,000
1701	REDWOOD	$ 25,000	$ 225,000	$ 250,000	no bldg. In flood plain		$ 13,300
1702	SUMAC	$ 115,200	$ 150,000	$ 265,200	house		$ 50,000
1706	SUMAC	$ 160,000	$ 150,000	$ 310,000	house		$ 50,000
1800	SUMAC	$ 201,400	$ 180,000	$ 381,400	house		$ 50,000
1890	SUMAC	$ 131,200		$ 131,200	house		$ 50,000
1880	SUMAC	$ 131,200		$ 131,200	house		$ 50,000
1840	SUMAC	$ 131,200		$ 131,200	house		$ 50,000
1734	SUMAC	$ 133,900	$ 180,000	$ 313,900	house		$ 37,100
1710	SUMAC	$ 40,000	$ 180,000	$ 220,000	house		$ 21,200
1590	SUMAC	$ 138,700	$ 247,500	$ 386,200	house		$ 50,000
1595	SUMAC	$ 96,000	$ 216,000	$ 312,000	house		$ 50,000
1565	SUMAC	$ 164,900	$ 150,000	$ 314,900	house		$ 50,000
1555	SUMAC	$ 189,000		$ 189,000	house		$ 50,000
1560	SUMAC	$ 32,000	$ 210,000	$ 242,000	house		$ 17,000
1550	SUMAC	$ 189,000	$ 150,000	$ 339,000	house		$ 50,000
1540	SUMAC	$ 159,000	$ 165,000	$ 324,000	walkout bsmt/grdn lvl		$ 50,000
1530	SUMAC	$ 242,600	$ 165,000	$ 407,600	walkout bsmt/grdn lvl		$ 50,000
1510	SUMAC	$ 195,000	$ 150,000	$ 345,000	house		$ 50,000
1527	SUMAC	$ 115,000	$ 150,000	$ 265,000	house		$ 50,000
1525	SUMAC	$ 89,600	$ 150,000	$ 239,600	house		$ 75,300
1505	SUMAC	$ 150,900	$ 165,000	$ 315,900	house		$ 50,000
1502	SUMAC	$ 55,000	$ 150,000	$ 205,000	house		$ 29,400
1495	SUMAC	$ 203,200	$ 150,000	$ 353,200	house		$ 50,000
1485	SUMAC	$ 157,600	$ 150,000	$ 307,600	house		$ 50,000

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
1357	SUMAC	$ 19,500		$ 19,500	no bldg. In flood plain		$ 10,300
1550	TAMARACK	$ 187,500	$ 150,000	$ 337,500	house		$ 50,000
1510	TAMARACK	$ 175,600	$ 150,000	$ 325,600	house		$ 50,000
1500	TAMARACK	$ 237,700	$ 150,000	$ 387,700	house		$ 50,000
1496	TAMARACK	$ 203,900	$ 150,000	$ 353,900	house		$ 50,000
1488	TAMARACK	$ 170,000	$ 150,000	$ 320,000	house		$ 50,000
1480	TAMARACK	$ 165,400	$ 150,000	$ 315,400	house		$ 50,000
1377	TAMARACK	$ 97,300	$ 210,000	$ 307,300	house		$ 50,000
1315	TAMARACK	$ 114,600	$ 247,500	$ 362,100	house		$ 50,000
1235	TAMARACK	$ 85,300	$ 210,000	$ 295,300	house		$ 45,200
1485	UPLAND	$ 109,900	$ 225,000	$ 334,900	house		$ 50,000
1501	UPLAND	$ 4,800	$ 180,000	$ 184,800	trailer		$ 2,500
1435	UPLAND	$ 71,700	$ 225,000	$ 296,700	house		$ 38,000
1490	UPLAND	$ 53,400	$ 210,000	$ 263,400	house		$ 28,300
1480	UPLAND	$ 63,100	$ 247,500	$ 310,600	new house		$ 33,400
1276	UPLAND	$ 12,800	$ 210,000	$ 222,800	trailer		$ 6,800
1204	UPLAND	$ 11,500	$ 178,500	$ 190,000	house		$ 6,100
1205	UPLAND	$ 79,500	$ 165,800	$ 245,300	house		$ 42,100
1301	UPLAND	$ 52,500	$ 210,000	$ 262,500	house		$ 27,800
1705	UPLAND	$ 31,900	$ 225,000	$ 256,900	house		$ 16,900
1675	UPLAND	$ 84,900	$ 195,000	$ 279,900	house		$ 45,000
1625	UPLAND	$ 57,900	$ 97,000	$ 154,900	house		$ 30,700
1605	UPLAND	$ 15,000	$ 180,000	$ 195,000	house		$ 8,000
1590	UPLAND	$ 122,800	$ 210,000	$ 332,800	house		$ 50,000
1560	UPLAND	$ 29,500	$ 180,000	$ 209,500	house		$ 15,600
1545	UPLAND	$ 85,300	$ 225,000	$ 310,300	house		$ 54,700
1535	UPLAND	$ 138,300	$ 225,000	$ 363,300	house		$ 50,000
1502	UPLAND	$ 76,200	$ 180,000	$ 256,200	no bldg. In flood plain		$ 40,400
1500	UPLAND	$ 144,900	$ 210,000	$ 354,900	house		$ 53,000
1885	UPLAND	$ 73,300	$ 202,500	$ 275,800	house		$ 38,800
1865	UPLAND	$ 153,400	$ 210,000	$ 363,400	house		$ 50,000

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
1825	UPLAND	$ 60,600	$ 316,800	$ 377,400	preschool		$ 32,100
1825	UPLAND	$ 60,600	$ 316,800	$ 377,400	preschool		$ 32,100
1391	VIOLET	$ 12,800	$ 217,000	$ 229,800	trailer		$ 6,800
1550	VIOLET	$ 19,800	$ 225,000	$ 244,800	house		$ 10,500
1510	VIOLET	$ 85,300	$ 225,000	$ 310,300	house		$ 45,200
1480	VIOLET	$ 106,400	$ 225,000	$ 331,400	house		$ 50,000
1400	VIOLET	$ 102,500	$ 225,000	$ 327,500	house		$ 50,000
1800	VIOLET	$ 103,300	$ 225,000	$ 328,300	house		$ 50,000
1750	VIOLET	$ 70,300	$ 225,000	$ 295,300	house		$ 37,300
TOTAL	**83**	**$ 9,227,700**			**TOTAL FP COSTS - AREA 7**		**$ 3,321,600**
	AREA - 8						
1897	SUMAC	$ 4,500,940		$ 4,500,940	Crestview Elementary School	$ 82,000	
TOTAL	**1**	**$ 4,500,940**			**TOTAL FP COSTS - AREA 8**		**$ 82,000.00**
	AREA - 9						
2220	SPOTSWOOD	$ 430,300	$ 225,000	$ 655,300	house	$ 60,200	0.14
2455	SUMAC	$ 218,700	$ 262,500	$ 481,200	house	$ 41,300	0.19
	AVERAGE	$ 430,300		$ 655,300		$ 50,750	0.17
	MAXIMUM					$ 51,000	
4240	19TH	$ 90,800	$ 202,500	$ 293,300	house		$ 15,400
4270	19TH	$ 76,800	$ 168,800	$ 245,600	house		$ 13,100
4306	19TH	$ 68,500	$ 168,800	$ 237,300	house		$ 11,600
4220	19TH	$ 132,300	$ 202,500	$ 334,800			$ 22,500
4198	19TH	$ 228,500	$ 162,000	$ 390,500			$ 38,800
4097	26TH	$ 20,000	$ -	$ 20,000	house		$ 3,400
2590	AGATE	$ 105,700	$ 180,000	$ 285,700	house		$ 18,000

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
1965	RIVERSIDE	$ 598,500	$ 210,000	$ 808,500			$ 51,000
1987	RIVERSIDE	$ 425,900	$ 225,000	$ 650,900			$ 51,000
4450	RUBY	$ 125,300	$ 198,400	$ 323,700	house		$ 21,300
2250	SPOTSWOOD	$ 289,600	$ 225,000	$ 514,600	house		$ 49,200
2220	SPOTSWOOD	$ 430,300	$ 225,000	$ 655,300	house		$ 60,200
2210	SPOTSWOOD	$ 397,400	$ 225,000	$ 622,400	house		$ 51,000
2473	SUMAC	$ 66,500	$ 262,500	$ 329,000	house		$ 11,300
2455	SUMAC	$ 218,700	$ 262,500	$ 481,200	house		$ 41,300
2446	SUMAC	$ 93,100	$ 281,300	$ 374,400	house		$ 15,800
2156	TAMARACK	$ 96,400	$ 270,000	$ 366,400	house		$ 16,400
2140	TAMARACK	$ 181,900	$ 270,000	$ 451,900	building		$ 30,900
2140	TAMARACK	$ 181,900	$ 270,000	$ 451,900	house		$ 30,900
2130	TAMARACK	$ 111,800	$ 270,000	$ 381,800	house		$ 19,000
2500	TOPAZ	$ 201,600	$ 198,400	$ 400,000	house		$ 34,300
2490	TOPAZ	$ 77,800	$ 198,400	$ 276,200	house		$ 13,200
2505	TOPAZ	$ 220,800	$ 198,400	$ 419,200	house		$ 37,500
2400	TOPAZ	$ 159,100	$ 198,400	$ 357,500	house		$ 27,000
2455	TOPAZ	$ 159,600	$ 207,000	$ 366,600	house		$ 27,100
2305	TOPAZ	$ 128,700	$ 198,400	$ 327,100	house		$ 21,900
2435	TOPAZ	$ 77,300	$ 207,000	$ 284,300	house		$ 13,100
2525	TOPAZ	$ 84,600	$ 198,400	$ 283,000	no bldg. in flood plain		$ 14,400
2020	UPLAND	$ 79,100	$ 262,500	$ 341,600	house		$ 13,400
2090	UPLAND	$ 109,400	$ 210,000	$ 319,400	house		$ 18,600
2010	UPLAND	$ 110,600	$ 210,000	$ 320,600	house		$ 18,800
2005	UPLAND	$ 84,600	$ 210,000	$ 294,600	house		$ 14,400
1937	UPLAND	$ 70,200	$ 210,000	$ 280,200	house		$ 11,900
1917	UPLAND	$ 119,300	$ 202,500	$ 321,800	house		$ 20,300
TOTAL	**34**	**$ 5,622,600**			**TOTAL FP COSTS - AREA 9**		**$ 858,000**
	AREA - 10						
4066	26TH	$ 81,600	$ 232,500	$ 314,100	house	$ 73,300	0.90

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
	AVERAGE	$ 81,600		$ 314,100		$ 73,300	0.90
	MAXIMUM					$ 73,000	
4090	26TH	$ 178,600	$ 186,000	$ 364,600	house		$ 73,000
4066	26TH	$ 81,600	$ 232,500	$ 314,100	house		$ 73,000
TOTAL	**2**	**$ 260,200**			**TOTAL FP COSTS - AREA 10**		**$ 146,000**
	AREA - 11						
3975	28TH	$ 477,200	$ 190,800	$ 668,000	Elks picnic building		**$0.00**
	1						
	AREA - 12						
4195	CORRIENTE	$ 109,500	$ 81,000	$ 190,500	house		
	AVERAGE	$ 109,500		$ 190,500			
4235	CORRIENTE	$ 125,000	$ 81,000	$ 206,000	house		
4225	CORRIENTE	$ 111,900	$ 81,000	$ 192,900	house		
4215	CORRIENTE	$ 132,100	$ 81,000	$ 213,100	house		
4205	CORRIENTE	$ 101,900	$ 81,000	$ 182,900	house		
4195	CORRIENTE	$ 109,500	$ 81,000	$ 190,500	house		
4185	CORRIENTE	$ 137,200	$ 101,300	$ 238,500	house		
4176	CULEBRA	$ 138,400	$ 101,300	$ 239,700	house		
4186	CULEBRA	$ 104,200	$ 81,000	$ 185,200	house		
4166	CULEBRA	$ 107,500	$ 101,300	$ 208,800	house		
4156	CULEBRA	$ 124,600	$ 101,300	$ 225,900	house		
4236	PIEDRA	$ 149,000	$ 81,000	$ 230,000	house		
4226	PIEDRA	$ 124,100	$ 81,000	$ 205,100	house		
4216	PIEDRA	$ 115,700	$ 81,000	$ 196,700	house		
4206	PIEDRA	$ 109,500	$ 81,000	$ 190,500	house		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
4196	PIEDRA	$ 124,900	$ 81,000	$ 205,900	house		
TOTAL	**15**	**$ 1,815,500**					
	AREA - 13						
4230	CORRIENTE	$ 91,000	$ 67,000	$ 158,000	town home w/o bsmt		
	AVERAGE	$ 91,000		$ 158,000			
4268	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4270	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4278	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4280	CORRIENTE	$ 78,500	$ 67,000	$ 145,500	town home w/o bsmt		
4282	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4258	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4260	CORRIENTE	$ 80,100	$ 67,000	$ 147,100	town home w/o bsmt		
4262	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4238	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4240	CORRIENTE	$ 78,200	$ 67,000	$ 145,200	town home w/o bsmt		
4242	CORRIENTE	$ 78,200	$ 67,000	$ 145,200	town home w/o bsmt		
4244	CORRIENTE	$ 92,300	$ 67,000	$ 159,300	town home w/o bsmt		
4248	CORRIENTE	$ 90,800	$ 67,000	$ 157,800	town home w/o bsmt		
4250	CORRIENTE	$ 78,200	$ 67,000	$ 145,200	town home w/o bsmt		
4252	CORRIENTE	$ 91,000	$ 67,000	$ 158,000	town home w/o bsmt		
4255	CORRIENTE	$ 114,900	$ 81,000	$ 195,900	house		
4235	CORRIENTE	$ 91,000	$ 67,000	$ 158,000	town home w/o bsmt		
4230	CORRIENTE	$ 91,000	$ 67,000	$ 158,000	town home w/o bsmt		
4224	CORRIENTE	$ 91,400	$ 67,000	$ 158,400	town home w/o bsmt		
4228	CORRIENTE	$ 91,200	$ 67,000	$ 158,200	town home w/o bsmt		
4218	CORRIENTE	$ 91,000	$ 67,000	$ 158,000	town home w/o bsmt		
4220	CORRIENTE	$ 91,000	$ 67,000	$ 158,000	town home w/o bsmt		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
4208	CORRIENTE	$ 91,900	$ 67,000	$ 158,900	town home w/o bsmt		
4210	CORRIENTE	$ 78,900	$ 67,000	$ 145,900	town home w/o bsmt		
4212	CORRIENTE	$ 78,900	$ 67,000	$ 145,900	town home w/o bsmt		
4214	CORRIENTE	$ 91,900	$ 67,000	$ 158,900	town home w/o bsmt		
4202	CORRIENTE	$ 91,900	$ 67,000	$ 158,900	town home w/o bsmt		
4204	CORRIENTE	$ 91,700	$ 67,000	$ 158,700	town home w/o bsmt		
	FLOODWALL FOR ALL THE ABOVE HOUSES IN AREAS 12 AND 13						**$ 376,800**
TOTAL	**29**	**$ 2,492,400**			**TOTAL FP COSTS**		
					FOR AREAS 12 AND 13		**$ 376,800**
TOTAL	**294**	**$ 28,831,740**			**TOTAL - ALL AREAS**		**$ 7,915,200**

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

ALTERNATE A

		Flood Control Improvements						Improvements Not Required for Flood Control Mitigation				
Reach	Alternate	Const. Costs ($)	ROW Costs ($)	Channel O & M ($)	Public-Sub-Total ($)	Private-Sub-Total ($)	TOTAL ($)	Const. Costs ($)	ROW Costs ($)	Sub-Total ($)	Location of Costs	Adjustments
Reach 1	Maintain Existing Configuration	$0	$0	$618,000	$618,000	$0	**$618,000**	$0	$0	$0	from Table 8.8	
Reach 2	Floodproofing	$0	$0	$0	$0	$539,400	**$539,400**	$0	$0	$0	from Table 8.9	
Reach 3A	100-Year Containment	$5,833,000	$742,400	$216,000	$6,791,400	$0	**$6,791,400**	$0	$0	$0	Costs Folder-Final/WC-ALT-100YR CHANNEL-UPDATED 5-16-07	
Reach 4A	100-Year Containment	$3,663,000	$589,300	$479,000	$4,731,300	$0	**$4,731,300**	$0	$0	$0	Costs Folder-Final/WC-ALT-100YR CHANNEL-UPDATED 5-16-07	
Reach 5A	100-Year Containment	$3,110,000	$509,800	$282,000	$3,901,800	$0	**$3,901,800**	$0	$0	$0	Costs Folder-Final/WC-ALT-100YR CHANNEL-UPDATED 5-16-07	
Reach 6	HHZ Containment/Floodproofing	$1,020,000	$205,800	$253,000	$1,478,800	$2,390,300	**$3,869,100**	$101,500	$0	$101,500		
Reach 6	Overflow Channel at Centennial Sch.	**$933,500**	$0	$0	$933,500	$0	**$933,500**					**See Worksheet for Revised Alternate Costs**
Reach 6	Extend Garnet Ln. Ped Bridge	**$150,000**	$0	$0	$150,000	$0	**$150,000**					**See Worksheet for Revised Alternate Costs**
TOTAL Reach 6		**$2,103,500**	**$205,800**	**$253,000**	**$2,562,300**	**$2,390,300**	**$4,952,600**	**$101,500**	**$0**	**$101,500**		
Reach 7	Maintain Existing Configuration with Safe Access to Crestview Elementary School via 19th Street and Upland	$0	$0	$807,000	$807,000	$0	**$807,000**	$0	$0	$0	from Table 8.8	
Reach 7	**Channel Transition & Drop Structure**	**$30,000**	**$0**	**$0**	**$30,000**	**$0**	**$30,000**	**$0**	**$0**	**$0**		**See Worksheet for Revised Alternate Costs**
TOTAL Reach 7		**$30,000**	**$0**	**$807,000**	**$837,000**	**$0**	**$837,000**	**$0**	**$0**	**$0**		
Reach 8	Maintain Existing Configuration	$0	$0	$289,000	$289,000	$0	**$289,000**	$0	$0	$0	from Table 8.8	
TOTAL ALL REACHES		**$14,739,500**	**$2,047,300**	**$2,944,000**	**$19,730,800**	**$2,929,700**	**$22,660,500**	**$101,500**	**$0**	**$101,500**		
ORIGINAL PHASE A REPORT TOTALS					**$23,689,100**	**$4,993,300**	**$28,682,400**					

ALTERNATE B

Reach	Alternate										Location of Costs	Adjustments
Reach 1	Maintain Existing Configuration	$0	$0	$618,000	$618,000	$0	**$618,000**	$0	$0	$0	from Table 8.8	
Reach 2	Floodproofing	$0	$0	$0	$0	$539,400	**$539,400**	$0	$0	$0	All from Table 8.10	
Reach 3B	HHZ Containment/Floodproofing	$5,256,000	$560,100	$434,000	$6,250,100	$3,505,600	**$9,755,700**	$0	$0	$0	Public from Table 8.9 - Private from Table 8.10 "Const Costs"	
Reach 4B	HHZ Containment/Floodproofing	$2,773,000	$358,800	$774,000	$3,905,800	$3,117,300	**$7,023,100**	$0	$0	$0	Public from Table 8.9 - Private from Table 8.10 "Const Costs"	
Reach 4B	**Add Cross Drainage @ Kalmia**	**$151,200**	**$0**	**$0**	**$151,200**	**$0**	**$151,200**	**$0**	**$0**	**$0**		**See Worksheet for Revised Alternate Costs**
TOTAL Reach 4B		**$2,924,200**	**$358,800**	**$774,000**	**$4,057,000**	**$3,117,300**	**$7,174,300**	**$0**	**$0**	**$0**		
Reach 5B	HHZ Containment/Floodproofing	$119,000	$0	$493,000	$612,000	$2,528,200	**$3,140,200**	$49,000	$0	$49,000	Public from Table 8.9 - Private from Table 8.10 "Const Costs"	
Reach 6	HHZ Containment/Floodproofing	$1,020,000	$205,800	$253,000	$1,478,800	$2,390,300	**$3,869,100**	$101,500	$0	$101,500	Public from Table 8.9 - Private from Table 8.10 "Const Costs"	
Reach 6	Overflow Channel at Centennial Sch.	**$933,500**	$0	$0	$933,500	$0	**$933,500**					**See Worksheet for Revised Alternate Costs**
Reach 6	Extend Garnet Ln. Ped Bridge	**$150,000**	$0	$0	$150,000	$0	**$150,000**					**See Worksheet for Revised Alternate Costs**
TOTAL Reach 6		**$2,103,500**	**$205,800**	**$253,000**	**$2,562,300**	**$2,390,300**	**$4,952,600**	**$101,500**	**$0**	**$101,500**		
Reach 7	Maintain Existing Configuration with Safe Access to Crestview Elementary School via 19th Street and Upland	$0	$0	$807,000	$807,000	$0	**$807,000**	$0	$0	$0	from Table 8.8	
Reach 7	**Channel Transition & Drop Structure**	**$30,000**	**$0**	**$0**	**$30,000**	**$0**	**$30,000**	**$0**	**$0**	**$0**		**See Worksheet for Revised Alternate Costs**
TOTAL Reach 7		**$30,000**	**$0**	**$807,000**	**$837,000**	**$0**	**$837,000**	**$0**	**$0**	**$0**		
Reach 8	Maintain Existing Configuration	$0	$0	$289,000	$289,000	$0	**$289,000**	$0	$0	$0	from Table 8.8	
TOTAL ALL REACHES		**$10,432,700**	**$1,124,700**	**$3,668,000**	**$15,225,400**	**$12,080,800**	**$27,306,200**	**$150,500**	**$0**	**$150,500**		
ORIGINAL PHASE A REPORT TOTALS					**$23,689,100**	**$4,993,300**	**$28,682,400**					

NOTE: O & M COSTS ARE PRESENT VALUE, P = 50 years, I = 3%

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 8 - ALTERNATE A - MAINTAIN EXISTING CONFIGURATION

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$0**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$289,000**											
PUBLIC SUB-TOTAL COSTS	**$289,000**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$289,000**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											
						PED						
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
CHANNEL O&M COSTS	**$289,000**											Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**											Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 7 - ALTERNATE A - MAINTAIN EXISTING CONFIGURATION WITH SAFE ACCESS TO CRESTVIEW SCHOOL

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$0**											
Channel Transition & Drop Structure	**$30,000**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$807,000**											
PUBLIC SUB-TOTAL COSTS	**$837,000**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$837,000**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
SUB-TOTAL	**$0**											

SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**DROP STRUCT**	**SEDIMENT CAPTURE**	**PED TRAIL REQD**	**MISC COSTS**	**WETLAND MITIG.**	**SUB-TOTAL**	**ADD 40%**	**TOTAL**
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**

CHANNEL O&M COSTS	**$807,000**	Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**	Refer to FLOODPROOFING COSTS-1-13-06
IMPROVEMENTS NOT REQUIRED		

REVISIONS

	LF	Width	Height	Excav	Low Flow	Seed	Landscape	**TOTAL**
Channel Transition US 19th	80	40	2	$3,600	$2,000	$300	$1,600	$7,500
	Length	Width	Acres	Cost				
Wetland Mitigation	80	30	0.06	$7,000				$7,000
					No.	Unit Cost	Cost	
Drop Structure-Horseshoe 2' Deep					1	$15,000	$15,000	
							$29,500	**SAY $30,000**

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 6 - ALTERNATE A - HIGH HAZARD CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS

CONSTRUCTION COSTS	**$1,020,000**
Overflow Channel Centennial Sch.	**$933,500**
Lengthen Ped. Bridge at Garnet Ln.	**$150,000**
ROW COSTS	**$205,800**
CHANNEL O&M COSTS	**$253,000**
PUBLIC SUB-TOTAL COSTS	**$2,562,300**
PRIVATE SUB-TOTAL COSTS	**$2,390,300**
TOTAL	**$4,952,600**

IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION

CONSTRUCTION COSTS	$101,500
ROW COSTS	$0
SUB-TOTAL	**$101,500**

	Length	Width	Height	Cells	Area	RCB	RCB	Roadway Restor.	Sub-total Crossing	Misc. Crossing	**Total Estimated**
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**
19th Street	40	16	5	3	240	187	$140,000	$70,000	$210,000	$84,000	$294,000

	Length	Cost/LF	
Ped. Bridge at Garnet Ln.	120	$1,500	$180,000
			$474,000

CHANNEL	Length	Width	Depth	Excav	Low Flow	Seeding	Landscape	Sub-total
D/S 19th	160	70	2	$12,500	$4,000	$1,000	$3,200	$20,700
Garnet Ln	700	80	2	$62,300	$17,500	$4,900	$14,000	$98,700
								$119,400

DROP STRUCTURES

SEDIMENT CAPTURE FACILITY

PEDESTRIAN TRAIL REQ'D.	Length	Unit Cost	Sub-Total	**TOTAL**
Ped. Trail D/S 19th	300	$50	$15,000	
Ped. Trail at School	900	$50	$45,000	**$60,000**

MISCELLANEOUS

WETLAND MITIGATION

	Length	Width	Acres	Cost
	860	30	0.6	**$75,000**

SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**DROP STRUCT**	**SEDIMENT CAPTURE**	**PED TRAIL REQD**	**MISC COSTS**	**WETLAND MITIG.**	**SUB-TOTAL**	**ADD 40%**	**TOTAL**
	$474,000	$119,400	$0	$0	$60,000	$0	$75,000	$728,400	291,360	**1,020,000**

ROW COSTS	Length (ft)	Width (ft)	Area (acres	Sub-total ROW	Add 5%	**ROW Costs**
D/S 19th	160	70	0.26	$32,654	$1,633	$34,287
Garnet Ln	700	80	1.29	$163,269	$8,163	$171,433
						$205,800
ROW TOTAL			**$205,800**			

	HHZ
CHANNEL O&M COSTS	**$253,000**

Refer to 0217WC_O&Mrepair$FINAL Spreadsheet

FLOODPROOFING	Floodproofing	O & M	**Total**
	$1,856,300	$534,000	**$2,390,300**

Refer to FLOODPROOFING COSTS-1-13-06

IMPROVEMENTS NOT REQUIRED	Length	Sub-total	40%	Sub-Total	**TOTAL**
Ped Trail D/S 19th	450	$22,500	$9,000	$31,500	
Ped. Trail at School	1000	$50,000	$20,000	$70,000	**$101,500**

REVISIONS

			TOTAL	
Overflow Channel Centennial School			**$933,500**	**Memo dated January 23, 2008**
	Length	Units		
Lengthen Ped. Bridge at Garnet Ln.	100	$1,500	$150,000	
By 100' was 120' now 220'				
			$150,000	

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 5A - ALTERNATE A -100-YEAR CONTAINMENT

FLOOD CONTROL IMPROVEMENTS

CONSTRUCTION COSTS	**$3,110,000**
ROW COSTS	**$509,800**
CHANNEL O&M COSTS	**$282,000**
PUBLIC SUB-TOTAL COSTS	**$3,901,800**
PRIVATE SUB-TOTAL COSTS	**$0**
TOTAL	**$3,901,800**

IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION

CONSTRUCTION COSTS	$0
ROW COSTS	$0
SUB-TOTAL	**$0**

	Length	Width	Height	Cells	Area	RCB	RCB	Roadway Restor.	Sub-total Crossing	Misc. Crossing	**Total Estimated**
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**
26th Street	100	10	6	4	240	474	$356,000	$178,000	$534,000	$213,600	$747,600
Winding Trail Drive	60	12	4	5	240	356	$267,000	$133,500	$400,500	$160,200	$560,700

	Length	Cost/LF	
Modify Trail Crossing	100	$200	$20,000
at U/S Winding Trail Dr.			
Modify Farmers	100	$250	$25,000
Ditch Crossing			**$1,353,300**

CHANNEL	Length	Width	Depth	Excav	Low Flow	Ped. Conc. Trail	Seeding	Landscape	TOTAL
D/S 26th - 600'	600	100	7	$168,333	$15,000	$30,000	$5,165	$12,000	$230,499
600' to Winding Trail	820	80	7	$230,056	$20,500	$41,000	$5,647	$16,400	$313,603
D/S Winding Trail	280	80	7	$78,556	$7,000	$14,000	$1,928	$5,600	$107,084
									$651,200

DROP STRUCTURES		No.	Unit Cost	Total
26th to 28th		11	$10,000	**$110,000**

SEDIMENT CAPTURE FACILITY

PEDESTRIAN TRAIL REQ'D	Length	Cost/LF	
26th D/S/	350	$50	**$17,500**

WETLAND MITIGATION

	Length	Width	Acres	Cost
	1700	18	0.7	**$89,300**

SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**DROP STRUCT**	**SEDIMENT CAPTURE**	**PED TRAIL REQD**	**MISC COSTS**	**WETLAND MITIG.**	**SUB-TOTAL**	**ADD 40%**	**TOTAL**
	$1,353,300	$651,200	$110,000	$0	$17,500	$0	$89,300	$2,221,300	$888,520	**$3,110,000**

ROW COSTS	Length (ft)	Width (ft)	Area (acres	Sub-total ROW	Add 5%	**ROW Costs**
D/S 26th	575	100	1.3	$167,642	$8,382	$176,024
D/S 26th - 600'	815	100	1.9	$237,615	$11,881	$249,496
D/S Winding Trail	275	100	0.6	$80,177	$4,009	$84,186
TOTAL REACH 5						**$509,800**

CHANNEL O&M COSTS	**$282,000**	Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**	Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 5B - ALTERNATE B -HHZ CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS

CONSTRUCTION COSTS	**$119,000**
ROW COSTS	**$0**
CHANNEL O&M COSTS	**$493,000**
PUBLIC SUB-TOTAL COSTS	**$612,000**
PRIVATE SUB-TOTAL COSTS	**$2,528,200**
TOTAL	**$3,140,200**

IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION

CONSTRUCTION COSTS	$49,000
ROW COSTS	$0
SUB-TOTAL	**$49,000**

	Length	Width	Height	Cells	Area	RCB	RCB	Roadway Restor.	Sub-total Crossing	Misc. Crossing	**Total Estimated**
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**
	Length	Cost/LF									
Low Flow Crossing D/S Winding Trail	40	$250									$10,000
											$10,000

	Length	Width	Depth	Excav	Low Flow	Ped. Conc. Trail	Seeding	Landscape	**TOTAL**
CHANNEL									
Transition U/S 28th	200	50	3	$16,700	$0	$0	$1,000	$0	**$17,700**

DROP STRUCTURES

SEDIMENT CAPTURE FACILITY

PEDESTRIAN TRAIL REQ'D.		Length	Cost/LF	
D/S 26th		350	$50	$17,500
U/S 28th		200	$50	$10,000
			TOTAL	**$27,500**

WETLAND MITIGATION	Length	Width	Acres	Cost
	200	50	0.23	**$29,155**

SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**DROP STRUCT**	**SEDIMENT CAPTURE**	**PED TRAIL REQD**	**MISC COSTS**	**WETLAND MITIG.**	**SUB-TOTAL**	**ADD 40%**	**TOTAL**
	$10,000	$17,700	$0	$0	$27,500	$0	$29,155	$84,355	$33,742	**$119,000**

ROW COSTS	Length (ft)	Width (ft)	Area (acres	Sub-total ROW	Add 5%	**ROW Costs**
	HHZ					
CHANNEL O&M COSTS	**$493,000**					

FLOODPROOFING	Floodproofing	O & M	**TOTAL**
	$2,035,200	$493,000	**$2,528,200**

IMPROVEMENTS NOT REQUIRED		Length		Unit Cost		Sub-total	40%	Total
D/S 26th Ped. Crossing		100		$100		$10,000	$4,000	$14,000
D/S 26th Trail		500		$50		$25,000	$10,000	$35,000
								$49,000

Refer to 0217WC_O&Mrepair$FINAL Spreadsheet

Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 4A - ALTERNATE A - 100-YEAR CONTAINMENT

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$3,663,000**											
ROW COSTS	**$589,300**											
CHANNEL O&M COSTS	**$479,000**											
PUBLIC SUB-TOTAL COSTS	**$4,731,300**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$4,731,300**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
SUB-TOTAL	**$0**											
								Roadway	Sub-total	Misc.	**Total**	
	Length	Width	Height	Cells	Area	RCB	RCB	Restor.	Crossing	Crossing	**Estimated**	
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**	
28th Street	120	20	9	1	180	258	$194,000	$97,000	$291,000	$116,400	$407,400	
Kalmia Avenue	60	5	6	1	30	49	$37,000	$18,500	$55,500	$22,200	$77,700	
Modify Fire Access Crossing	40	20	9	2	360	172	$129,000	$64,500	$193,500	$77,400	$270,900	
	Length	Cost/LF										
Low Flow Trail Crossing	50	$200									$10,000	
Pedestrian Bridge D/S Kalmia	100	$1,500									$150,000	
TOTAL											**$756,000**	
							Ped. Conc.					
CHANNEL	Length	Width	Depth	Excav	Low Flow	Seeding	Trail	Landscape	Sub-total			
Overflow Channel	715	80	9	$200,597	$17,875	$4,924		$14,300	$237,696			
U/S Kalmia	500	100	7	$140,278	$12,500	$4,304		$10,000	$167,082			
D/S Kalmia	1200	50	9	$110,000	$30,000	$5,165		$24,000	$169,165			
2 1/2' Stepped Boulder Walls-West	1200	$300							$360,000			
2 1/2' Stepped Boulder Walls-East	1200	$400							$480,000			
									$1,414,000			
DROP STRUCTURES		No. Drops	Unit Cost	Total								
28th to Kalmia		5	$10,000	$50,000								
Kalmia to SH119		5	$10,000	$50,000								
				$100,000								
SEDIMENT CAPTURE FACILITY												
PEDESTRIAN TRAIL REQ'D.	Length	Cost/LF	Cost	Total								
D/S 28th	800	$50	$40,000									
U/S Kalmia	500	$50	$25,000	**$65,000**								
MISCELLANEOUS												
WETLAND MITIGATION												
	Length	Width	Acres	Cost								
	2415	40	2.2	**$281,700**								
					PED							
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$756,000	$1,414,000	$100,000	$0	$65,000	$0	$281,700	$2,616,700	$1,046,680	**$3,663,000**		
ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**						
	(ft)	(ft)	(acres	ROW	5%	**Costs**						
NW 28th	715	100	1.6	$208,460	$10,423	$218,883						
East Side 28th	490	100	1.1	$142,860	$7,143	$150,003						
D/S Kalmia	730	60	1.0	$127,700	$6,385	$134,085						
D/S Fire Access	470	60	0.6	$82,218	$4,111	$86,329						
TOTAL						**$589,300**						
CHANNEL O&M COSTS	**$479,000**											Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**											Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 4B - ALTERNATE B - HHZ CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS											
CONSTRUCTION COSTS	**$2,773,000**										
Cross Drain Culvert	**$151,200**										
ROW COSTS	**$358,800**										
CHANNEL O&M COSTS	**$774,000**										
PUBLIC SUB-TOTAL COSTS	**$4,057,000**										
PRIVATE SUB-TOTAL COSTS	**$3,117,300**										
TOTAL	**$7,174,300**										
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION											
CONSTRUCTION COSTS	$0										
ROW COSTS	$0										
SUB-TOTAL	**$0**										
								Roadway	Sub-total	Misc.	**Total**
	Length	Width	Height	Cells	Area	RCB	RCB	Restor.	Crossing	Crossing	**Estimated**
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**
28th Street	120	20	9	1	180	258	$194,000	$97,000	$291,000	$116,400	$407,400
Low Flow Trail Crossing	50	$200									$20,000
Kalmia Avenue	60	5	6	1	30	49	$37,000	$18,500	$55,500	$22,200	$77,700
Pedestrian Bridge D/S Kalmia	100	$1,500									$150,000
Modify Fire Access Crossing	40	20	9	2	360	172	$129,000	$64,500	$193,500	$77,400	$270,900
TOTAL											**$926,000**
							Ped. Conc.				
CHANNEL	Length	Width	Depth	Excav	Low Flow	Seeding	Trail	Landscape	Sub-total		
Overflow Channel	715	80	7	$200,597	$17,875	$4,924		$14,300	$237,696		
D/S Kalmia	1200	50	2	$110,000	$30,000	$5,165		$24,000	$169,165		
	Length	Cost/LF									
2 1/2' Stepped Boulder Walls	1200	$300							$360,000		
									$766,900		
DROP STRUCTURES											
SEDIMENT CAPTURE FACILITY											
PEDESTRIAN TRAIL REQ'D.	Length	Unit Cost	Sub-total	Total							
D/S 28th	800	$50	$40,000								
U/S Kalmia	500	$50	$25,000	**$65,000**							
MISCELLANEOUS											
WETLAND MITIGATION											
	Length	Width	Acres	Cost							
	1915	40	1.8	**$223,400**							
					PED						
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**	
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**		
	$926,000	$766,900	$0	$0	$65,000	$0	$223,400	$1,981,300	$792,520	**$2,773,000**	
ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**					
	(ft)	(ft)	(acres	ROW	5%	**Costs**					
Overflow Channel	715	80	1.3	$166,768	$8,338	$175,106					
D/S Kalmia	1200	50	1.4	$174,931	$8,747	$183,678					
TOTAL						**$358,800**					
	HHZ										
CHANNEL O&M COSTS	**$774,000**										
FLOODPROOFING	Floodproofing	O & M	**TOTAL**								
	$1,850,300	$1,267,000	**$3,117,300**								

REVISIONS	Length	Width	Depth	No. Cells	Area (sf)	Area (cy)	RCB Cost	Roadway Restor. Cost	Sub-total Crossing Cost	Misc. Crossing Cost	Total
Cross Drain Culvert	160	6	2	1	12	95	$72,000	$36,000	$108,000	$43,200	**$151,200**

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 3A - ALTERNATE A - 100-YEAR CONTAINMENT

FLOOD CONTROL IMPROVEMENTS

CONSTRUCTION COSTS	**$5,833,000**
ROW COSTS	**$742,400**
CHANNEL O&M COSTS	**$216,000**
PUBLIC SUB-TOTAL COSTS	**$6,791,400**
PRIVATE SUB-TOTAL COSTS	**$0**
TOTAL	**$6,791,400**

IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION

CONSTRUCTION COSTS	$0
ROW COSTS	$0
TOTAL	**$0**

	Length	Width	Height	Cells	Area	RCB	RCB	Roadway Restor.	Sub-total Crossing	Misc. Crossing	**Total Estimated**
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**
Iris Avenue and 34th Street	400	10	8	3	240	1600	$1,200,000	$600,000	$1,800,000	$720,000	$2,520,000
Spring Creek	40	10	6	4	240	190	$143,000	$71,500	$214,500	$85,800	$300,300
Railroad	20	12	5	4	240	101	$76,000	$38,000	$114,000	$45,600	$159,600
	Length	Cost/LF									
D/S Spring Creek - Ped Bridge	100	$1,500									$150,000
Modify Boulder & Whiterock	100	$250									$25,000
Ditch Crossing											
TOTAL											**$3,154,900**

		Channel	Channel	Excavation	Low Flow	Pedestrian Concrete	Seed, Fert.	Landscaping	**Total Channel**
CHANNEL	Length	Top Width	Depth		Channel	Trail	Mulch		**Costs**
Transition U/S Iris	350	60	2	$98,194	$8,750		$1,808	$7,000	$115,752
D/S 34th-Enlarge Channel	1300	80	7	$364,722	$32,500		$8,953	$26,000	$432,175
TOTAL REACH 3									**$548,000**

DROP STRUCTURES		No. Drops	Unit Cost	Total
34th to Spring Creek	Spring Creek	3	$10,000	$30,000
				$30,000

PEDESTRIAN TRAIL REQ'D.	Length	Cost
D/S SH119	1200	$60,000
D/S Iris	900	$45,000
D/S Spring	300	$15,000
at Ped Crossing	900	$45,000
		$165,000

MISCELLANEOUS	
Modify Inlet at Foothills/47th	**$100,000**

WETLAND MITIGATION	Length	Width	Acres	Total
	1650	35	1.3	**$168,370**

SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**DROP STRUCT**	**SEDIMENT CAPTURE**	**PED TRAIL REQD**	**MISC COSTS**	**WETLAND MITIG.**	**SUB-TOTAL**	**ADD 40%**	**TOTAL**
	$3,154,900	$548,000	$30,000	$0	$165,000	$100,000	$168,370	$4,166,270	$1,666,508	**$5,833,000**

ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**
	(ft)	(ft)	(acres	ROW	5%	**Costs**
3115 Iris						$437,600
D/S SH119	250	100	0.6	$72,888		
D/S Bank Bridge	550	100	1.3	$160,354		
D/S 34th	840	10	0.2	$24,490		
D/S Spring Creek Pl	415	10	0.1	$12,099		
D/S Railroad	70	100	0.2	$20,409		
				$290,240	$14,512	$304,800
						$742,400

CHANNEL O&M COSTS	**$216,000**	Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**	Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 3B - ALTERNATE B - HHZ CONTAINMENT/FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$5,256,000**											
ROW COSTS	**$560,100**											
CHANNEL O&M COSTS	**$434,000**											
PUBLIC SUB-TOTAL COSTS	**$6,250,100**											
PRIVATE SUB-TOTAL COSTS	**$3,505,600**											
TOTAL	**$9,755,700**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											
								Roadway	Sub-total	Misc.	**Total**	
	Length	Width	Height	Cells	Area	RCB	RCB	Restor.	Crossing	Crossing	**Estimated**	
CROSSINGS	(ft)	(ft)	(ft)	(No.)	(sf)	(cy)	Cost	Cost	Cost	Cost	**Cost**	
Iris Avenue and 34th Street	400	10	8	3	240	1600	$1,200,000	$600,000	$1,800,000	$720,000	$2,520,000	
Spring Creek	40	10	6	4	240	190	$143,000	$71,500	$214,500	$85,800	$300,300	
Railroad	20	12	5	4	240	101	$76,000	$38,000	$114,000	$45,600	$159,600	
	Length	Cost/LF										
D/S Spring Creek - Ped Bridge	100	$1,500									$150,000	
Modify Boulder & Whiterock	100	$250									$25,000	
Ditch Crossing												
TOTAL											**$3,154,900**	
						Pedestrian			**Total**			
		Channel	Channel	Excavation	Low Flow	Concrete	Seed, Fert.	Landscaping	**Channel**			
CHANNEL	Length	Top Width	Depth		Channel	Trail	Mulch		**Costs**			
Transition U/S Iris	350	60	2	$98,194	$8,750		$1,808	$7,000	$115,752			
N & S Overbank	500	80	2	$44,500	$12,500		$3,500	$10,000	$70,500			
TOTAL REACH 3									**$186,252**			
DROP STRUCTURES												
PEDESTRIAN TRAIL REQ'D.		Length	Cost									
D/S SH119		1200	$60,000									
D/S Iris		900	$45,000									
D/S Spring		300	$15,000									
at Ped Crossing		300	$15,000									
			$135,000									
MISCELLANEOUS												
Modify Inlet at Foothills/47th				**$100,000**								
WETLAND MITIGATION	Length	Width	Acres	**Total**								
Transition U/S Iris	350	60	0.5	$61,200								
D/S Spring Creek	500	80	0.9	$116,600								
				$177,800								
						PED						
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**ADD**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$3,154,900	$186,252	$0	$0	$135,000	$100,000	$177,800	$3,753,952	$1,501,581	**$5,256,000**		
ROW COSTS	Length	Width	Area	Sub-total	Add	**ROW**						
	(ft)	(ft)	(acres	ROW	5%	**Costs**						
3115 Iris						$437,600						
D/S Spring Creek Pl	500	80	0.9	$116,621								
				$116,621	$5,831	$122,452						
						$560,100						
	HHZ											
CHANNEL O&M COSTS	**$434,000**											Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	Floodproofing	O & M	**TOTAL**									
	$2,929,600	$576,000	**$3,505,600**									Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS

REACH 2 - ALTERNATE A - FLOODPROOFING

FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$0**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$0**											
PUBLIC SUB-TOTAL COSTS	**$0**											
PRIVATE SUB-TOTAL COSTS	**$539,400**											
TOTAL	**$539,400**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
TOTAL	**$0**											

					PED						
			DROP	SEDIMENT	TRAIL	MISC	WETLAND	SUB-	ADD	**TOTAL**	
SUB-TOTAL CONSTRUCTION COSTS	CROSSINGS	CHANNELS	STRUCT	CAPTURE	REQD	COSTS	MITIG.	TOTAL	40%		
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	

CHANNEL O&M COSTS				Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	Floodproofing	O & M	**TOTAL**	
	$207,400	$332,000	**$539,400**	Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK - REVISED 8/27/10 - RECOMMENDED ALTERNATE COSTS												
REACH 1 - ALTERNATE A - MAINTAIN EXISTING CONFIGURATION												
FLOOD CONTROL IMPROVEMENTS												
CONSTRUCTION COSTS	**$0**											
ROW COSTS	**$0**											
CHANNEL O&M COSTS	**$618,000**											
PUBLIC SUB-TOTAL COSTS	**$618,000**											
PRIVATE SUB-TOTAL COSTS	**$0**											
TOTAL	**$618,000**											
IMPROVEMENTS NOT REQUIRED FOR FLOOD CONTROL MITIGATION												
CONSTRUCTION COSTS	$0											
ROW COSTS	$0											
SUB-TOTAL	**$0**											
						PED						
			DROP	**SEDIMENT**	**TRAIL**	**MISC**	**WETLAND**	**SUB-**	**CONTING**	**TOTAL**		
SUB-TOTAL CONSTRUCTION COSTS	**CROSSINGS**	**CHANNELS**	**STRUCT**	**CAPTURE**	**REQD**	**COSTS**	**MITIG.**	**TOTAL**	**40%**			
	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**		
CHANNEL O&M COSTS	**$618,000**											Refer to 0217WC_O&Mrepair$FINAL Spreadsheet
FLOODPROOFING	**$0**											Refer to FLOODPROOFING COSTS-1-13-06

WONDERLAND CREEK
FLOODPROOFING COSTS
2/9/06

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
	AREA - 1						
1545	UPLAND - FM	$ 85,300	$ 225,000	$ 310,300	Single Family, Ranch	$ 54,700.00	0.64
1500	UPLAND - FM	$ 144,900	$ 210,000	$ 354,900	Single Family, Multi-Level	$ 53,000.00	0.37
1525	SUMAC - FM	$ 89,600	$ 150,000	$ 239,600	Single Family, Ranch	$ 75,300.00	0.84
1502	SUMAC - FM	$ 55,000	$ 150,000	$ 205,000	Single Family, Ranch	$ 29,400.00	0.53
1734	SUMAC - FM	$ 133,900	$ 180,000	$ 313,900	Single Family, Multi-Level	$ 37,100.00	0.28
4140	17TH	$ 313,900	$ 180,000	$ 493,900	Single Family, Multi-Level	$ 47,800.00	0.15
	AVERAGE	$ 137,100		$ 319,600		$ 49,550.00	0.47
	MAXIMUM					$ 50,000.00	
4165	15TH	$ 157,000	$ 239,000	$ 396,000	Single Family, Multi-Level		$ 50,000.00
4164	15TH	$ 222,500	$ 295,000	$ 517,500	Single Family, Multi-Level		$ 50,000.00
4156	15TH	$ 241,700	$ 324,500	$ 566,200	Single Family, Multi-Level		$ 50,000.00
4144	15TH	$ 270,700	$ 324,500	$ 595,200	Single Family, Multi-Level		$ 50,000.00
4140	17TH	$ 313,900	$ 180,000	$ 493,900	Single Family, Multi-Level		$ 47,800.00
1880	REDWOOD	$ 250,000	$ 255,000	$ 505,000	Single Family, Multi-Level		$ 50,000.00
4170	RIVERSIDE	$ 119,800	$ 191,200	$ 311,000	Single Family, Multi-Level		$ 50,000.00
1490	RIVERSIDE	$ 188,800	$ 167,300	$ 356,100	Single Family, Multi-Level		$ 50,000.00
1470	RIVERSIDE	$ 137,500	$ 167,300	$ 304,800	Single Family, Multi-Story Townhome		$ 50,000.00
1460	RIVERSIDE	$ 150,800	$ 167,300	$ 318,100	Single Family, Multi-Story Townhome		$ 50,000.00
1450	RIVERSIDE	$ 169,700	$ 167,300	$ 337,000	Single Family, Multi-Level		$ 50,000.00
1440	RIVERSIDE	$ 156,500	$ 167,300	$ 323,800	Single Family, Multi-Level		$ 50,000.00
1420	RIVERSIDE	$ 151,600	$ 167,300	$ 318,900	Single Family, Multi-Level		$ 50,000.00

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
1380	RIVERSIDE	$ 100,300	$ 167,300	$ 267,600	Single Family, Multi-Level		$ 47,000.00
1370	RIVERSIDE	$ 131,500	$ 167,300	$ 298,800	Single Family, Multi-Level		$ 50,000.00
1350	RIVERSIDE	$ 132,000	$ 167,300	$ 299,300	Single Family, Multi-Level		$ 50,000.00
1330	RIVERSIDE	$ 121,900	$ 167,300	$ 289,200	Single Family, Multi-Level		$ 50,000.00
1310	RIVERSIDE	$ 112,300	$ 167,300	$ 279,600	Single Family, Multi-Level		$ 50,000.00
1307	RIVERSIDE	$ 77,000	$ 295,000	$ 372,000	Single Family		$ 36,100.00
1301	RIVERSIDE	$ 171,700	$ 295,000	$ 466,700	Single Family, Multi-Level		$ 50,000.00
1300	RIVERSIDE	$ 113,200	$ 167,300	$ 280,500	Single Family, Multi-Level		$ 50,000.00
1245	RIVERSIDE	$ 148,000	$ 324,500	$ 472,500	Single Family, Multi-Level		$ 50,000.00
1225	RIVERSIDE	$ 138,900	$ 324,500	$ 463,400	Single Family, Multi-Level		$ 50,000.00
1300	SUMAC	$ 121,700	$ 324,500	$ 446,200	Single Family, Ranch		$ 50,000.00
1286	SUMAC	$ 75,000	$ 295,000	$ 370,000	Single Family, Multi-Level		$ 35,100.00
1224	SUMAC	$ 145,700	$ 324,500	$ 470,200	Single Family, Ranch		$ 50,000.00
1206	SUMAC	$ 77,300	$ 236,000	$ 313,300	Single Family, Ranch		$ 36,200.00
1204	SUMAC	$ 134,100	$ 324,500	$ 458,600	Single Family, Multi-Level		$ 50,000.00
1200	SUMAC	$ 176,000	$ 295,000	$ 471,000	Single Family, Multi-Level		$ 50,000.00
TOTAL	**29**	**$ 4,507,100**			**TOTAL FP COSTS - AREA 1**		**$ 1,402,200.00**
	AREA - 2						
2300	EMERALD	$ 114,000	$ 479,400	$ 593,400	Single Family, Ranch	$ 90,600.00	0.79
2100	EMERALD	$ 490,600	$ 479,400	$ 970,000	Single Family, Ranch	$ 48,800.00	0.10
2528	PAMPAS	$ 318,900	$ 368,800	$ 687,700	Single Family, Ranch	$ 56,800.00	0.18
	AVERAGE	$ 307,833		$ 750,367		$ 52,800.00	0.36
	MAXIMUM					$ 53,000.00	
2300	EMERALD	$ 114,000	$ 479,400	$ 593,400	Single Family, Ranch		$ 53,000.00
2290	EMERALD	$ 190,400	$ 516,300	$ 706,700	Single Family, Ranch		$ 53,000.00
2200	EMERALD	$ 216,100	$ 553,100	$ 769,200	Single Family, Ranch		$ 53,000.00
2190	EMERALD	$ 47,300	$ 295,000	$ 342,300	Single Family, Multi-Level		$ 17,000.00
2150	EMERALD	$ 94,700	$ 516,300	$ 611,000	Single Family, Ranch		$ 34,100.00
2105	EMERALD	$ 152,900	$ 442,500	$ 595,400	Single Family, Ranch		$ 53,000.00

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
2100	EMERALD	$ 490,600	$ 479,400	$ 970,000	Single Family, Ranch		$ 48,800.00
2590	NORWOOD	$ 361,300	$ 412,500	$ 773,800	Single Family, Multi-Level		$ 53,000.00
2560	NORWOOD	$ 409,500	$ 412,500	$ 822,000	Single Family, Multi-Level		$ 53,000.00
2503	NORWOOD	$ 307,400	$ 368,800	$ 676,200	Single Family, Multi-Level		$ 53,000.00
2471	NORWOOD	$ 279,800	$ 368,800	$ 648,600	Single Family, Multi-Level		$ 53,000.00
2580	PAMPAS	$ 259,500	$ 405,600	$ 665,100	Single Family, Multi-Level		$ 53,000.00
2564	PAMPAS	$ 281,400	$ 405,600	$ 687,000	Single Family, Multi-Level		$ 53,000.00
2546	PAMPAS	$ 308,500	$ 368,800	$ 677,300	Single Family, Ranch		$ 53,000.00
2537	PAMPAS	$ 579,200	$ 405,600	$ 984,800	Single Family, Split Level		$ 53,000.00
2528	PAMPAS	$ 318,900	$ 368,800	$ 687,700	Single Family, Ranch		$ 53,000.00
2505	PAMPAS	$ 604,000	$ 405,600	$ 1,009,600	Single Family, Multi-Level		$ 53,000.00
2500	PAMPAS	$ 291,900	$ 368,800	$ 660,700	Single Family, Ranch		$ 53,000.00
2195	POPLAR	$ 148,000	$ 357,000	$ 505,000	Single Family, Multi-Level		$ 53,000.00
2155	POPLAR	$ 160,300	$ 324,500	$ 484,800	Single Family, Multi-Level		$ 53,000.00
2115	POPLAR	$ 234,400	$ 324,500	$ 558,900	Single Family, Ranch		$ 53,000.00
1953	POPLAR	$ 175,800	$ 324,500	$ 500,300	Single Family, Multi-Level		$ 53,000.00
2486	PREMIER	$ 425,900	$ 442,500	$ 868,400	Single Family, Multi-Level		$ 53,000.00
2440	PREMIER	$ 411,000	$ 405,600	$ 816,600	Single Family, Multi-Level		$ 53,000.00
2424	PREMIER	$ 545,400	$ 442,500	$ 987,900	Single Family, Multi-Level		$ 53,000.00
3881	26TH	$ 351,000	$ 412,500	$ 763,500	Single Family, Multi-Level		$ 53,000.00
3855	26TH	$ 262,500	$ 412,500	$ 675,000	Single Family, Multi-Level		$ 53,000.00
3833	26TH	$ 172,800	$ 412,500	$ 585,300	Single Family, Split Level		$ 53,000.00
3827	26TH	$ 164,100	$ 412,500	$ 576,600	Single Family, Multi-Level		$ 53,000.00
4415	GARNET	$ 177,700	$ 516,300	$ 694,000	Single Family, Multi-Level		$ 53,000.00
4081	GARNET	$ 123,300	$ 976,700	$ 1,100,000	Single Family, Ranch		$ 44,400.00
4072	19TH	$ 354,800	$ 413,600	$ 768,400	PRIVATE ELEM SEC, Masonry		$ 127,700.00
TOTAL	**32**	**$ 9,014,400**			**TOTAL FP COSTS - AREA 2**		**$ 1,703,000.00**
	AREA - 3						
3850	26TH	$ 215,200	$ 322,500	$ 537,700	Single Family, 0	$ 46,200.00	0.21
	AVERAGE	$ 215,200		$ 537,700		$ 46,200.00	0.21

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
	MAXIMUM					$ 46,000.00	
3890	26TH	$ 225,300	$ 295,600	$ 520,900	Single Family, Split Level		$ 46,000.00
3852	26TH	$ 431,100	$ 322,500	$ 753,600	Single Family, Multi-Level		$ 46,000.00
3850	26TH	$ 215,200	$ 322,500	$ 537,700	Single Family, Multi-Level		$ 45,200.00
3840	26TH	$ 239,700	$ 295,600	$ 535,300	Single Family, Multi-Level		$ 46,000.00
3836	26TH	$ 324,800	$ 295,600	$ 620,400	Single Family, Multi-Level		$ 46,000.00
3880	FOLSOM	$ 223,300	$ 236,500	$ 459,800	Single Family, Multi-Level		$ 46,000.00
3870	FOLSOM	$ 190,500	$ 236,500	$ 427,000	Single Family, Split Level		$ 40,000.00
3860	FOLSOM	$ 315,200	$ 236,500	$ 551,700	Single Family, Multi-Level		$ 46,000.00
3830	FOLSOM	$ 228,700	$ 236,500	$ 465,200	Single Family, Multi-Level		$ 46,000.00
TOTAL	**9**	**$ 2,393,800**			**TOTAL FP COSTS - AREA 3**		**$ 407,200.00**
	AREA - 4						
3860	BIRCHWOOD	$ 231,000	$ 279,500	$ 510,500	Single Family, Multi-Level	$ 43,800.00	0.19
3850	BIRCHWOOD	$ 164,800	$ 279,500	$ 444,300	Single Family, Multi-Level	$ 43,800.00	0.27
	AVERAGE	$ 395,800		$ 954,800		$ 43,800.00	0.19
	MAXIMUM					$ 44,000.00	
3898	BIRCHWOOD	$ 205,500	$ 322,500	$ 528,000	Single Family, Multi-Level		$ 39,000.00
3897	BIRCHWOOD	$ 211,500	$ 322,500	$ 534,000	Single Family, Split Level		$ 40,200.00
3895	BIRCHWOOD	$ 245,100	$ 279,500	$ 524,600	Single Family, Multi-Level		$ 44,000.00
3890	BIRCHWOOD	$ 215,900	$ 279,500	$ 495,400	Single Family, Multi-Level		$ 41,000.00
3885	BIRCHWOOD	$ 202,800	$ 279,500	$ 482,300	Single Family, Multi-Level		$ 38,500.00
3880	BIRCHWOOD	$ 195,100	$ 215,000	$ 410,100	Single Family, Multi-Level		$ 37,100.00
3875	BIRCHWOOD	$ 193,400	$ 279,500	$ 472,900	Single Family, Multi-Level		$ 36,700.00
3870	BIRCHWOOD	$ 233,700	$ 279,500	$ 513,200	Single Family, Multi-Level		$ 44,000.00
3865	BIRCHWOOD	$ 210,900	$ 279,500	$ 490,400	Single Family, Multi-Level		$ 40,100.00
3860	BIRCHWOOD	$ 231,000	$ 279,500	$ 510,500	Single Family, Multi-Level		$ 43,800.00
3855	BIRCHWOOD	$ 235,800	$ 279,500	$ 515,300	Single Family, Split Level		$ 44,000.00
3850	BIRCHWOOD	$ 164,800	$ 279,500	$ 444,300	Single Family, Multi-Level		$ 31,300.00

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3849	BIRCHWOOD	$ 207,300	$ 279,500	$ 486,800	Single Family, Ranch		$ 39,400.00
3844	BIRCHWOOD	$ 215,400	$ 279,500	$ 494,900	Single Family, Split Level		$ 40,900.00
3840	BIRCHWOOD	$ 264,000	$ 279,500	$ 543,500	Single Family, Multi-Level		$ 44,000.00
3885	NORTHBROOK	$ 155,900	$ 193,500	$ 349,400	Single Family, Multi-Level		$ 29,600.00
3879	NORTHBROOK	$ 166,800	$ 193,500	$ 360,300	Single Family, Multi-Level		$ 31,700.00
3875	NORTHBROOK	$ 157,000	$ 193,500	$ 350,500	Single Family, Multi-Level		$ 29,800.00
3869	NORTHBROOK	$ 156,200	$ 193,500	$ 349,700	Single Family, Multi-Level		$ 29,700.00
3865	NORTHBROOK	$ 142,000	$ 193,500	$ 335,500	Single Family, Multi-Level		$ 27,000.00
3859	NORTHBROOK	$ 135,000	$ 193,500	$ 328,500	Single Family, Multi-Level		$ 25,700.00
3855	NORTHBROOK	$ 138,200	$ 193,500	$ 331,700	Single Family, Multi-Level		$ 26,300.00
2730	WINDING TRAIL	$ 183,600	$ 279,500	$ 463,100	Single Family, Split Level		$ 34,900.00
2726	WINDING TRAIL	$ 187,500	$ 279,500	$ 467,000	Single Family, Multi-Level		$ 35,600.00
2724	WINDING TRAIL	$ 194,300	$ 279,500	$ 473,800	Single Family, Multi-Level		$ 36,900.00
2714	WINDING TRAIL	$ 198,900	$ 279,500	$ 478,400	Single Family, Ranch		$ 37,800.00
TOTAL	**26**	**$ 5,047,600**			**TOTAL FP COSTS - AREA 4**		**$ 949,000.00**
	AREA - 5						
3815	NORTHBROOK	$ 1,003,300	$ 86,900	$ 1,090,200	CONDOS, Condo	$ 30,900.00	0.03
	AVERAGE	$ 1,003,300		$ 1,090,200		$ 30,900.00	0.03
	MAXIMUM					$ 31,000.00	
3845	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3845	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3845	NORTHBROOK	$ 142,800	$ 89,800	$ 232,600	CONDOS, Condo		
3845	NORTHBROOK	$ 149,900	$ 95,800	$ 245,700	CONDOS, Condo		
3845	NORTHBROOK	$ 206,300	$ 137,300	$ 343,600	CONDOS, Multi-Story Condo		
3845	NORTHBROOK	$ 225,900	$ 137,300	$ 363,200	CONDOS, Condo		
		$ 984,300					$ 29,500.00
3835	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3835	NORTHBROOK	$ 138,800	$ 86,900	$ 225,700	CONDOS, Condo		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3835	NORTHBROOK	$ 142,800	$ 89,800	$ 232,600	CONDOS, Condo		
3835	NORTHBROOK	$ 149,900	$ 89,800	$ 239,700	CONDOS, Condo		
3835	NORTHBROOK	$ 196,700	$ 137,300	$ 334,000	CONDOS, Multi-Story Condo		
3835	NORTHBROOK	$ 219,100	$ 137,300	$ 356,400	CONDOS, Condo		
		$ 977,000					$ 29,300.00
3825	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3825	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3825	NORTHBROOK	$ 149,900	$ 89,800	$ 239,700	CONDOS, Condo		
3825	NORTHBROOK	$ 142,800	$ 89,800	$ 232,600	CONDOS, Condo		
3825	NORTHBROOK	$ 193,300	$ 137,300	$ 330,600	CONDOS, Multi-Story Condo		
3825	NORTHBROOK	$ 193,300	$ 137,300	$ 330,600	CONDOS, Multi-Story Condo		
		$ 938,700					$ 28,200.00
3815	NORTHBROOK	$ 136,200	$ 86,900	$ 223,100	CONDOS, Condo		
3815	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3815	NORTHBROOK	$ 142,800	$ 89,800	$ 232,600	CONDOS, Condo		
3815	NORTHBROOK	$ 142,800	$ 89,800	$ 232,600	CONDOS, Condo		
3815	NORTHBROOK	$ 225,900	$ 137,300	$ 363,200	CONDOS, Condo		
3815	NORTHBROOK	$ 225,900	$ 137,300	$ 363,200	CONDOS, Condo		
		$ 1,003,300					$ 30,100.00
3805	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3805	NORTHBROOK	$ 129,700	$ 86,900	$ 216,600	CONDOS, Condo		
3805	NORTHBROOK	$ 151,600	$ 95,800	$ 247,400	CONDOS, Condo		
3805	NORTHBROOK	$ 142,800	$ 89,800	$ 232,600	CONDOS, Condo		
3805	NORTHBROOK	$ 229,700	$ 137,300	$ 367,000	CONDOS, Condo		
3805	NORTHBROOK	$ 225,900	$ 137,300	$ 363,200	CONDOS, Condo		
		$ 1,009,400					$ 30,300.00
TOTAL	**5**	**$ 9,825,400**			**TOTAL FP COSTS - AREA 5**		**$ 147,400.00**
	AREA - 6						

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3705/15	BIRCHWOOD	$ 1,893,300	$ 57,100	$ 1,950,400	CONDOS, Condo	$ 58,900.00	0.03
	AVERAGE	$ 1,893,300		$ 1,950,400		$ 58,900.00	0.03
	MAXIMUM					$ 59,000.00	
3795	BIRCHWOOD	$ 113,500	$ 73,400	$ 186,900	CONDOS, Condo		
3795	BIRCHWOOD	$ 113,500	$ 73,400	$ 186,900	CONDOS, Condo		
3795	BIRCHWOOD	$ 113,500	$ 73,400	$ 186,900	CONDOS, Condo		
3795	BIRCHWOOD	$ 113,500	$ 73,400	$ 186,900	CONDOS, Condo		
3795	BIRCHWOOD	$ 136,900	$ 93,800	$ 230,700	CONDOS, Multi-Story Condo		
3795	BIRCHWOOD	$ 136,900	$ 93,800	$ 230,700	CONDOS, Multi-Story Condo		
3795	BIRCHWOOD	$ 136,900	$ 93,800	$ 230,700	CONDOS, Multi-Story Condo		
3795	BIRCHWOOD	$ 136,900	$ 93,800	$ 230,700	CONDOS, Multi-Story Condo		
		$ 1,001,600					$ 30,000.00
3785	BIRCHWOOD	$ 95,000	$ 85,000	$ 180,000	CONDOS, Condo		
3785	BIRCHWOOD	$ 135,100	$ 85,000	$ 220,100	CONDOS, Condo		
3785	BIRCHWOOD	$ 102,900	$ 74,100	$ 177,000	CONDOS, Condo		
3785	BIRCHWOOD	$ 102,900	$ 74,100	$ 177,000	CONDOS, Condo		
3785	BIRCHWOOD	$ 204,500	$ 148,200	$ 352,700	CONDOS, Multi-Story Condo		
3785	BIRCHWOOD	$ 200,400	$ 148,200	$ 348,600	CONDOS, Multi-Story Condo		
3785	BIRCHWOOD	$ 115,700	$ 135,300	$ 251,000	CONDOS, Multi-Story Condo		
3785	BIRCHWOOD	$ 168,500	$ 135,300	$ 303,800	CONDOS, Multi-Story Condo		
		$ 1,125,000					$ 33,800.00
3775	BIRCHWOOD	$ 100,100	$ 63,200	$ 163,300	CONDOS, Condo		
3775	BIRCHWOOD	$ 98,200	$ 63,200	$ 161,400	CONDOS, Condo		
3775	BIRCHWOOD	$ 96,200	$ 63,200	$ 159,400	CONDOS, Condo		
3775	BIRCHWOOD	$ 91,300	$ 57,100	$ 148,400	CONDOS, Condo		
3775	BIRCHWOOD	$ 151,000	$ 115,600	$ 266,600	CONDOS, Multi-Story Condo		
3775	BIRCHWOOD	$ 135,700	$ 105,400	$ 241,100	CONDOS, Multi-Story Condo		
3775	BIRCHWOOD	$ 127,100	$ 94,500	$ 221,600	CONDOS, Multi-Story Condo		
3775	BIRCHWOOD	$ 149,800	$ 102,000	$ 251,800	CONDOS, Multi-Story Condo		
3765	BIRCHWOOD	$ 100,100	$ 63,200	$ 163,300	CONDOS, Condo		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3765	BIRCHWOOD	$ 100,100	$ 63,200	$ 163,300	CONDOS, Condo		
3765	BIRCHWOOD	$ 91,300	$ 57,100	$ 148,400	CONDOS, Condo		
3765	BIRCHWOOD	$ 91,300	$ 57,100	$ 148,400	CONDOS, Condo		
3765	BIRCHWOOD	$ 151,000	$ 115,600	$ 266,600	CONDOS, Multi-Story Condo		
3765	BIRCHWOOD	$ 154,100	$ 115,600	$ 269,700	CONDOS, Multi-Story Condo		
3765	BIRCHWOOD	$ 139,700	$ 102,000	$ 241,700	CONDOS, Multi-Story Condo		
3765	BIRCHWOOD	$ 146,700	$ 102,000	$ 248,700	CONDOS, Multi-Story Condo		
3755	BIRCHWOOD	$ 100,100	$ 63,200	$ 163,300	CONDOS, Condo		
3755	BIRCHWOOD	$ 100,100	$ 67,300	$ 167,400	CONDOS, Condo		
3755	BIRCHWOOD	$ 91,300	$ 57,100	$ 148,400	CONDOS, Condo		
3755	BIRCHWOOD	$ 90,600	$ 57,100	$ 147,700	CONDOS, Condo		
3755	BIRCHWOOD	$ 128,900	$ 105,400	$ 234,300	CONDOS, Multi-Story Condo		
3755	BIRCHWOOD	$ 129,400	$ 115,600	$ 245,000	CONDOS, Multi-Story Condo		
3755	BIRCHWOOD	$ 139,800	$ 102,000	$ 241,800	CONDOS, Multi-Story Condo		
3755	BIRCHWOOD	$ 127,100	$ 94,500	$ 221,600	CONDOS, Multi-Story Condo		
		$ 2,831,000					$ 59,000.00
3745	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3745	BIRCHWOOD	$ 84,200	$ 55,800	$ 140,000	CONDOS, Condo		
3745	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3745	BIRCHWOOD	$ 98,200	$ 55,800	$ 154,000	CONDOS, Condo		
3745	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3745	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3745	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3745	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3735	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3735	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3735	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3735	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3735	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3735	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3735	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3735	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3725	BIRCHWOOD	$ 109,700	$ 70,000	$ 179,700	CONDOS, Condo		
3725	BIRCHWOOD	$ 109,400	$ 70,000	$ 179,400	CONDOS, Condo		
3725	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3725	BIRCHWOOD	$ 93,300	$ 55,800	$ 149,100	CONDOS, Condo		
3725	BIRCHWOOD	$ 138,500	$ 104,700	$ 243,200	CONDOS, Multi-Story Condo		
3725	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3725	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
3725	BIRCHWOOD	$ 138,500	$ 104,000	$ 242,500	CONDOS, Multi-Story Condo		
		$ 2,809,900					$ 59,000.00
3715	BIRCHWOOD	$ 96,200	$ 57,100	$ 153,300	CONDOS, Condo		
3715	BIRCHWOOD	$ 96,200	$ 57,100	$ 153,300	CONDOS, Condo		
3715	BIRCHWOOD	$ 102,100	$ 65,300	$ 167,400	CONDOS, Condo		
3715	BIRCHWOOD	$ 100,800	$ 65,300	$ 166,100	CONDOS, Condo		
3715	BIRCHWOOD	$ 134,100	$ 97,900	$ 232,000	CONDOS, Multi-Story Condo		
3715	BIRCHWOOD	$ 134,100	$ 90,400	$ 224,500	CONDOS, Multi-Story Condo		
3715	BIRCHWOOD	$ 142,300	$ 115,600	$ 257,900	CONDOS, Multi-Story Condo		
3715	BIRCHWOOD	$ 137,800	$ 105,400	$ 243,200	CONDOS, Multi-Story Condo		
3705	BIRCHWOOD	$ 95,400	$ 57,100	$ 152,500	CONDOS, Condo		
3705	BIRCHWOOD	$ 96,200	$ 57,100	$ 153,300	CONDOS, Condo		
3705	BIRCHWOOD	$ 102,100	$ 65,300	$ 167,400	CONDOS, Condo		
3705	BIRCHWOOD	$ 109,300	$ 65,300	$ 174,600	CONDOS, Condo		
3705	BIRCHWOOD	$ 125,400	$ 89,800	$ 215,200	CONDOS, Multi-Story Condo		
3705	BIRCHWOOD	$ 134,100	$ 97,900	$ 232,000	CONDOS, Multi-Story Condo		
3705	BIRCHWOOD	$ 149,400	$ 115,600	$ 265,000	CONDOS, Multi-Story Condo		
3705	BIRCHWOOD	$ 137,800	$ 105,400	$ 243,200	CONDOS, Multi-Story Condo		
		$ 1,893,300					$ 58,900.00
TOTAL	**5**	**$ 9,660,800**			**TOTAL FP COSTS - AREA 6**		**$ 240,700.00**

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
	AREA - 7						
3671	HAZELWOOD	$ 486,100	$ 193,500	$ 679,600	Single Family, Multi-Story Townhome	$ 48,900.00	0.10
3677	**AVERAGE**	$ 486,100		$ 679,600		$ 48,900.00	0.10
	MAXIMUM					$ 49,000.00	
3677	HAZELWOOD	$ 118,800	$ 193,500	$ 312,300	Single Family, Multi-Story Townhome		
3675	HAZELWOOD	$ 136,200	$ 193,500	$ 329,700	Single Family, Multi-Story Townhome		
3673	HAZELWOOD	$ 101,500	$ 193,500	$ 295,000	Single Family, Multi-Story Townhome		
3671	HAZELWOOD	$ 129,600	$ 193,500	$ 323,100	Single Family, Multi-Story Townhome		
		$ 486,100					$ 48,900.00
3659	HAZELWOOD	$ 130,200	$ 193,500	$ 323,700	Single Family, Multi-Story Townhome		
3648	HAZELWOOD	$ 162,500	$ 193,500	$ 356,000	Single Family, Multi-Level		
3646	HAZELWOOD	$ 167,900	$ 193,500	$ 361,400	Single Family, Multi-Level		
3644	HAZELWOOD	$ 176,900	$ 193,500	$ 370,400	Single Family, Multi-Level		
3642	HAZELWOOD	$ 176,900	$ 193,500	$ 370,400	Single Family, Multi-Level		
		$ 814,400					$ 49,000.00
3600	HAZELWOOD	$ 249,100	$ 277,900	$ 527,000	SPECIAL PURPOSE, BLDG/POOL		$ 24,900.00
TOTAL	**3**	**$ 1,549,600**			**TOTAL FP COSTS - AREA 7**		**$ 122,800.00**
	AREA - 8						
2875	ISLAND	$ 227,000	$ 360,000	$ 587,000	Single Family, Multi-Level	$ 48,500.00	0.21
	AVERAGE	$ 227,000		$ 587,000		$ 48,500.00	0.21
	MAXIMUM					$ 49,000.00	
2880	ISLAND	$ 410,200	$ 495,000	$ 905,200	Single Family, Multi-Level		$ 49,000.00
2875	ISLAND	$ 227,000	$ 360,000	$ 587,000	Single Family, Multi-Level		$ 48,500.00
TOTAL	**2**	**$ 637,200**			**TOTAL FP COSTS - AREA 8**		**$ 97,500.00**

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
	AREA - 9						
2800	KALMIA - A106	$ 156,000	$ 125,000	$ 281,000	CONDOS, Condo - One Unit	$ 600,000.00	
	AVERAGE	$ 156,000		$ 281,000			
2800	KALMIA	$ 2,367,200	1,543,500	3,910,700	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 3,138,300	1,984,500	5,122,800	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 3,074,600	1,984,500	5,059,100	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 919,100	588,000	1,507,100	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 1,757,700	1,102,500	2,860,200	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 1,729,200	1,102,500	2,831,700	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 1,235,200	808,500	2,043,700	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 2,288,500	1,470,000	3,758,500	CONDOS, Condo - Entire Bldg.		
2800	KALMIA	$ 2,306,800	1,470,000	3,776,800	CONDOS, Condo - Entire Bldg.		
	MAXIMUM TOTAL FOR ALL BUILDINGS IN 2800 KALMIA AREA						$ 600,000.00
TOTAL		**$ 18,816,600**			**TOTAL FP COSTS - AREA 9**		**$ 600,000.00**
	AREA-10						
2938	KALMIA	$ 156,000	$ 125,000	$ 281,000	CONDOS, Condo	$ 1,000,000.00	
	AVERAGE	$ 156,000		$ 281,000			
2850	KALMIA	$ 8,935,000	$ 6,360,000	15,295,000	9 ABOVE UNITS, Multi-Level		
2852	KALMIA						
2854	KALMIA						
2856	KALMIA						
2858	KALMIA						
2870	KALMIA						
2880	KALMIA						

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
2890	KALMIA						
2896	KALMIA						
	MAXIMUM TOTAL FOR ALL BUIDINGS IN 2850 KALMIA AREA						$ 1,000,000.00
TOTAL		**$ 8,935,000**			**TOTAL FP COSTS - AREA 10**		**$ 1,000,000.00**
	AREA - 11						
2960	DIAGONAL	$ 4,811,600	$ 2,006,300	$ 6,817,900	BANKS, Concrete	$ 37,200.00	0.01
TOTAL	**1**	**$ 4,811,600**			**TOTAL FP COSTS - AREA 11**		**$ 37,200.00**
	AREA - 12						
2990	DIAGONAL	$ 41,000	$ 503,400	$ 544,400	SERVICE STATION, Masonry	$ 164,800.00	4.02
TOTAL	**1**	**$ 41,000**			**TOTAL FP COSTS - AREA 12**		**$ 164,800.00**
	AREA - 13						
3033	IRIS	$ 1,295,200	$ 1,093,200	$ 2,388,400	BANKS, Masonry	$ 22,100.00	0.02
3101	IRIS	$ 1,772,600	$ 693,200	$ 2,465,800	OFFICES, Masonary		$ 35,500.00
3033	IRIS	$ 1,295,200	$ 1,093,200	$ 2,388,400	BANKS, Masonary		$ 22,100.00
TOTAL	**2**	**$ 3,067,800**			**TOTAL FP COSTS - AREA 13**		**$ 57,600.00**
	AREA - 14						
3115	IRIS	$ 112,200	$ 301,000	$ 413,200	OFFICES, Masonry	$ 71,800.00	0.64
	MAXIMUM					$ 72,000.00	
3333	IRIS	$ 307,600	$ 241,500	$ 549,100	OFFICES, Masonary		$ 72,000.00

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3115	IRIS	$ 112,200	$ 301,000	$ 413,200	MISCELLANEOUS, Ranch		$ 71,800.00
TOTAL	**2**	**$ 419,800**			**TOTAL FP COSTS - AREA 14**		**$ 143,800.00**
	AREA - 15						
3350	30TH	$ 3,450,000	$ 2,050,000	$ 5,500,000	9 ABOVE UNITS, Multi-Level	$ 75,300.00	0.02
	Increase Capacity of Swale on East Side of Building						$ 75,300.00
TOTAL	**1**	**$ 3,450,000**			**TOTAL FP COSTS - AREA 15**		**$ 75,300.00**
	AREA - 16						
3355	BRIDGER	$ 57,500	$ 62,000	$ 119,500	CONDOS, Condo	$ 16,300.00	
3240	IRIS	$ 96,900	$ 62,000	$ 158,900	CONDOS, Condo	$ 130,100.00	
	AVERAGE	$ 57,500		$ 119,500			
3240	IRIS	$ 96,900	$ 62,000	$ 158,900	CONDOS, Condo		
3240	IRIS	$ 65,600	$ 62,000	$ 127,600	CONDOS, Condo		
3240	IRIS	$ 66,100	$ 62,000	$ 128,100	CONDOS, Condo		
3240	IRIS	$ 63,700	$ 62,000	$ 125,700	CONDOS, Condo		
3240	IRIS	$ 65,000	$ 62,000	$ 127,000	CONDOS, Condo		
3240	IRIS	$ 99,400	$ 62,000	$ 161,400	CONDOS, Condo		
3240	IRIS	$ 95,700	$ 62,000	$ 157,700	CONDOS, Condo		
3240	IRIS	$ 98,100	$ 62,000	$ 160,100	CONDOS, Condo		
3240	IRIS	$ 115,500	$ 62,000	$ 177,500	CONDOS, Condo		
3240	IRIS	$ 97,100	$ 62,000	$ 159,100	CONDOS, Condo		
3240	IRIS	$ 114,900	$ 62,000	$ 176,900	CONDOS, Condo		
3240	IRIS	$ 82,000	$ 62,000	$ 144,000	CONDOS, Condo		
3240	IRIS	$ 96,800	$ 62,000	$ 158,800	CONDOS, Condo		
3240	IRIS	$ 63,700	$ 62,000	$ 125,700	CONDOS, Condo		
3240	IRIS	$ 66,500	$ 62,000	$ 128,500	CONDOS, Condo		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3240	IRIS	$ 63,800	$ 62,000	$ 125,800	CONDOS, Condo		
3240	IRIS	$ 96,900	$ 62,000	$ 158,900	CONDOS, Condo		
3240	IRIS	$ 116,000	$ 62,000	$ 178,000	CONDOS, Condo		
3240	IRIS	$ 92,000	$ 62,000	$ 154,000	CONDOS, Condo		
3240	IRIS	$ 93,500	$ 62,000	$ 155,500	CONDOS, Condo		
3240	IRIS	$ 52,000	$ 62,000	$ 114,000	CONDOS, Condo		
3240	IRIS	$ 65,700	$ 62,000	$ 127,700	CONDOS, Condo		
3240	IRIS	$ 61,800	$ 62,000	$ 123,800	CONDOS, Condo		
3240	IRIS	$ 64,600	$ 62,000	$ 126,600	CONDOS, Condo		
3240	IRIS	$ 92,000	$ 62,000	$ 154,000	CONDOS, Condo		
3240	IRIS	$ 93,500	$ 62,000	$ 155,500	CONDOS, Condo		
3240	IRIS	$ 98,100	$ 62,000	$ 160,100	CONDOS, Condo		
3240	IRIS	$ 126,300	$ 62,000	$ 188,300	CONDOS, Condo		
3240	IRIS	$ 97,600	$ 62,000	$ 159,600	CONDOS, Condo		
3240	IRIS	$ 119,400	$ 62,000	$ 181,400	CONDOS, Condo		
3240	IRIS	$ 97,000	$ 62,000	$ 159,000	CONDOS, Condo		
3240	IRIS	$ 97,800	$ 62,000	$ 159,800	CONDOS, Condo		
3240	IRIS	$ 63,700	$ 62,000	$ 125,700	CONDOS, Condo		
3240	IRIS	$ 96,500	$ 62,000	$ 158,500	CONDOS, Condo		
3240	IRIS	$ 97,800	$ 62,000	$ 159,800	CONDOS, Condo		
3240	IRIS	$ 101,700	$ 62,000	$ 163,700	CONDOS, Condo		
3240	IRIS	$ 116,000	$ 62,000	$ 178,000	CONDOS, Condo		
	TOTAL STRUC.	**$ 3,290,700**					$ 130,100.00
3355	BRIDGER	$ 57,500	$ 62,000	$ 119,500	CONDOS, Condo		$ 16,300.00
TOTAL	**2**				**TOTAL FP COSTS - AREA 16**		**$ 146,400.00**
	AREA - 17						

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3375	34TH	$ 4,100,000	$ 1,900,000	$ 6,000,000	9 ABOVE UNITS, Multi-Level	$ 169,400.00	0.04
TOTAL	**1**	**$ 4,100,000**			**TOTAL FP COSTS - AREA 17**		**$ 169,400.00**
	AREA - 18						
3318/22	34TH	$ 333,100	$ 140,000	$ 473,100	Single Family, Multi-Story Townhome	$ 43,300.00	0.13
	AVERAGE	$ 333,100		$ 473,100		$ 43,300.00	0.13
	MAXIMUM					$ 43,000.00	
3390	34TH	$ 81,100	$ 100,000	$ 181,100	Single Family, Townhome		
3390	34TH	$ 80,900	$ 100,000	$ 180,900	Single Family, Multi-Story Townhome		
3390	34TH	$ 80,900	$ 100,000	$ 180,900	Single Family, Multi-Story Townhome		
3390	34TH	$ 80,400	$ 100,000	$ 180,400	Single Family, Townhome		
		$ 323,300					$ 42,000.00
3380	34TH	$ 80,400	$ 100,000	$ 180,400	Single Family, Townhome		
3380	34TH	$ 80,900	$ 100,000	$ 180,900	Single Family, Multi-Story Townhome		
3380	34TH	$ 80,900	$ 100,000	$ 180,900	Single Family, Multi-Story Townhome		
3380	34TH	$ 40,800	$ 100,000	$ 140,800	Single Family, Townhome		
		$ 283,000					$ 36,800.00
3370	34TH	$ 81,100	$ 100,000	$ 181,100	Single Family, Townhome		
3370	34TH	$ 80,400	$ 100,000	$ 180,400	Single Family, Townhome		
3370	34TH	$ 80,900	$ 100,000	$ 180,900	Single Family, Multi-Story Townhome		
3370	34TH	$ 80,900	$ 100,000	$ 180,900	Single Family, Multi-Story Townhome		
		$ 323,300					$ 42,000.00
3360	34TH	$ 81,100	$ 100,000	$ 181,100	Single Family, Townhome		
3360	34TH	$ 80,900	$ 100,000	$ 180,900	Single Family, Multi-Story Townhome		
3360	34TH	$ 63,000	$ 100,000	$ 163,000	Single Family, Multi-Story Townhome		
3360	34TH	$ 69,000	$ 100,000	$ 169,000	Single Family, Townhome		
		$ 294,000					$ 38,200.00
3350	34TH	$ 81,700	$ 100,000	$ 181,700	Single Family, Multi-Story Townhome		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3350	34TH	$ 81,100	$ 100,000	$ 181,100	Single Family, Townhome		
3350	34TH	$ 81,700	$ 100,000	$ 181,700	Single Family, Multi-Story Townhome		
3350	34TH	$ 81,800	$ 100,000	$ 181,800	Single Family, Townhome		
		$ 326,300					$ 42,400.00
3344	34TH	$ 108,700	$ 140,000	$ 248,700	Single Family, Multi-Story Townhome		
3342	34TH	$ 103,700	$ 140,000	$ 243,700	Single Family, Multi-Story Townhome		
3340	34TH	$ 112,400	$ 140,000	$ 252,400	Single Family, Multi-Story Townhome		
		$ 324,800					$ 42,200.00
3338	34TH	$ 112,400	$ 140,000	$ 252,400	Single Family, Multi-Story Townhome		
3336	34TH	$ 103,700	$ 140,000	$ 243,700	Single Family, Multi-Story Townhome		
3334	34TH	$ 111,000	$ 140,000	$ 251,000	Single Family, Multi-Story Townhome		
		$ 327,100					$ 42,500.00
3332	34TH	$ 112,400	$ 140,000	$ 252,400	Single Family, Multi-Story Townhome		
3330	34TH	$ 103,700	$ 140,000	$ 243,700	Single Family, Multi-Story Townhome		
3328	34TH	$ 103,700	$ 140,000	$ 243,700	Single Family, Multi-Story Townhome		
3326	34TH	$ 103,700	$ 140,000	$ 243,700	Single Family, Multi-Story Townhome		
3324	34TH	$ 112,400	$ 140,000	$ 252,400	Single Family, Multi-Story Townhome		
		$ 535,900					$ 43,300.00
3322	34TH	$ 105,000	$ 140,000	$ 245,000	Single Family, Multi-Story Townhome		
3320	34TH	$ 108,700	$ 140,000	$ 248,700	Single Family, Multi-Story Townhome		
3318	34TH	$ 119,400	$ 140,000	$ 259,400	Single Family, Multi-Story Townhome		
		$ 333,100					$ 43,000.00
3314	34TH	$ 112,400	$ 140,000	$ 252,400	Single Family, Multi-Story Townhome		
3316	34TH	$ 103,700	$ 140,000	$ 243,700	Single Family, Multi-Story Townhome		
		$ 216,100					$ 28,100.00
3310	34TH	$ 112,400	$ 140,000	$ 252,400	Single Family, Multi-Story Townhome		
3312	34TH	$ 112,400	$ 140,000	$ 252,400	Single Family, Multi-Story Townhome		
		$ 224,800					$ 29,200.00
3595	SPRING CREEK	$ 147,400	$ 140,000	$ 287,400	Single Family, Multi-Story Townhome		
3585	SPRING CREEK	$ 140,000	$ 140,000	$ 280,000	Single Family, Multi-Story Townhome		
3575	SPRING CREEK	$ 140,000	$ 140,000	$ 280,000	Single Family, Multi-Story Townhome		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3565	SPRING CREEK	$ 140,000	$ 140,000	$ 280,000	Single Family, Multi-Story Townhome		
		$ 567,400					$ 43,000.00
3557	SPRING CREEK	$ 100,900	$ 140,000	$ 240,900	Single Family, Multi-Story Townhome		
3551	SPRING CREEK	$ 100,900	$ 140,000	$ 240,900	Single Family, Multi-Story Townhome		
3545	SPRING CREEK	$ 106,300	$ 140,000	$ 246,300	Single Family, Multi-Story Townhome		
3535	SPRING CREEK	$ 106,300	$ 140,000	$ 246,300	Single Family, Multi-Story Townhome		
		$ 414,400					$ 43,000.00
3527	SPRING CREEK	$ 129,900	$ 140,000	$ 269,900	Single Family, Multi-Story Townhome		
3521	SPRING CREEK	$ 129,900	$ 140,000	$ 269,900	Single Family, Multi-Story Townhome		
3517	SPRING CREEK	$ 127,000	$ 140,000	$ 267,000	Single Family, Multi-Story Townhome		
3511	SPRING CREEK	$ 127,000	$ 140,000	$ 267,000	Single Family, Multi-Story Townhome		
3507	SPRING CREEK	$ 127,000	$ 140,000	$ 267,000	Single Family, Multi-Story Townhome		
		$ 640,800					$ 43,000.00
3435	SPRING CREEK	$ 128,000	$ 140,000	$ 268,000	Single Family, Multi-Story Townhome		
3425	SPRING CREEK	$ 128,000	$ 140,000	$ 268,000	Single Family, Multi-Story Townhome		
3415	SPRING CREEK	$ 108,800	$ 140,000	$ 248,800	Single Family, Multi-Story Townhome		
3405	SPRING CREEK	$ 128,000	$ 140,000	$ 268,000	Single Family, Multi-Story Townhome		
		$ 492,800					$ 43,000.00
3495	SPRING CREEK	$ 129,900	$ 140,000	$ 269,900	Single Family, Multi-Story Townhome		
3485	SPRING CREEK	$ 127,000	$ 140,000	$ 267,000	Single Family, Multi-Story Townhome		
3475	SPRING CREEK	$ 107,900	$ 140,000	$ 247,900	Single Family, Multi-Story Townhome		
		$ 364,800					$ 43,000.00
TOTAL	**58**	**$ 5,991,900**			**TOTAL FP COSTS - AREA 18**		**$ 644,700.00**
	AREA - 19						
3595	HAYDEN	$ 276,000	$ 300,000	$ 576,000	4-8 UNITS, Multi-Level	$ 43,900.00	0.16
	AVERAGE	$ 276,000		$ 576,000		$ 43,900.00	0.16
3700	HAYDEN	$ 270,000	$ 300,000	$ 570,000	4-8 UNITS, Multi-Level		$ 43,200.00

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3690	HAYDEN	$ 270,000	$ 300,000	$ 570,000	HOUSING AUTHORITY, Multi-Level		$ 43,200.00
3660	HAYDEN	$ 270,000	$ 300,000	$ 570,000	HOUSING AUTHORITY, Multi-Level		$ 43,200.00
3640	HAYDEN	$ 270,000	$ 300,000	$ 570,000	4-8 UNITS, Multi-Level		$ 43,200.00
3620	HAYDEN	$ 140,000	$ 200,000	$ 340,000	4-8 UNITS, Multi-Level		$ 22,400.00
3600	HAYDEN	$ 270,000	$ 300,000	$ 570,000	4-8 UNITS, Multi-Level		$ 43,200.00
3595	HAYDEN	$ 276,000	$ 300,000	$ 576,000	4-8 UNITS, Multi-Level		$ 43,900.00
3515	HAYDEN	$ 210,000	$ 200,000	$ 410,000	4-8 UNITS, Multi-Level		$ 33,600.00
3485	HAYDEN	$ 210,000	$ 200,000	$ 410,000	4-8 UNITS, Multi-Level		$ 33,600.00
3405	HAYDEN	$ 210,000	$ 200,000	$ 410,000	HOUSING AUTHORITY, Multi-Level		$ 33,600.00
TOTAL	**10**	**$ 2,396,000**			**TOTAL FP COSTS - AREA 19**		**$ 383,100.00**
	AREA - 20						
3315	TALISMAN	$ 396,800	$ 95,000	$ 491,800	Single Family, Multi-Story Townhome	$ 51,300.00	0.13
	AVERAGE	$ 396,800		$ 491,800		$ 51,300.00	0.13
	MAXIMUM					$ 51,000.00	
3740	IRIS	$ 105,200	$ 95,000	$ 200,200	Single Family, Multi-Story Townhome		
3740	IRIS	$ 95,200	$ 95,000	$ 190,200	Single Family, Multi-Story Townhome		
3740	IRIS	$ 85,000	$ 95,000	$ 180,000	Single Family, Multi-Story Townhome		
3740	IRIS	$ 96,300	$ 95,000	$ 191,300	Single Family, Townhome		
		$ 381,700					$ 49,600.00
3660	IRIS	$ 101,100	$ 95,000	$ 196,100	Single Family, Multi-Story Townhome		
3660	IRIS	$ 91,400	$ 95,000	$ 186,400	Single Family, Multi-Story Townhome		
3660	IRIS	$ 91,400	$ 95,000	$ 186,400	Single Family, Multi-Story Townhome		
3660	IRIS	$ 91,100	$ 95,000	$ 186,100	Single Family, Townhome		
		$ 375,000					$ 48,800.00
3630	IRIS	$ 97,700	$ 95,000	$ 192,700	Single Family, Multi-Story Townhome		
3630	IRIS	$ 91,400	$ 95,000	$ 186,400	Single Family, Multi-Story Townhome		
3630	IRIS	$ 91,400	$ 95,000	$ 186,400	Single Family, Multi-Story Townhome		
3630	IRIS	$ 91,100	$ 95,000	$ 186,100	Single Family, Townhome		

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
		$ 371,600					$ 48,300.00
3600	IRIS	$ 101,100	$ 95,000	$ 196,100	Single Family, Multi-Story Townhome		
3600	IRIS	$ 91,400	$ 95,000	$ 186,400	Single Family, Multi-Story Townhome		
3600	IRIS	$ 91,400	$ 95,000	$ 186,400	Single Family, Multi-Story Townhome		
3600	IRIS	$ 91,100	$ 95,000	$ 186,100	Single Family, Townhome		
		$ 375,000					$ 48,800.00
3865	TALISMAN	$ 106,100	$ 95,000	$ 201,100	Single Family, Multi-Story Townhome		
3865	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3865	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3865	TALISMAN	$ 80,000	$ 95,000	$ 175,000	Single Family, Townhome		
		$ 378,100					$ 49,200.00
3797	TALISMAN	$ 109,000	$ 95,000	$ 204,000	Single Family, Multi-Story Townhome		
3797	TALISMAN	$ 99,200	$ 95,000	$ 194,200	Single Family, Multi-Story Townhome		
3797	TALISMAN	$ 99,200	$ 95,000	$ 194,200	Single Family, Multi-Story Townhome		
3797	TALISMAN	$ 72,000	$ 95,000	$ 167,000	Single Family, Townhome		
		$ 379,400					$ 49,300.00
3707	TALISMAN	$ 109,600	$ 95,000	$ 204,600	Single Family, Multi-Story Townhome		
3707	TALISMAN	$ 99,100	$ 95,000	$ 194,100	Single Family, Multi-Story Townhome		
3707	TALISMAN	$ 99,100	$ 95,000	$ 194,100	Single Family, Multi-Story Townhome		
3707	TALISMAN	$ 98,800	$ 95,000	$ 193,800	Single Family, Townhome		
		$ 406,600					$ 51,000.00
3727	TALISMAN	$ 106,100	$ 95,000	$ 201,100	Single Family, Multi-Story Townhome		
3727	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3727	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3727	TALISMAN	$ 95,800	$ 95,000	$ 190,800	Single Family, Townhome		
		$ 393,900					$ 51,000.00
3747	TALISMAN	$ 107,700	$ 95,000	$ 202,700	Single Family, Multi-Story Townhome		
3747	TALISMAN	$ 87,300	$ 95,000	$ 182,300	Single Family, Multi-Story Townhome		
3747	TALISMAN	$ 97,800	$ 95,000	$ 192,800	Single Family, Multi-Story Townhome		
3747	TALISMAN	$ 97,500	$ 95,000	$ 192,500	Single Family, Townhome		
		$ 390,300					$ 50,700.00

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
3787	TALISMAN	$ 106,100	$ 95,000	$ 201,100	Single Family, Multi-Story Townhome		
3787	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3787	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3787	TALISMAN	$ 95,800	$ 95,000	$ 190,800	Single Family, Townhome		
		$ 393,900					$ 51,000.00
3835	TALISMAN	$ 106,100	$ 95,000	$ 201,100	Single Family, Multi-Story Townhome		
3835	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3835	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3835	TALISMAN	$ 95,800	$ 95,000	$ 190,800	Single Family, Townhome		
		$ 393,900					$ 51,000.00
3325	TALISMAN	$ 109,000	$ 95,000	$ 204,000	Single Family, Multi-Story Townhome		
3325	TALISMAN	$ 99,200	$ 95,000	$ 194,200	Single Family, Multi-Story Townhome		
3325	TALISMAN	$ 99,200	$ 95,000	$ 194,200	Single Family, Multi-Story Townhome		
3325	TALISMAN	$ 99,200	$ 95,000	$ 194,200	Single Family, Townhome		
		$ 406,600					$ 51,000.00
3315	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3315	TALISMAN	$ 109,000	$ 95,000	$ 204,000	Single Family, Multi-Story Townhome		
3315	TALISMAN	$ 96,000	$ 95,000	$ 191,000	Single Family, Multi-Story Townhome		
3315	TALISMAN	$ 95,800	$ 95,000	$ 190,800	Single Family, Townhome		
		$ 396,800					$ 51,000.00
TOTAL	**52**	**$ 5,042,800**			**TOTAL FP COSTS - AREA 20**		**$ 650,700.00**
	AREA - 21						
3080	CENTER GREEN	$ 7,373,100	$ 2,103,500	$ 9,476,600	HOSPITAL, Concrete	$ 214,700.00	0.03
TOTAL	**1**	**$ 7,373,100**			**TOTAL FP COSTS - AREA 21**		**$ 214,700.00**
	AREA - 22						
4752	FRANKLIN	$ 148,700	$ 168,300	$ 317,000	Single Family, Multi-Story Townhome		
	AVERAGE	$ 148,700		$ 317,000			

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
4772	FRANKLIN	$ 158,300	$ 176,000	$ 334,300	Single Family, Multi-Story Townhome		
4770	FRANKLIN	$ 148,500	$ 153,000	$ 301,500	Single Family, Multi-Story Townhome		
4768	FRANKLIN	$ 153,600	$ 153,000	$ 306,600	Single Family, Multi-Story Townhome		
4762	FRANKLIN	$ 152,000	$ 153,000	$ 305,000	Single Family, Multi-Story Townhome		
4760	FRANKLIN	$ 148,600	$ 153,000	$ 301,600	Single Family, Multi-Story Townhome		
4754	FRANKLIN	$ 148,700	$ 153,000	$ 301,700	Single Family, Multi-Story Townhome		
4752	FRANKLIN	$ 148,700	$ 168,300	$ 317,000	Single Family, Multi-Story Townhome		
4750	FRANKLIN	$ 175,600	$ 153,000	$ 328,600	Single Family, Multi-Story Townhome		
	FLOODPROOFING FOR ALL OF THE ABOVE UNITS						$ 80,250.00
TOTAL	**9**	**$ 1,234,000**			**TOTAL FP COSTS - AREA 22**		**$ 80,250.00**
	AREA - 23						
3114	BELL	$ 528,000	$ 111,000	$ 639,000	Single Family, Multi-Story Townhome	$ 10,800.00	0.02
3110	**AVERAGE**	$ 528,000		$ 639,000		$ 10,800.00	0.02
3116	BELL	$ 132,000	$ 111,000	$ 243,000	Single Family, Multi-Story Townhome		
3114	BELL	$ 132,000	$ 111,000	$ 243,000	Single Family, Multi-Story Townhome		
3112	BELL	$ 132,000	$ 111,000	$ 243,000	Single Family, Multi-Story Townhome		
3110	BELL	$ 132,000	$ 111,000	$ 243,000	Single Family, Multi-Story Townhome		
		$ 528,000					$ 10,800.00
3108	BELL	$ 170,400	$ 111,000	$ 281,400	Single Family, Multi-Story Townhome		
3106	BELL	$ 170,400	$ 111,000	$ 281,400	Single Family, Multi-Story Townhome		
3104	BELL	$ 170,400	$ 111,000	$ 281,400	Single Family, Multi-Story Townhome		
3102	BELL	$ 170,400	$ 111,000	$ 281,400	Single Family, Multi-Story Townhome		
		$ 681,600					$ 13,600.00

St. No.	Street Name	Structure Value ($)	Land Value ($)	Total Value ($)	Structure Description	Flood Damage Unit Cost ($)	Flood Proofing Ratio\Costs
TOTAL	**8**	**$ 1,209,600**			**TOTAL FP COSTS - AREA 23**		**$ 24,400.00**
	AREA - 24						
4939	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4987	NOBLE PARK	$ 157,800	$ 127,000	$ 284,800	Single Family, Multi-Story Townhome		
4985	NOBLE PARK	$ 149,600	$ 127,000	$ 276,600	Single Family, Multi-Story Townhome		
4973	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4971	NOBLE PARK	$ 149,300	$ 127,000	$ 276,300	Single Family, Multi-Story Townhome		
4967	NOBLE PARK	$ 151,100	$ 127,000	$ 278,100	Single Family, Multi-Story Townhome		
4965	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4953	NOBLE PARK	$ 144,600	$ 127,000	$ 271,600	Single Family, Multi-Story Townhome		
4951	NOBLE PARK	$ 144,600	$ 127,000	$ 271,600	Single Family, Multi-Story Townhome		
4949	NOBLE PARK	$ 161,800	$ 127,000	$ 288,800	Single Family, Multi-Story Townhome		
4947	NOBLE PARK	$ 170,800	$ 127,000	$ 297,800	Single Family, Multi-Story Townhome		
4945	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4943	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4939	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4937	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4925	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4923	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4919	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4917	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4905	NOBLE PARK	$ 149,200	$ 127,000	$ 276,200	Single Family, Multi-Story Townhome		
4903	NOBLE PARK	$ 157,800	$ 127,000	$ 284,800	Single Family, Multi-Story Townhome		
	FLOODPROOFING FOR ALL UNITS						$ 85,600.00
TOTAL	**21**	**$ 3,028,600**			**TOTAL FP COSTS - AREA 24**		**$ 85,600.00**

		Structure	Land	Total		Flood Damage	Flood Proofing
St.	Street	Value	Value	Value	Structure	Unit Cost	Ratio\Costs
No.	Name	($)	($)	($)	Description	($)	
TOTAL	**280**	**$ 112,553,700**			**TOTAL - ALL AREAS**		**$ 9,547,750.00**

Technical Memorandums

M E M O R A N D U M

TO: Bob Harberg, P.E. – Utilities Division
Eric Lessard, P.E. – Utilities Division

FROM: David Love, P.E. – Love & Associates, Inc.

REF: 0217GX – SUB-ALTERNATE ANALYSIS SUMMARY FOLLOWING PUBLICATION OF PHASE A REPORT FOR FOURMILE CANYON AND WONDERLAND CREEKS MAJOR DRAINAGEWAY PLAN REPORT

DATE: December 5, 2007
Updated January 23, 2008

The Fourmile Canyon and Wonderland Creek Floodplain Restudy (Letter of Map Revision – LOMR) was adopted by FEMA in March 2007. Love & Associates then prepared the *Phase A Drainageway Master Plan Report – Alternate Analysis* for the Urban Drainage and Flood Control District (UDFCD) and the City of Boulder which was published in May 2007. Following publication of the *Fourmile Canyon Creek and Wonderland Creek Major Drainageway Master Plan, Phase A Report*, the initial Public Open House (9-27-07) and the first presentation to the Water Resource Advisory Board (10-15-07), City staff received several comments and questions regarding the 'recommended plan' in the Phase A report. In response to many of these questions and/or comments raised, City staff requested Love & Associates, Inc. to re-visit and/or reanalyze alternate options at specific locations along Fourmile and/or Wonderland Creeks. The following Memorandum is a summary of additional alternates and their associated estimated costs at the various locations requested to for reconsideration.

ADDITIONAL FOURMILE CANYON AND WONDERLAND CREEK ALTERNATES CONSIDERED TO BE CONSIDERED BY STAFF:

A. Upper Fourmile Containment Reservoir

One alternate briefly considered in the original Fourmile Canyon Creek Major Drainageway Master Plan – Phase A Alternate Analysis published in June 2000 considered a large reservoir constructed on Upper Fourmile to decrease the spill from Fourmile Canyon Creek to Wonderland Creek.

800 Jefferson Avenue, Suite B Louisville, Colorado 80027-1873 Phone: 303-673-9795 Fax: 303-673-9796

The June 2000 report states an off-channel detention pond would require approximately 30 surface acres of City Open Space acreage and would include a 10 feet high embankment and approximately 1.3 million cubic yards of excavation in order to decrease the outflow of Fourmile Canyon Creek to 1,000 cfs which would be conveyed completely in the Fourmile channel. An on-channel reservoir would be required to be even larger. This alternate was rejected due to the enormity of project cost and the impact to City Open Space lands.

At the request of several individual property owners, City staff requested Love again revisit this alternate and estimate the costs for constructing this reservoir in 2007 dollars. Using the hydrology previously developed by Love & Associates and estimating the reservoir volume based on the flow tributary to the design point just upstream of Broadway, Love & Associates developed a hydrograph at this location. The assumptions used were design of a 1,000 cfs channel which would convey flood discharges through the proposed reservoir site. The channel would side channel spill to storage located both north and south of Fourmile Canyon Creek. The reservoir was then sized for the cumulative volume in excess of what will be contained and conveyed in the channel. Assuming a reservoir depth of 10 feet for safety, approximately 30 acres of land would be required to contain this volume. Due to the steep terrain, a series of stepped reservoirs would be needed and 1.3 million cubic yards of excavation would be necessary to achieve the required volume. Both City of Boulder Parks and City Open Space property would be required for this reservoir. The 1,000 cfs discharged downstream of this reservoir would be contained in the existing Fourmile channel and there would be no spill discharge from Fourmile Canyon Creek to Wonder Creek downstream during a 100-year event.

Table 1 outlines the estimated costs associated with this detention pond alternate. In light of the cost estimate of $55 million and significant Open Space and Park lands required for this alternate this Alternate continues to be cost prohibitive and was not considered a viable option.

Table 1
Upstream 30-acre Reservoir - Estimated Costs

Description	Quantity	Unit	Unit Cost	Item Total
Channel Excavation (190 sf x 3600 lf)	684000	CY	$ 15	$ 10,260,000
Pond Excavation	1300000	CY	$ 15	$ 19,500,000
Pond Embankment	300000	CY	$ 7	$ 2,100,000
Remove & Replace Topsoil (30 acres x 6")	24200	CY	$ 8	$ 193,600
Grade Control Structures	33	EA	$ 18,750	$ 618,750
Seeding/Mulching	30	AC	$ 3,750	$ 112,500
Land Acquisition	30	AC	$ 127,000	$ 3,810,000
Spillways/Outlet Works	1	LS	$ 2,500,000	$ 2,500,000
Wetland Mitigation (20 ft x 3600 ft)	1.65	AC	$ 127,000	$ 209,917

Contingency/Mobilization	25%	-		$ 9,826,192
Engineering/Administration	15%	-		$ 5,895,715
ESTIMATED COSTS				**$ 55,026,674**

DETENTION POND PARAMETERS:

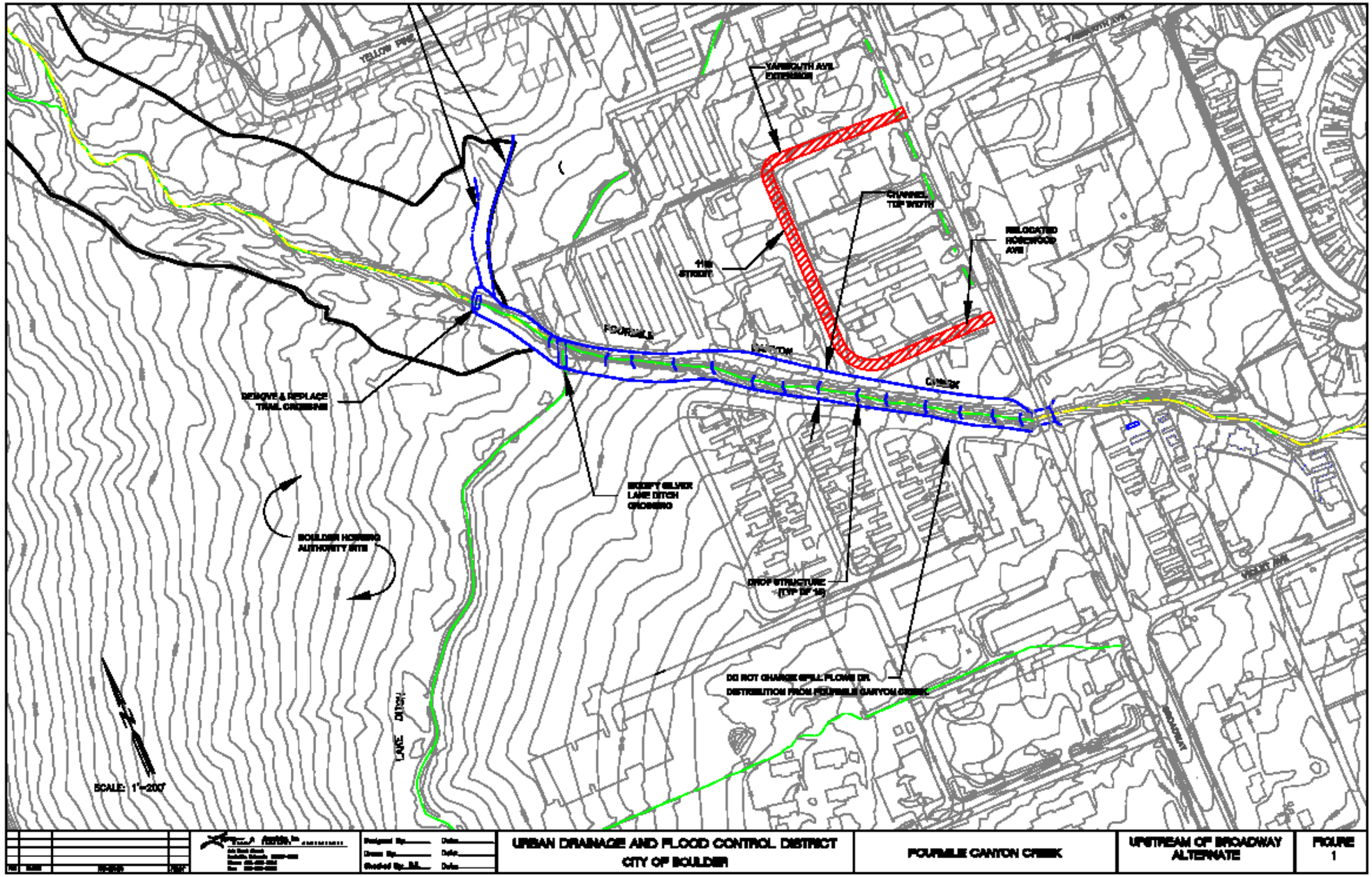
Pond Volume required with 1000 cfs channel	259	AC-FT	417,853	CY
Pond Depth (assumed)	10	FT		
Area required assuming 100% land efficiency	25.9	AC	Assumed	30 Acres
Excavation Required (due to steep terrain)	1,300,000	CY		

B. Flow collection and redistribution upstream of Broadway

Following the Public Open House held on September 27, 2007 owners of commercial property just upstream of Broadway (on the north bank of Fourmile Canyon Creek) approached City staff regarding modification of an alternate previously explored in the June 2000 Fourmile Phase A Report whereby flows along Fourmile Canyon Creek were proposed to be collected upstream of their commercial property and redistributed on the downstream side of Broadway. The original alternate was not considered in the combined Fourmile-Wonderland Creek Master Plan because of the decision by the City and the UDFCD to not contain the spill flows above Broadway. However, City Staff requested Love & Associates to reconsider an alternate at this location that might allow for minimization or elimination of the conveyance (floodway) and/or High Hazard Zone from this property north of the creek as the City anticipates future redevelopment of properties along Broadway as indicated in the *North Boulder Subarea Plan*. In keeping with UDFCD policy; however, the spill from Fourmile south of the creek must remain unchanged regardless of which alternate is selected. Containing a portion of the spill results in adverse impacts to properties downstream on Fourmile Canyon Creek.

Love analyzed an additional alternate along Reach 6a of Fourmile Canyon Creek sizing an area of conveyance to carry the average right overbank 100-year flow (approximately 1300 cfs). Love's analysis extends from the west (upstream) side of Broadway to just west of the low flow trail crossing at the west side of Jack Lacy's property. The 100-year channel has been widened through this stretch as shown on Figure 1 to convey the right overbank flow. The spill from Fourmile Canyon Creek to Wonderland Creek is not changed by this alternate. The cost for these channel and road improvements is estimated at $2,378,000. This cost includes the channel improvements as well as roadway improvements for Yarmouth and Rosewood. This alternate would result in a modified floodway and High Hazard Zone (HHZ). However, some properties would still remain in the floodplain and flood insurance would still be required/recommended.

Figure 1 Flow Collection & Redistribution Upstream of Broadway



A progress meeting was held at Love & Associates offices on November 15, 2007 with City and UDFCD staff. City staff will present this alternate as a possible scenario the developer may undertake in the future to improve his site for future development. The City may or may not participate financially in implementing such an alternate.

Figure 1 illustrates the components of this alternate included in the estimated costs of this alternate. Table 2 estimates costs associated with the collection/redistribution scenario.

Table 2
Collection/Redistribution Upstream of Broadway - Estimated Costs

Description	Quantity	Unit	Unit Cost	Item Total
Channel Excavation (240 sf x 1400 lf)	12450	CY	$ 13	$ 161,850
Interceptor Channels (150 sf x 200 lf)	1111	CY	$ 13	$ 14,443
Grade Control Structures	15	EA	$ 25,500	$ 382,500
Rock Wall - North Bank (8.5 ft x 1000 ft)	8500	FSF	$ 32	$ 272,000
Utility Relocations (w, ss, gas, elec)	1	LS	$ 19,100	$ 19,100
Remove & Replace Silver Lake Ditch Crossing	1	LS	$ 31,750	$ 31,750
Remove & Replace Pedestrian Trail Crossing	1	LS	$ 31,750	$ 31,750
Remove & Replace Pedestrian Trail	600	LF	$ 51	$ 30,600
Revegetation (80 ft x 1400 ft + 50 ft x 200 ft)	2.8	AC	$ 3,800	$ 10,640
Landscaping (80 ft x 1400 ft + 50 ft x 200 ft)	2.8	AC	$ 12,700	$ 35,560
Wetland Mitigation (30 ft x 1400 ft)	0.96	AC	$ 127,000	$ 122,452
Contingency/Mobilization	25%	-	$ 950,795	$278,161
Engineering/Administration	15%	-	$ 1,188,493	$ 166,896
SUB-TOTAL				**$ 1,557,702**
Roadway Improvements*				
Yarmouth Avenue	1	LS	$ 254,000	$ 254,000
11th Street	1	LS	$ 222,250	$ 222,250
Rosewood Avenue	1	LS	$ 127,000	$ 127,000
Utility Installations*				
Yarmouth Avenue	1	LS	$ 107,950	$ 107,950
11th Street	1	LS	$ 109,250	$ 109,250
Contingency/Mobilization/Engineering/Admin*	0%	-		
SUB-TOTAL				**$ 820,450**
COMBINED COST ESTIMATE				**$ 2,378,152**

***** Roadway/utility costs for this alternate were developed by City staff and contingencies have already been added to their costs and brought forward to 2007 costs.

C. Improved Channel near Centennial Middle School as an alternate to purchasing three properties.

Love & Associates' recommended alternate for Reach 6 on Wonderland Creek includes the City's future acquisition of three residential properties near Centennial Middle School adjacent to Wonderland Creek. In preparation for the September 27, 2007 Public Meeting, Love & Associates was requested to reexamine additional alternates for removing these three properties currently in the HHZ.

Our analysis was based on the following assumption: Under the previous (Greenhorne & O'mara) regulatory flood study which indicated no spill from Fourmile to Wonderland Creek, the properties recommended for acquisition on Poplar and Emerald were not in the HHZ. With the current knowledge that these properties are in the HHZ with the new spill hydrology, Love developed an alternate for City and UDFCD consideration based on providing 100-year conveyance for only that portion of the discharge in excess of the previous 100-year discharge.

Two options were analyzed for conveying the additional 100-year flow in Wonderland Creek resulting from the decision not to contain the spill flows from Fourmile Canyon Creek at Broadway. The previous regulatory study had a 100-year flow of 990 cfs at Centennial Middle School. The current adopted floodplain study has a 100-year flow of 2,285 cfs at 19th Street (just upstream of the school). Therefore, the additional alternates analyzed at this location required conveying the additional 100-year discharge of 1295 cfs in a channel or box culvert.

The following are possible alternatives to acquiring HHZ properties on Poplar and Emerald along Wonderland Creek:

- Install a large pipe or box culvert under Centennial Middle School's playing field/track to convey the additional 1295 cfs. Two 12'W x 6'H reinforced box culverts (RCB) would be required to convey only the additional 100-year flow (1295 cfs).
- Construct a channel to convey the additional 1295 cfs. Using a 5' depth, 4:1 side slope, trapezoidal channel and a 7 fps velocity (assumed), the channel would need to be approximately 60' wide with an 18-foot bottom width. The attached drawing shows a red lined layout of this supplemental channel. If this alternate is selected by the City and the UDFCD, a natural type channel configuration would be recommended.

Figure 2 illustrates the area of channelization or the reach of box culvert under the school track. Table 3 includes cost estimates for the additional alternates identified for the portion of Wonderland Creek Reach 6 near Centennial Middle School and the properties recommended for acquisition.

RIVERSIDE AVE.

GARNET LN

FOURMILE CANYON CREEK

PEDESTRIAN TRAIL CROSSING

EXCAVATE 2' DEEP ON NORTH OVERBANK FOR ADDITIONAL CHANNEL CAPACITY

EXCAVATE 2' DEEP ON NORTH AND SOUTH BANK TO INCREASE CHANNEL CAPACITY

EMERALD RD

PEDESTRIAN TRAIL

19TH ST.

EXCAVATE 2' DEEP ON NORTH AND SOUTH BANK TO INCREASE CHANNEL CAPACITY

CONSTRUCT OVERFLOW CHANNEL

WONDERLAND CREEK

PEDESTRIAN TRAIL

REMOVE & REPLACE PEDESTRIAN BRIDGE WITH 120' STRUCTURE

POPLAR AVE.

20TH ST.

PURCHASE 2 STRUCTURES IN HIGH HAZARD ZONE AND 0.5' FLOODWAY

WONDERLAND CREEK

200 0 100 200 400

(IN FEET)

Original Scale: 1 inch = 200 ft.

GROUND CONTROL SURVEY BY: MERRICK & COMPANY
AERIAL PHOTOGRAPHY BY: MERRICK & COMPANY
TOPOGRAPHIC MAPPING BY: MERRICK & COMPANY
CONTOUR INTERVAL: ONE FEET
DATE FLOWN: 2003
DATUM: HORIZONTAL – NAD83, COLORADO STATE PLANE COORD. – NORTH, VERTICAL – NAVD88

PREPARED BY:
Lone & Associates, Inc.
water resource consultants
600 Jefferson Avenue – Suite B
Louisville, Colorado 80027-1873
Phone: (303) 673-9795
Fax: (303) 673-9798

DESIGNED:	SDL
DRAWN:	PEM
CHECKED:	DJL
DATE:	11/06

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
CITY OF BOULDER, COLORADO

FOURMILE CANYON CREEK AND WONDERLAND CREEK MASTER PLAN

IMPROVED CHANNEL AT CENTENNIAL MIDDLE SCHOOL

FIGURE 2

Table 3
Reach 6 Alternates near Centennial Middle School – Estimated Cost

Alternate	Cost	Total Reach 6 Cost
HHZ Containment including Property Acquisition (Published Alternate)	$ 1,593,200	$ 3,168,300
HHZ Containment including Channelization of Additional Flow (New Alternate)	$ 933,500	$ 2,508,600
HHZ Containment including Conveyance of Additional Flow in RCB (New Alternate)	$ 3,406,000	$ 4,981,100

Neither the supplemental channel nor the RCBs require acquisition of any residential structures. As discussed with the City and UDFCD at the November 15th Progress Meeting, Love understands the Project Sponsors (City and UDFCD) prefer (and will likely recommend) the alternate which incorporates the channelization of the additional flow.

D. Upland between 19th and 20th

Love & Associates was also asked by the City Staff to analyze improvements to contain the flood hazard zones at 2020 Upland. In order to collect the 100-year flood at the intersection of Upland and 19th, both the Upland and 19th Street road crossings would have to be replaced since flood water flowing south over Upland east of 19th would be inundating the site. Table 4 includes the costs from our recommended alternate for the reach from upstream of Upland to the downstream property line for 2020 Upland. Also included in Table 4 is a temporary transition from the new channel to the existing floodplain which will have to be constructed (approximate additional construction cost of $40,000).

Table 4
Upland between 19th and 20th - Estimated Costs

1	Channel Excavation (465 sf x 1290 lf)	22,225	CY	$ 177,822
2	Grade Control Structure	8	EA	$ 128,016
3	19th Street 8'x38' RCB	1	EA	$ 320,040
4	Upland Avenue 8'x38' RCB	1	EA	$ 320,040
5	Utility Relocations	1	LS	$ 24,003
6	Remove Pedestrian Bridge	1	LS	$ 1,600
7	Pedestrian Trail	1165	LF	$ 37,285
8	Structure Acquisition-1885 Upland Ave.	1	LS	$ 709,500
9	Revegetation (115 ft x 1290 ft)	3.4	AC	$ 8,161
10	Landscaping (115 ft x 1290 ft)	3.4	AC	$ 27,203
11	Wetland Mitigation (30 ft x 1290 ft)	0.9	AC	$ 72,009

12	Contingency/Mobilization	25%	-	$ 392,791
13	Engineering/Administration	15%	-	$ 294,594
	Subtotal			$2,510,000

Table 4 does not include the construction costs on the property downstream of 19th. These channel costs are assumed to be borne by the adjacent developer.

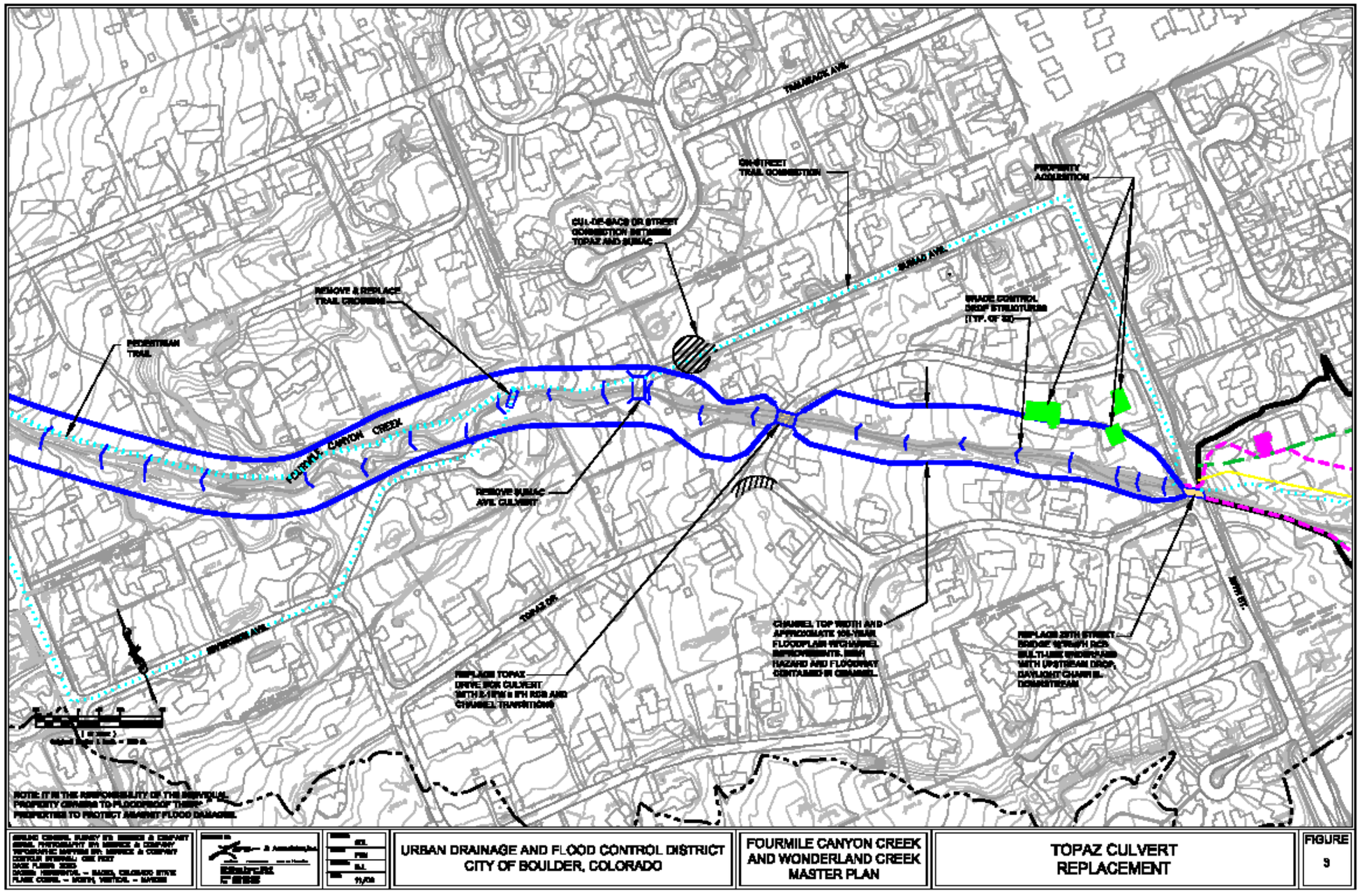
E. Topaz Culvert Replacement

The published Phase A report proposes to remove the crossing at Topaz making it a cul-de-sac. City staff requested Love size and estimate a cost for construction of a 100-year structure at this location. Table 5 includes the estimated costs for this structure using pricing similar to that employed for other structures recommended for replacement along the creek. Figure 3 indicates the location and size of road improvements required at Topaz based upon this alternate.

Table 5
Topaz 100-year Culvert - Estimated Cost

Item No.	Description	Quantity	Unit	Item Total
1	Channel Excavation	1	LS	$134,444
2	Remove Existing Culvert, Wingwalls and Pavement	1	LS	$5,000
3	Grade Control Structures	1	LS	$45,000
4	2-12-foot-Wide x 6-foot-High Reinforced Concrete Box Culverts (includes RCB Culverts and Road Restoration)	1	LS	$168,000
5	Landscaping/Revegetation	1	LS	$12,821
6	Wetland Mitigation	1	LS	$31,500
7	ROW/Easements	1	LS	$36,736
8	Contingency/Mobilization	25%	-	$108,375
9	Engineering/Administration	15%	-	$65,025
	TOTAL			**$606,901**

Figure 3 TOPAZ bridge replacement



F. Insurance Premium Summary

The City of Boulder requested Love compile a summary of Insurance Premium estimates for properties located in the Fourmile Canyon Creek , Wonderland Creek and the spill area floodplains. In determining the flood insurance premium for these flood prone properties, Love made the following assumptions:

- Structure value was taken from City of Boulder most recent Boulder County Assessor's data base.
- Premiums were assigned to each property based on general premium tables published on www.floodsmart.gov for low and high risk structures which assume a $500 deductible and no-basement.
- Structure values were rounded up for premium classification and Building and Contents premium applied to account for contents insurance estimate.
- Class 7 Community Rating System insurance premium reduction (15%) was applied.
- Zone designation dependent upon finished first floor (FF) depth of water for 100-year and 500-year events was taken from the previously published damage analysis.

The NFIP Manual can provide detailed, case-by-case insurance costs including premium calculations for structures with basements.

Insurance rates with respect to flood zone were applied and a summary of the cost of insurance per reach based on the properties in the Zone AE and Zone X floodplains is included in Table 6. Note: These are annual insurance premium costs and will be incurred each year.

Table 6
Annual Insurance Premium Estimated Costs

Fourmile Canyon Creek Floodplain Properties

Reach	# of Structures	Total Annual Premium
Lower FCC	18	$ 8,100
1-	0	$ -
2-	7	$ 3,700
3-	4	$ 4,200
4-	29	$ 40,400
5-	59	$ 66,600
6-	22	$ 34,500
Total FCC	139	$ 157,200

Wonderland Creek Floodplain Properties

	# of Structures	Total Annual Premium
1	0	$ -
2	16	$ 20,800
3	82	$ 77,800
4	5	$ 8,700
5	70	$ 67,300
6	19	$ 17,600
7	3	$ 2,600
8	1	$ 200
Total WC	196	$ 195,000

Total Annual Insurance Premium	335	$ 352,200

We have verified with Dan Carlson from FEMA and Diane Oestman of Flood Insurance Services the maximum coverages for residential/non-residential properties as well as contents coverage.

G. Partial containment and threshold frequency and impacts to County properties.

Following the October 15, 2007 WRAB meeting, City Staff requested Love respond to questions raised by Elizabeth Black, a property owner whose residence is located in the spill area. The following are the questions asked and Love's response:

Q: What is the maximum flood event the current creek channel can carry before it starts to spill to the south?
A: Approximately two (2) cfs begins to spill from the Fourmile Canyon Creek Channel at the 10-year flood event. Significant spills (700+ cfs) are occurring at the 50-year event. The 10-year event can be considered the threshold event at which water begins spilling from Fourmile Canyon Creek to Wonderland Creek.

Q: What event could the downstream County properties handle before these structures are impacted by floodwaters?
A: Downstream county properties begin to see water at their structures between a 20 to 50 year event for the current spill scenario depending upon the location of the structure. Any increased containment will result in these properties getting wet for smaller, more frequent events. The UDFCD has stated that they cannot support any alternates which result in adverse impacts to downstream properties unless mitigation is being proposed.

C I T Y O F B O U L D E R
WATER RESOURCES ADVISORY BOARD
AGENDA ITEM

MEETING DATE: August 17, 2009

AGENDA TITLE:

Fourmile Canyon and Wonderland Creek Major Drainageway flood mitigation planning update

PRESENTER/S:

Kurt Bauer, Engineering Project Manager

Bob Harberg, Utilities Planning and Project Management Coordinator

EXECUTIVE SUMMARY:

The purpose of this agenda item is to provide an update on the Fourmile Canyon Creek and Wonderland Creek flood mitigation planning effort including current staff recommendations.

A Major Drainageway Phase A plan, prepared by Love and Associates in June 2007, developed, evaluated, and recommended flood mitigation conceptual-level alternatives along both Wonderland and Fourmile Canyon Creeks. The work was jointly sponsored by the Urban Drainage and Flood Control District and the city. The report recommendations have been reviewed through an extensive public involvement process. Based on feedback from the public involvement process, staff believes there is general concurrence on the flood mitigation approach for all stream areas with the exception of Wonderland Creek between 26th St. and Foothills Parkway. In this area there are questions regarding the following two approaches:

1. Containment of the entire 100-year flood flows at public expense, thus mitigating all potential property damage due to the 100-year storm event
2. Containment of the high hazard flood zone at public expense, coupled with voluntary private financing of floodproofing private property owner's structures.

Staff has revisited these approaches and this agenda item provides a summary of that evaluation along with staff's preliminary recommendations and is seeking WRAB input and feedback.

BACKGROUND:

The Phase A study area includes the Fourmile Canyon Creek floodplain from the mouth of the canyon to its confluence with Boulder Creek and the Wonderland Creek floodplain from downstream of Wonderland Lake to its confluence with Goose Creek (**Figure 1)**. The study identified reaches of Fourmile Canyon Creek west of 19th Street where flow spills to Wonderland Creek during large events. It was determined to be unfeasible to eliminate the spills and as a result, all future mitigation measures along Wonderland will be sized to convey this increased flow caused by the spill from Fourmile Canyon Creek.

A broad range of alternatives were evaluated along specific reaches of both Fourmile Canyon Creek and Wonderland Creek. The alternatives included do nothing, construction of detention facilities, trans-basin diversions, acquisition of flood prone properties, high harzard zone containment and floodproofing of structures, channel modifications to provide 50-year conveyance capacity, and channel modifications to provide 100-year conveyance capacity. Providing flood water detention and constructing trans-basin diversions were eliminated from further consideration early on because of the cost and legal liabilities associated with these alternatives. For each of the remaining alternatives, estimates of probable construction cost, maintenance requirements, residual flood damage estimates, and a benefit/cost analysis was developed.

The report has gone through an extensive public involvement process including most recently:

- Greenways Advisory Committee (September 19, 2007),
- Public Open House (September 27, 2007),
- Water Resources Advisory Board (October 15, 2007, December 17, 2007, and January 28, 2008),
- Planning Board (February 21 and March 20, 2008),
- Public Hearing with City Council (November 10, 2008)
- City Council Special Study Session (April 28, 2009)

In January 2008 WRAB passed a motion with a 4-0 vote to recommend approval of the Phase A plan as modified by staff with the following recommendations and guiding principles as this project continues to future phases and more detailed concept design:

1. Protect life safety by addressing structures in the high hazard zone through:
    a) Acquiring properties from willing sellers
    b) Constructing flood improvements at time of redevelopment of properties along Fourmile Canyon Creek west of Broadway and Wonderland Creek near 30th.
    c) Constructing high hazard zone containment and other improvements as funding is available, including coordinating with the county on expediting improvements located jointly in the city and county.
2. The intent of the overall approach is to minimize disruption to private property and riparian areas. This implies that flooding during 100-year events will not be contained in a channel minimizing impacts to downstream properties. Many

3. During the next phase all potentially impacted properties and persons including students and parents should be notified of proposed approach and tradeoffs of minimizing property impacts versus the potential for flood damages.
4. Public education of flood risks should be emphasized including signage and flood markers and response plans for impacted schools.
5. Opportunities for facilitating and encouraging private flood proofing should be explored.
6. Continue to maintain high level of public involvement and feedback.
7. This non-structural approach requires active regulatory flood plain management in order to preserve flood conveyance areas.

On April 28, 2009 staff presented information to City Council during a Study Session to address issues raised during the November 2008 public hearing. Council members generally expressed support for the approach to flood mitigation planning and that existing policies were appropriate, with the following comments relating to the Phase A report:

- The current approach to flood mitigation should continue and is mostly in the right direction.
- Consider doing the least amount of work necessary with the structural improvement approach to mitigate flood hazards.
- Flood mitigation work proposed along Fourmile Canyon Creek east of 28th should be reconsidered and possibly scaled back.
- Alternatives that leave drainageways in their natural state should be a priority.
- Mitigation measures should be kept as "green" as possible, i.e. minimize use of asphalt and concrete.
- The need to disturb natural areas for the benefit of a few homes was questioned.
- Removal of structures from the 100-year floodplain was questioned if the removal/mitigation was only to reduce property damage. Focus removal efforts on structures in the high hazard and conveyance zone.
- City council members requested that proposed mitigation costs be presented to distinguish the cost of containing high hazard flood flows versus containing all 100-year flood flows.

ANALYSIS:

Council's comments can be summarized by the following key issue - should the city implement high hazard containment and floodproofing or construction of a 100-year channel system? This key issue relates to three remaining stream reaches, all located along Wonderland Creek.

The reaches still under evaluation are located between 26th Street and Foothills Parkway as shown in **Figure 1**. The existing floodplain is extensive in this segment of the creek with 111 structures (417 individually owned dwelling units) located in the 100-year floodplain and 24 structures (181 individually owned dwelling units) located in the High

Hazard Zone. Annual premiums are just over $154,000 to insure structures within this reach. Estimated potential flood damages averaged on an annual basis exceed $2.6 million. **Figure 2** graphically presents existing conditions.

Figure 3 graphically summarizes the HHZ Containment and Floodproofing alternative for this stream segment. This alternative includes:

- Construction of an overflow underpass and associated channel at 28th Street
- Channel modifications to reduce the high hazard zone from Kalmia Street to the Diagonal and upstream from Foothills Parkway
- Four new culvert crossings
- Separation of Wonderland Creek from the Boulder and Whiterock Ditch

This alternative would remove all 24 structures currently in the high hazard zone at an estimated public cost of just over $9.5 million and a private cost of $6.8 million. The private costs reflect the cost of property owners to floodproof their structures.

Figure 4 graphically summarizes the 100-year Channel alternative for this stream segment. The alternative includes:

- Channel modifications along the entire reach to provide adequate conveyance for the 100-year flows
- Eight culvert upgrades or replacements
- Construction of a bridge underpass and overflow channel
- Separation of Wonderland Creek from the Boulder and Whiterock Ditch

This alternative would remove all 111 structures from the 100-year flood hazard at an estimated public cost of just over $19.5 million.

The following presents a comparison between the two alternatives.

	100-Year Containment	**HHZ Containment and Floodproofing**
Cost	$19.5 million public $0 private	$9.5 million public $6.8 million private
Damage Reduction (present worth)	$66 million	$3.8 million (HHZ only) $54 million (voluntary floodproofing)
Structures	Removes all structures (111) from 100-year flood hazard	Removes all structures (24) from HHZ Zone, 61 structures remain in 100-year floodplain
Maintenance Costs	$1 million	$1.7 million
Insurance Premiums	$154,000 annual savings	$69,000 annual savings
Benefit / Cost Ratio	3.4	0.4 (HHZ only) 3.6 (HHZ and voluntary floodproofing)

Staff conducted a more detailed evaluation of the alternatives to identify the cost of proposed flood mitigation measures in relationship to the specific benefits of structures and dwelling units removed. **Attachment 1** and associated **Figure 5** present this analysis

for the High Hazard Containment alternative. **Attachment 2** and associated **Figure 6** present this analysis for the 100-year Containment alternative.

Staff conducted an open house on Wednesday, August 5 to solicit public input on whether to recommend high hazard containment and floodproofing or 100-year containment for Wonderland Creek reaches 5, 4, and 3. The meeting agenda is as follows:

- 6:30 – 7 p.m. open house
- 7 – 7:30 p.m. presentation
- 7:30 – 8 p.m. questions
- 8 – 8:30 p.m. open house

The open house included large-format figures graphically presenting existing conditions, HHZ Containment alternative, 100-year Containment alternative, and a comparative listing of differences between the alternatives. Staff were available to discuss the alternatives, answer questions, and document comments. Following the initial open house session, staff used a PowerPoint presentation to provide a summary of the planning effort, present the alternatives, and provide a summary comparison. A question and answer period followed the presentation. A final open house session concluded the meeting. Citizens were encouraged to provide comments either to staff or on comment sheets. Staff will provide an update on the outcome of the public open house that was held on Wednesday, August 5.

PRELIMINARY STAFF RECOMMENDATIONS:

The staff preliminary recommendation is a modified 100-year Containment alternative for Wonderland Creek between 26th Street and Foothills Parkway. The following describes the recommended modification.

The 100-year Containment Alternative includes a new bridge and channel modifications between the downstream side of the Diagonal Highway and the upstream side of Iris Avenue. These features have an estimated cost of just over $3.3 million. These proposed features would remove one commercial structure from the 100-year floodplain. The High Hazard Containment and Floodproofing alternative includes a new culvert and lesser channel modifications for this same reach of stream. The estimated cost for these features is approximately $1.5 million. Under this alternative, the one commercial structure would be removed from the high hazard zone but would remain within the 100-year floodplain. The estimated cost difference between the alternatives in this section of the stream is approximately $1.8 million. Staff believes that the cost difference to remove one structure from the 100-year floodplain justifies recommending consideration of the High Hazard Containment alternative for Wonderland Creek between the downstream side of the Diagonal Highway and the upstream side of Iris Avenue.

Staff recommends the 100-year Containment Alternative for the remaining reaches of Wonderland Creek between 26th Street and Foothills Parkway for the following reasons. Although at a higher public cost than the high hazard containment alternative, the 100-

year Containment alternative would remove all 110 structures currently located in the 100-year floodplain. Removing structures from the 100-year floodplain will result in annual savings of approximately $152,000 on flood insurance premiums and avoid the potential of over $2 million in average annual flood damages ($66 million present worth cost at 3% interest and 50 years.) In addition, the 100-year Containment alternative does not rely on voluntary actions from the public to implement floodproofing of individual structures. The cost of voluntary floodproofing of individual structures is significant ($25-$50K per property) and will not eliminate mortgage required flood insurance. As a result, staff believes that most homeowners will not choose to implement floodproofing measures.

Figures 5 and 6 and **Attachments 1 and 2** show the location and itemized costs associated with the two alternatives for this segment of Wonderland Creek. The following presents a comparison between the three alternatives.

	100-Year Containment	HHZ Containment and Floodproofing	Modified 100-Year Containment
Cost	$19.5 million public $0 private	$9.5 million public $6.8 million private	$17.6 million public $0 private[1]
Damage Reduction (present worth)	$66 million	$3.8 million (HHZ only) $54 million (voluntary floodproofing)	$65.5 million[2]
Structures	Removes all structures (111) from 100-year flood hazard	Removes all structures (24) from HHZ Zone, 61 structures remain in 100-year floodplain	Removes 110 structures from 100-year floodplain (one remains), removes all structures (24) from HHZ zone
Maintenance Costs	$1 million	$1.7 million	$1.1 million[2]
Insurance Premiums	$154,000 annual savings	$69,000 annual savings	$152,000 annual savings[2]
Benefit / Cost Ratio	3.4	0.4 (HHZ only) 3.6 (HHZ and voluntary floodproofing)	3.7

[1] One commercial property would require floodproofing
[2] Estimated based on ratio values

In addition, the original intent was that once the Phase A report was accepted by Council, staff would work with the consultant to develop Phase B of the flood mitigation study. This second phase of the project would develop preliminary design of recommended alternatives. The Phase B report would be reviewed as part of the city's Community and Environmental Assessment Process (CEAP). The Phase A recommended improvements, however, total greater than $32,000,000 in public expenditures and therefore will be implemented in phases over many years. The Phase B preliminary design and the associated CEAP will likely no longer be relevant when many of the recommended improvements would be implemented, many years from now. As a result, staff will not prepare a Phase B preliminary design report and associated CEAP. Specific projects will instead be developed using the Phase A report as a planning guide. Under this approach, design and CEAP would be developed for individual mitigation projects located along Wonderland and Fourmile Canyon Creeks. An example of this approach is the

Wonderland Creek Improvements Project that has begun for the reach of Wonderland Creek from Foothills Parkway upstream to 34th Street.

NEXT STEPS:

- Public hearing with the WRAB on September 21, 2009 and request for a final recommendation to Planning Board and Council.
- Public hearing with the Planning Board - October 2009
- Public hearing with the City Council – late 2009 or early 2010

ATTACHMENTS:

Figure 1: Location of Evaluated Reaches
Figure 2: Existing Conditions
Figure 3: High Hazard Containment and Floodproofing Alternative
Figure 4: 100-year Containment Alternative
Figure 5: HHZ Containment Itemized Cost Key
Attachment 1: HHZ Containment Itemized Costs
Figure 6: 100-Year Containment Itemized Cost Key
Attachment 2: 100-Year Containment Itemized Costs

Wonderland Creek Reaches 5, 4, 3
Comparison of Alternatives

Attachment 1

100-Year Channel Alternative

Reach Location	Item Number	Item Location	Item Raw Cost					Subtotal	Contingency (40%)	Total Cost	Removed from 100-year Floodplain	
			Crossing	Channel	Wetlands	Drops	ROW				Structures	Dwelling Units
26th to downstream side of 28th	1	26th	$747,600					$747,600				
	2	Winding Trail	$560,700					$560,700				
	3	26th to Winding Trail		$532,586				$532,586				
	4	Winding Trail to 28th		$105,172				$105,172				
	5	Winding Trail to 28th				$110,000		$110,000				
	6	26th to 28th			$126,740			$126,740				
	7	26th to 28th					$509,800	$509,800				
	8	28th	$407,400					$407,400				
								$3,099,998	$1,239,999	**$4,340,000**	51	146
Downstream side of 28th to	9	28th to Kalmia		$465,528				$465,528				
downstream side of Kalmia	10	28th to Kalmia					$294,650	$294,650				
	11	Kalmia	$77,700					$77,700				
								$837,878	$335,151	**$1,173,000**	0	0
Downstream side of Kalmia to	12	Kalmia to Diagonal		$2,340,000				$2,340,000				
Diagonal Highway	13	Kalmia to Diagonal				$100,000		$100,000				
	14	Kalmia to Diagonal			$168,290			$168,290				
	15	Kalmia to Diagonal					$294,650	$294,650				
	16	Modify Ped Bridge	$150,000					$150,000				
	17	Fire Access	$541,800					$541,800				
								$3,594,740	$1,437,896	**$5,033,000**	17	97
Diagonal Hwy to downstream side	18	Diagonal Hwy to Iris		$307,331				$307,331				
of Iris	19	Diagonal Hwy to Iris				$70,000		$70,000				
	20	Diagonal Hwy to Iris					$371,200	$371,200				
	21	Bank Bridge	$1,633,800					$1,633,800				
	22	34th and Iris	$2,520,000					$2,520,000				
								$4,902,331	$1,960,932	**$6,863,000**	10	47
Downstream side of Iris to	23	Iris to Foothills Parkway		$507,451				$507,451				
Foothills Parkway	24	Iris to Foothills Parkway			$82,660			$82,660				
	25	Iris to Foothills Parkway					$371,200	$371,200				
	26	Spring Creek	$94,500					$94,500				
	27	Railroad	$396,900					$396,900				
	28	Ditch crossing	$25,000					$25,000				
								$1,477,711	$591,084	**$2,069,000**	33	97
									Grand Total	**$19,478,000**	**111**	**387**

Wonderland Creek Reaches 5, 4, 3
Comparison of Alternatives

HHZ Containment / Floodproofing Alternative

Reach Location	Item Number	Item Location	Item Raw Cost: Crossing	Channel	Wetlands	Drops	ROW	Subtotal	Contingency (40%)	Total Cost	Removed from 100-year Floodplain: Structures	Dwelling Units
26th to downstream side of 28th								$0				
								$0	$0	**$0**	6	47
Downstream side of 28th to	1	28th	$407,400					$407,400				
downstream side of Kalmia	2	28th to Kalmia		$237,696				$237,696				
	3	28th to Kalmia					$161,000	$161,000				
								$806,096	$322,438	**$1,129,000**	0	0
Downstream side of Kalmia to	4	Modify ped bridge	$150,000					$150,000				
Diagonal Highway	5	Modify fire access	$541,800					$541,800				
	6	Kalmia to Diagonal		$240,000				$240,000				
	7	Kalmia to Diagonal			$83,400			$83,400				
	8	Kalmia to Diagonal					$161,000	$161,000				
								$1,176,200	$470,480	**$1,647,000**	9	15
Diagonal Hwy to downstream side	9	Bank culvert	$655,200					$655,200				
of Iris	10	34th and Iris	$2,520,000					$2,520,000				
	11	Diagonal to Iris		$115,752				$115,752				
	12	Diagonal to Iris					$280,000	$280,000				
								$3,570,952	$1,428,381	**$4,999,000**	4	46
Downstream side of Iris to	13	Iris to Foothills		$70,500				$70,500				
Foothills Parkway	14	Iris to Foothills			$86,800			$86,800				
	15	Iris to Foothills					$280,000	$280,000				
	16	Spring Creek	$373,800					$373,800				
	17	Railroad	$396,900					$396,900				
	18	Ditch Crossing	$25,000					$25,000				
								$1,233,000	$493,200	**$1,726,000**	31	97
											50	**205**

Grand Total Public Cost **$9,501,000**

Grand Total Private Cost **$6,815,000**

Total all Costs **$16,316,000**

Figure 1: Stream Reaches in Question

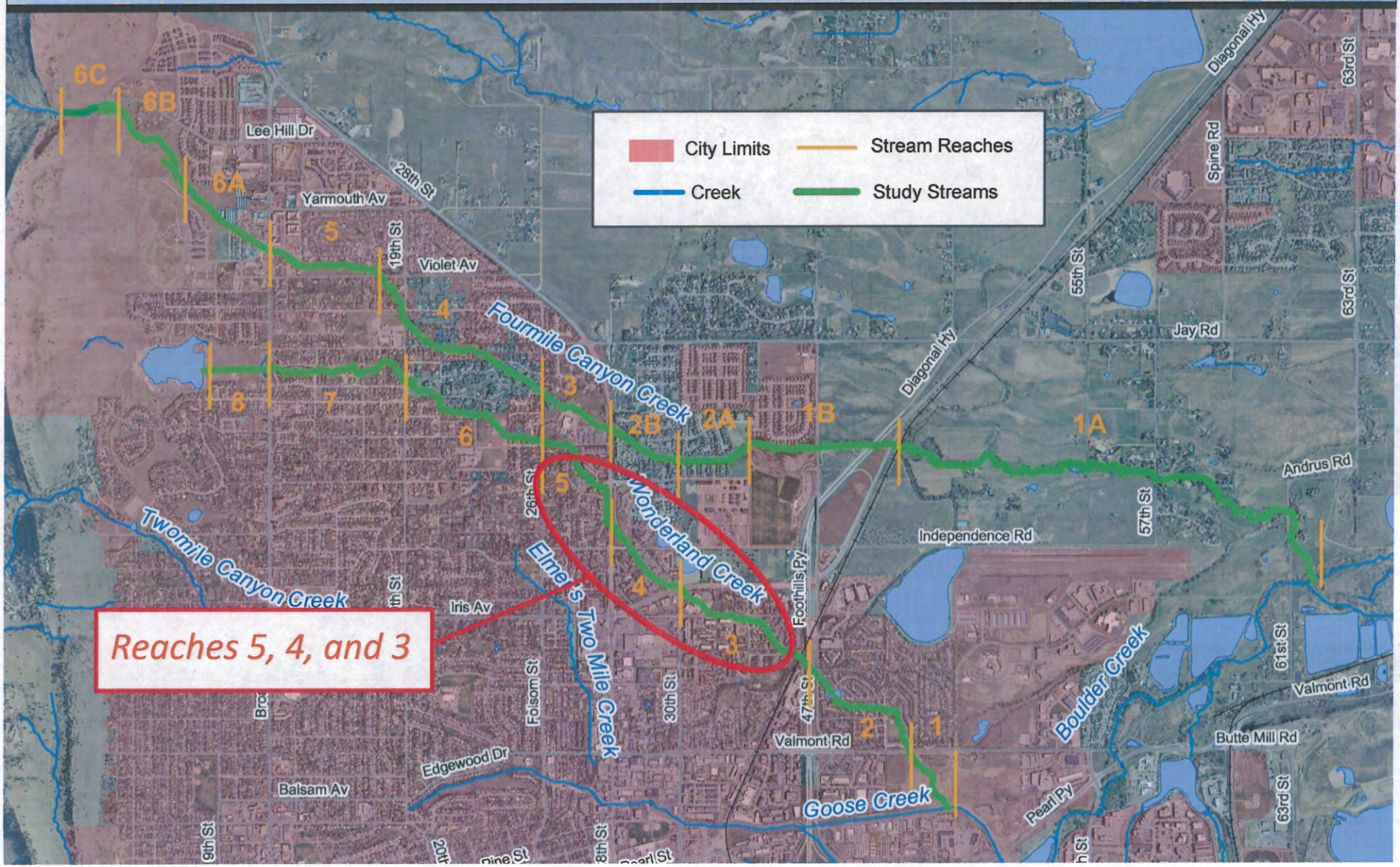
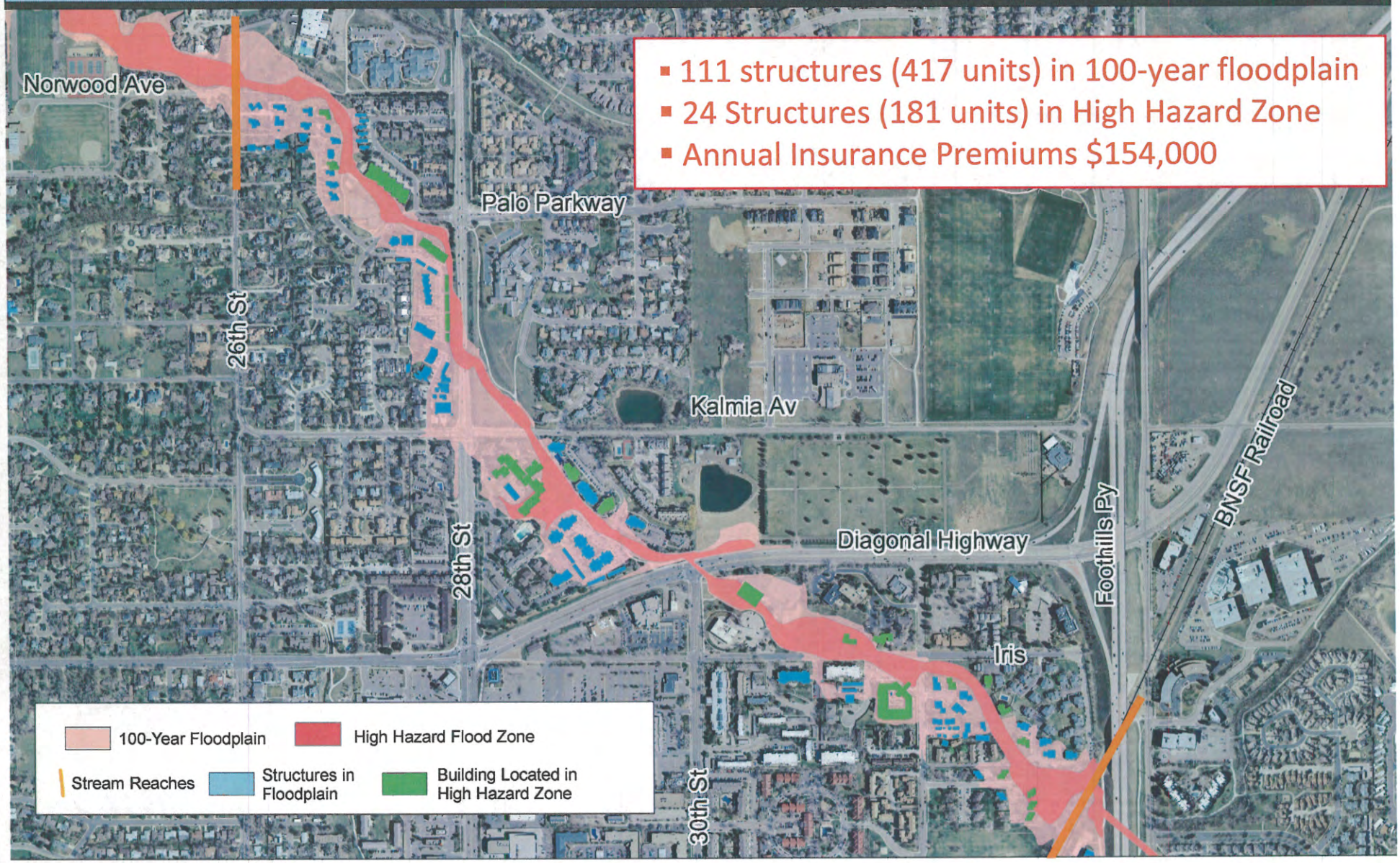


Figure 2: Existing Conditions



- 111 structures (417 units) in 100-year floodplain
- 24 Structures (181 units) in High Hazard Zone
- Annual Insurance Premiums $154,000

Figure 3: HHZ Containment and Floodproofing Alternative

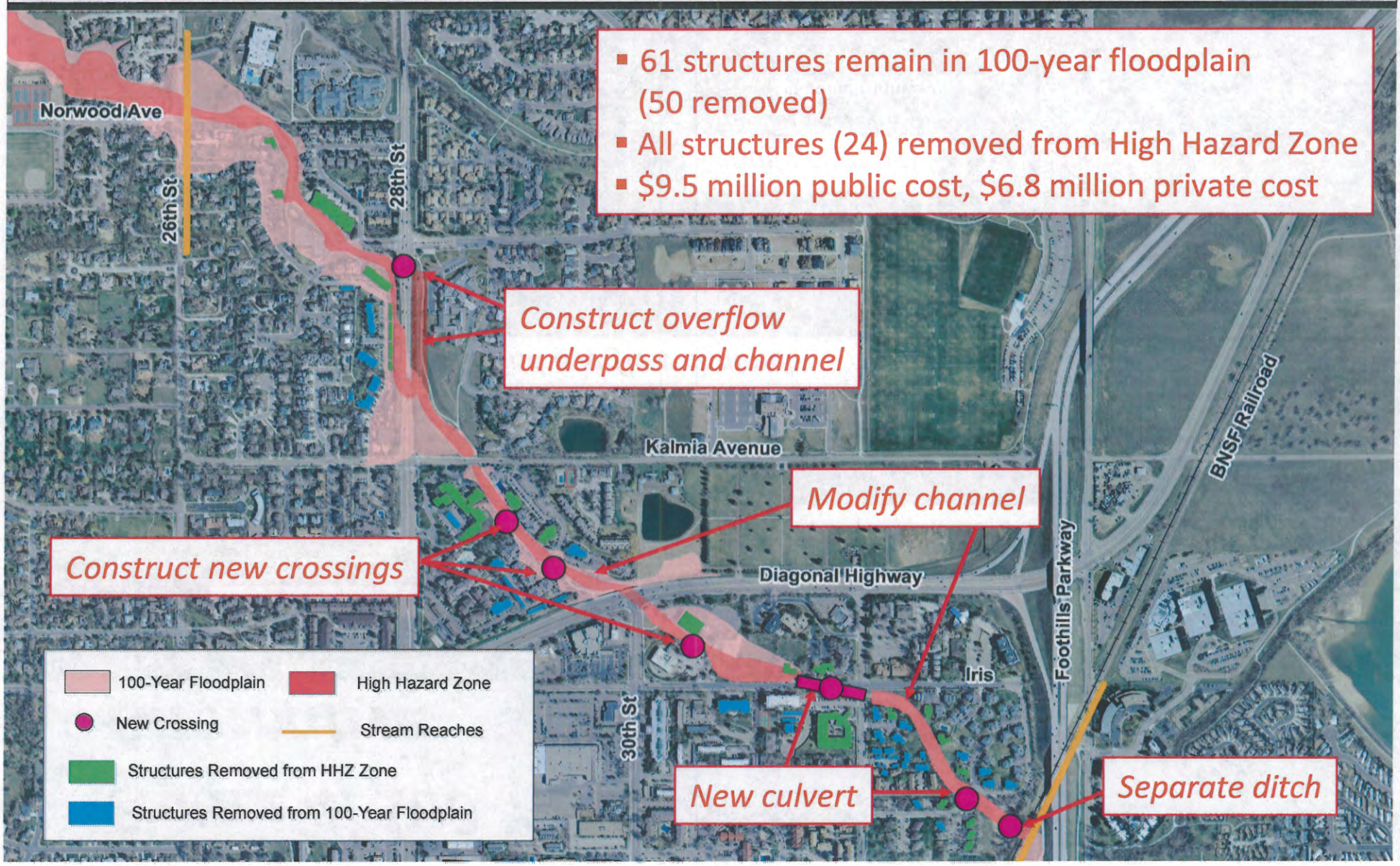
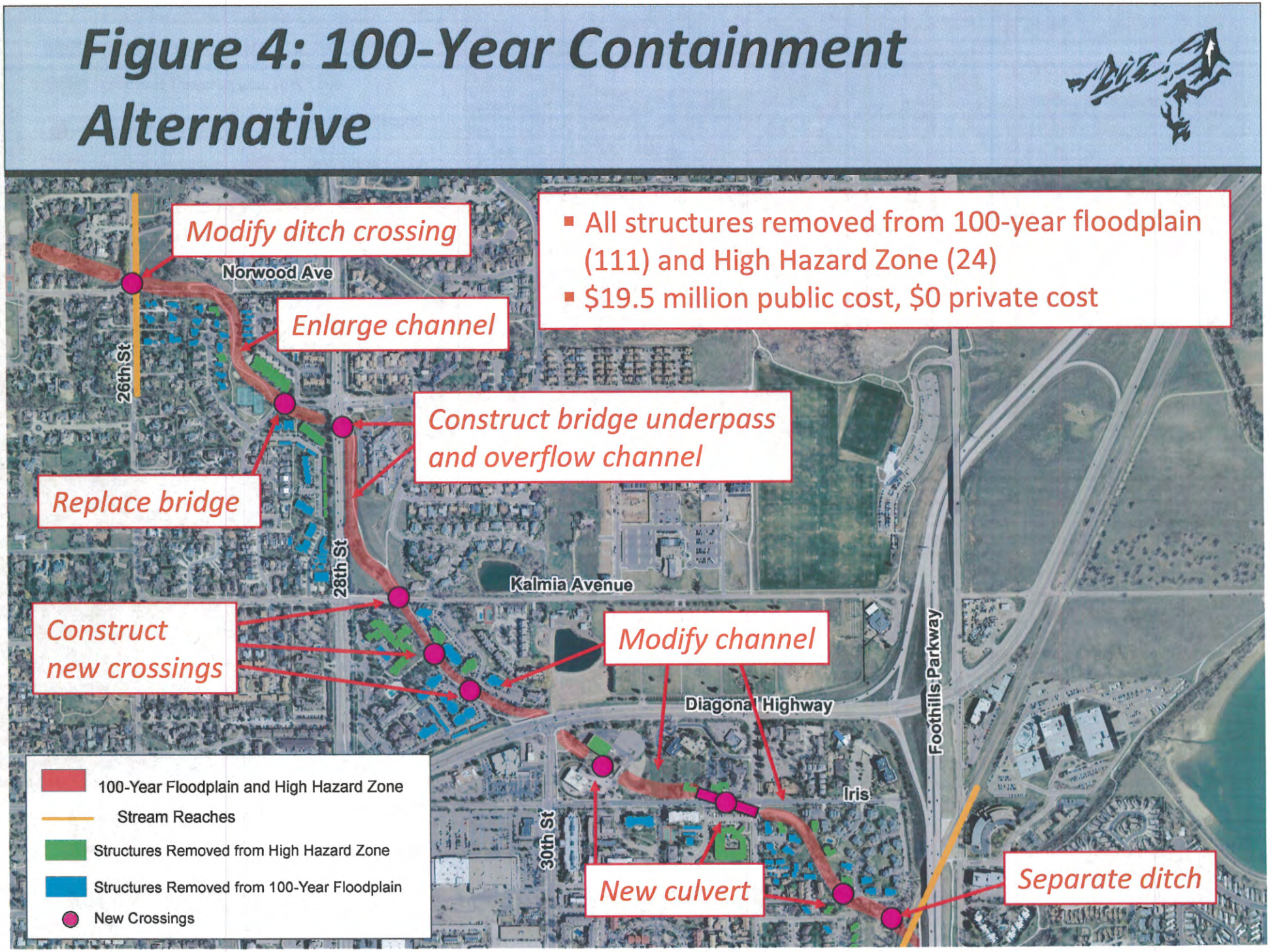


Figure 4: 100-Year Containment Alternative



- All structures removed from 100-year floodplain (111) and High Hazard Zone (24)
- $19.5 million public cost, $0 private cost

Figure 5: Wonderland Creek HHZ Containment Cost Key

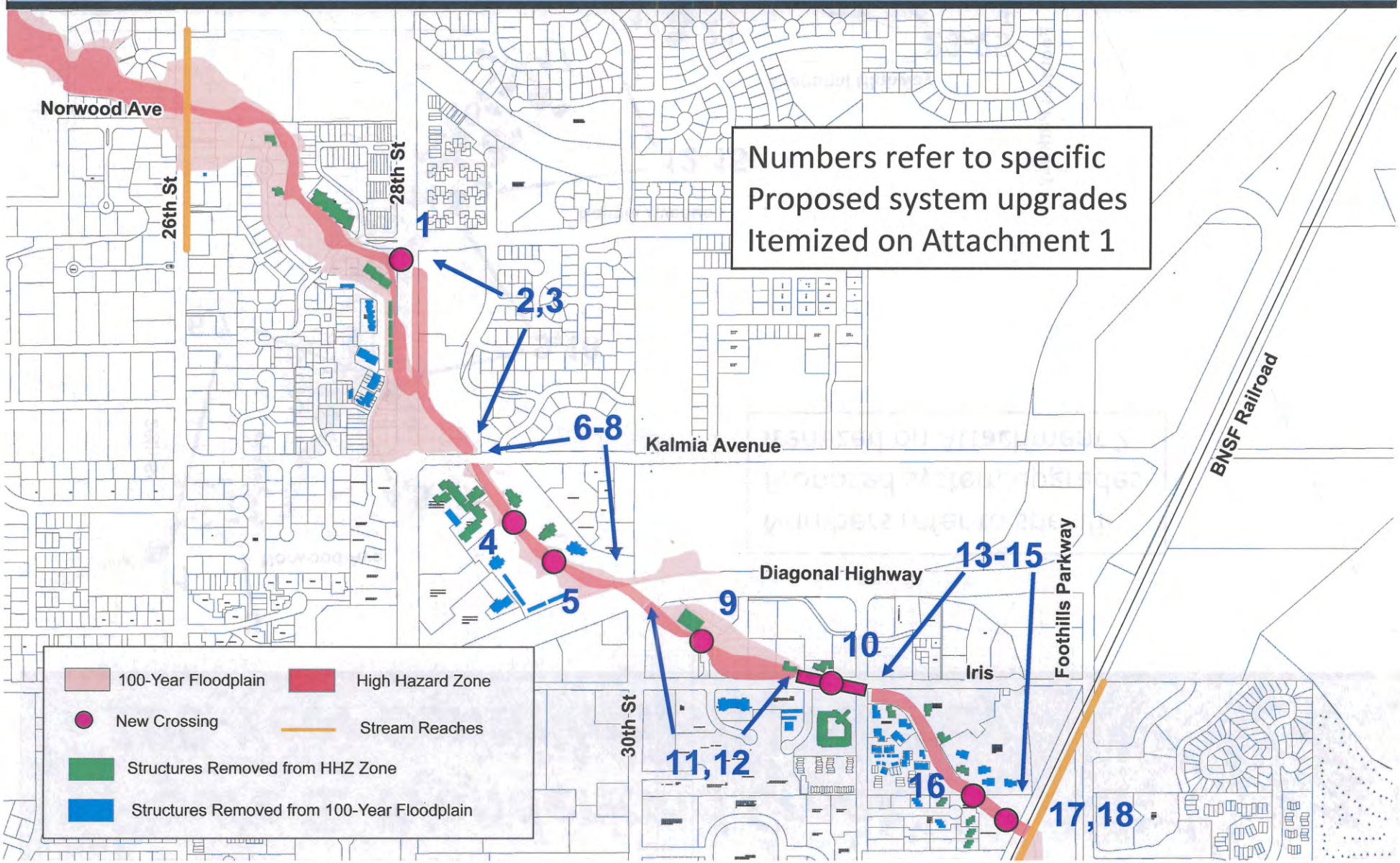
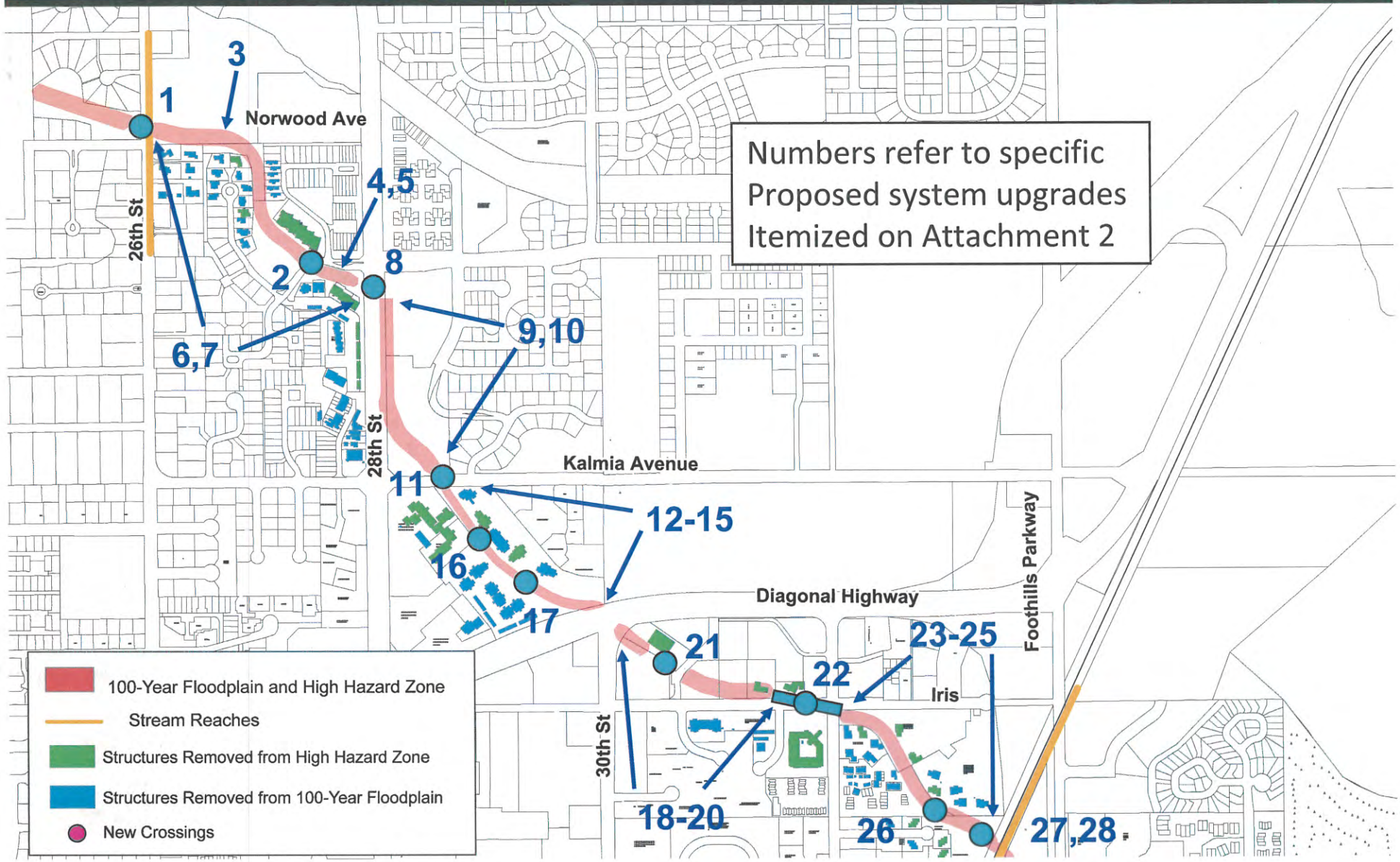


Figure 6: Wonderland Creek 100-Year Containment Cost Key



C I T Y O F B O U L D E R
WATER RESOURCES ADVISORY BOARD
AGENDA ITEM

MEETING DATE: September 21, 2009

AGENDA TITLE:
Final Recommendation on the Fourmile Canyon and Wonderland Creek Major Drainageway flood mitigation plan.

PRESENTERS:
Kurt Bauer, Engineering Project Manager
Bob Harberg, Utilities Planning and Project Management Coordinator
Annie Noble, Greenways Coordinator

PURPOSE:

Staff is finalizing the Fourmile Canyon Creek and Wonderland Creek Alternatives Analysis flood mitigation plan for acceptance by City Council and the Urban Drainage and Flood Control District. This evaluation provides a long-range plan that can be used to prioritize capital improvement projects in the context of the overall flood Capital Improvement Program (CIP), as well as provides information that allows staff, private property owners and the development community to plan and coordinate activities in recognition of the flood hazards and potential mitigation strategies. The purpose of this agenda item is to present the staff recommendations on the Fourmile Canyon Creek and Wonderland Creek flood mitigation planning effort and request a final recommendation from the Water Resources Advisory Board (WRAB). Please refer to the agenda item materials provided at the August 17, 2009 WRAB meeting that presents a more detailed analysis of alternatives, including supporting figures and detailed cost breakdowns.

BACKGROUND:

A Major Drainageway Phase A plan, prepared by Love and Associates in June 2007, developed, evaluated, and recommended flood mitigation conceptual-level alternatives along both Wonderland and Fourmile Canyon Creeks. The work was jointly sponsored by the Urban Drainage and Flood Control District and the city. The report recommendations have been reviewed through an extensive public involvement process.

Based on feedback from the public involvement process, staff believes there is general concurrence on the flood mitigation approach for all stream areas with the exception of Wonderland Creek between 26th St. and Foothills Parkway. In this area there are questions regarding the following two approaches:

1. Containment of the entire 100-year flood flows at public expense, thus mitigating all potential property damage due to the 100-year storm event
2. Containment of the high hazard flood zone at public expense, coupled with voluntary private financing of floodproofing private property owner's structures.

Additional information can be found in the agenda memorandum on this topic from the August 17, 2009 WRAB meeting at: (www.bouldercolorado.gov, Departments, Utilities, Water Resources Advisory Board, Previous Agenda, August 17, 2009).

In January 2008 WRAB passed a motion with a 4-0 vote to recommend approval of the Phase A plan as modified by staff with the following recommendations and guiding principles as this project continues to future phases and more detailed concept design:

1. Protect life safety by addressing structures in the high hazard zone through:
    a) Acquiring properties from willing sellers
    b) Constructing flood improvements at time of redevelopment of properties along Fourmile Canyon Creek west of Broadway and Wonderland Creek near 30th.
    c) Constructing high hazard zone containment and other improvements as funding is available, including coordinating with the county on expediting improvements located jointly in the city and county.
2. The intent of the overall approach is to minimize disruption to private property and riparian areas. This implies that flooding during 100-year events will not be contained in a channel minimizing impacts to downstream properties. Many properties including schools will experience shallow flooding under this approach.
3. During the next phase all potentially impacted properties and persons including students and parents should be notified of proposed approach and tradeoffs of minimizing property impacts versus the potential for flood damages.
4. Public education of flood risks should be emphasized including signage and flood markers and response plans for impacted schools.
5. Opportunities for facilitating and encouraging private flood proofing should be explored.
6. Continue to maintain high level of public involvement and feedback.
7. This non-structural approach requires active regulatory flood plain management in order to preserve flood conveyance areas.

On April 28, 2009 staff presented information to City Council during a Study Session to address issues raised during the November 2008 public hearing. Council members generally expressed support for the approach to flood mitigation planning and that existing policies were appropriate, with the following comments relating to the Phase A report:

1. The current approach to flood mitigation should continue and is mostly in the right direction.
2. Consider doing the least amount of work necessary with the structural improvement approach to mitigate flood hazards.
3. Flood mitigation work proposed along Fourmile Canyon Creek east of 28th should be reconsidered and possibly scaled back.
4. Alternatives that leave drainageways in their natural state should be a priority.
5. Mitigation measures should be kept as "green" as possible, i.e. minimize use of asphalt and concrete.

6. The need to disturb natural areas for the benefit of a few homes was questioned.
7. Removal of structures from the 100-year floodplain was questioned if the removal/mitigation was only to reduce property damage. Focus removal efforts on structures in the high hazard and conveyance zone.
8. City council members requested that proposed mitigation costs be presented to distinguish the cost of containing high hazard flood flows versus containing all 100-year flood flows.

ANALYSIS:

The existing floodplain along the reach of Wonderland Creek between 26th Street and Foothills Parkway is extensive, with 111 structures (417 dwelling units) located in the 100-year floodplain and 24 structures (181 dwelling units) located in the High Hazard Zone. Annual mortgage required flood insurance premiums are estimated to be approximately $154,000 within this reach and the present worth cost of estimated future flood damages is $66 million.

The HHZ Containment and Floodproofing alternative for this stream segment would reduce the width of the high hazard zone as required to remove all 24 structures currently in the high hazard zone at an estimated public cost of just over $9.5 million and a private cost of $6.8 million. The private costs reflect the cost of property owners to voluntarily floodproof their structures. This alternative includes:

- Construction of an overflow underpass and associated channel at 28th Street
- Channel modifications to reduce the high hazard zone from Kalmia Street to the Diagonal and upstream from Foothills Parkway
- Four culvert upgrades or replacements
- Separation of Wonderland Creek from the Boulder and Whiterock Ditch

The 100-year Containment alternative for this stream segment would narrow the floodplain as required to remove all 111 structures currently located in the 100-year floodplain at an estimated public cost of just over $19.5 million. This alternative includes:

- Channel modifications along the entire reach to provide adequate conveyance for the 100-year flows
- Eight culvert upgrades or replacements
- Construction of a bridge underpass and overflow channel
- Separation of Wonderland Creek from the Boulder and Whiterock Ditch

Staff recommends a modified 100-year Containment alternative for Wonderland Creek between 26th Street and Foothills Parkway. This recommendation is essentially the same as the 100-year Containment alternative with the exception that no improvements are recommended along Wonderland Creek from 30th Street/Diagonal Highway to just upstream of Iris. Only one commercial property is located along this segment of the stream and therefore no improvements are recommended for this segment of Wonderland Creek because of the high cost to provide 100-year containment ($3.3 million) or high hazard containment ($1.5 million) for this one commercial structure.

A modified 100-year Containment alternative is recommended for the following reasons. Although at a higher public cost than the High Hazard Containment alternative, the modified 100-year Containment alternative would narrow the floodplain as required to remove all but one of the 111 structures currently located in the 100-year floodplain. Narrowing the 100-year floodplain will result in estimated annual savings of approximately $150,000 on flood insurance premiums and avoid the potential of over $2 million in average annual flood damages ($64 million present worth cost at 3% interest and 50 years.) In addition, the 100-year Containment alternative does not rely on voluntary actions from the public to implement floodproofing of individual structures. The cost of voluntary floodproofing of individual structures is significant ($25-$50K per property) and will not eliminate mortgage required flood insurance. As a result, staff believes that most homeowners will not choose to implement floodproofing measures.

The following presents a comparison between the three alternatives. The agenda item materials provided at the August 17, 2009 WRAB meeting presents a more detailed documentation of the staff evaluation including supporting figures and detailed cost breakdowns.

	100-Year Containment	**HHZ Containment and Floodproofing**	**Modified 100-Year Containment (Staff Recommendation)**
Cost	$19.5 million public $0 private	$9.5 million public $6.8 million private	$16 million public $0 private[1]
Damage Reduction (present worth)	$66 million	$3.8 million (HHZ only) $54 million (voluntary floodproofing)	$64 million[2]
Structures	Removes all structures (111) from 100-year flood hazard	Removes all structures (24) from HHZ Zone, 61 structures remain in 100-year floodplain	Removes 110 structures from 100-year floodplain (one remains), removes all structures (24) from HHZ zone
Maintenance Costs	$1 million	$1.7 million	$1.1 million[2]
Insurance Premiums	$154,000 annual savings	$69,000 annual savings	$150,000 annual savings[2]
Benefit / Cost Ratio	3.4	0.4 (HHZ only) 3.6 (HHZ and voluntary floodproofing)	4.0

See main document for final costs

[1] One commercial property would require floodproofing [2] Estimated based on ratio values

The following presents a summary of recommended alternatives for all reaches along both Fourmile Canyon Creek and Wonderland Creek. The Phase A report and the January 28, 2009 WRAB agenda memorandum that summarizes the Phase A recommendations previously modified by staff can be found at: (www.bouldercolorado.gov, Departments, Utilities, Projects and Programs, Fourmile and Wonderland Flood Project). Please contact Kurt Bauer (303-441-4232) if you would like to view a hard copy of the Phase A Report.

Attachment 1 presents a graphical summary of the recommended alternatives.

Stream Reach	Recommendation	Estimated Public Cost ($million)[1]
Wonderland Creek		
▪ Wonderland Lake to 19th Street	Maintain existing conditions	$0
▪ 19th Street to 26th Street	High Hazard Containment[2]	$0.9
▪ 26th Street to Foothills Parkway	Modified 100-Year Containment[2]	$16
▪ Foothills Parkway to Goose Creek	Maintain existing conditions	$0
	Total for Wonderland:	$16.9
Fourmile Canyon Creek		
▪ City limits to Lee Hill Drive	Maintain existing conditions	$0
▪ Lee Hill Drive to 7th Street	High Hazard Containment	$.09
▪ 7th Street to Broadway	High Hazard Containment[2]	$2.4
▪ Broadway to 28th Street	High Hazard Containment[2]	$4.4
▪ 28th Street to Pleasant View Soccer Fields	No recommendation (in Boulder County)	$0
▪ Pleasant View Soccer Fields to BNSF Railroad	Maintain existing conditions	$0
▪ BNSF Railroad to Boulder Creek	No recommendation (in Boulder County)	$0
	Total for Fourmile Canyon:	$6.9
	Grand Total:	$23.8

[1] Does not include maintenance costs
[2] Recommendations modified by staff from Phase A Report

PUBLIC FUNDING FOR FLOOD MITIGATION BEYOND LIFE AND SAFETY:

The staff recommendation for flood mitigation along Wonderland Creek between 26th and Foothills Parkway would provide 100-year containment for the majority of this reach. The following bullet items present some reasons for this recommendation to spend public funds on flood mitigation that goes beyond protection of life and safety.

1. A Boulder Valley Comprehensive Plan policy states the city will protect the public and property from the devastating impacts of flooding in a timely and cost-effective manner. Staff recommendations along Wonderland Creek have a high benefit-cost ratio and would protect a substantial number of residential units.

2. The recommendation is supported by the basic policy of the Urban Drainage and Flood Control District that the major drainage system should be capable of conveying water without flooding buildings during the 100-year flood.

3. A mitigation strategy goal in the city's Multi-Hazard Mitigation Plan is to reduce vulnerability of people, property and the environment to natural hazards with particular emphasis on new and existing buildings and infrastructure.

4. Removing areas from flood hazard reduces the amount of resources required to provide emergency preparedness and emergency response activities.

5. Repair of flood damaged public infrastructure serving private properties located within flood hazard areas can be costly.

6. A significant flood event could have a major impact on government provided social services like housing and counseling.

7. The city could miss federal grant opportunities if lower benefit-cost ratio alternatives are selected (**Attachment 2** presents FEMA Hazard Mitigation Grant Program Guidance).

8. Private property damage affects the community as a whole by potentially lowering property values, sales taxes, and property taxes and impacting home purchasing or business location decisions.

9. The spill from Fourmile Canyon Creek was not recognized until the late 1990s. The resulting increase in downstream flood hazard has increased flood insurance rates for many structures located along Wonderland Creek.

STAFF RECOMMENDATION:

Staff recommends that the Phase A plan be approved with the following conditions:

1. As modified by staff and presented at the January 2008 WRAB meeting,
2. As modified to include the seven (7) recommendations and guiding principles approved by WRAB at the January WRAB meeting, as described above, and
3. As modified to include the additional modifications to the 100-year Containment alternative for Wonderland Creek between 26th Street and Foothills Parkway, as described above.

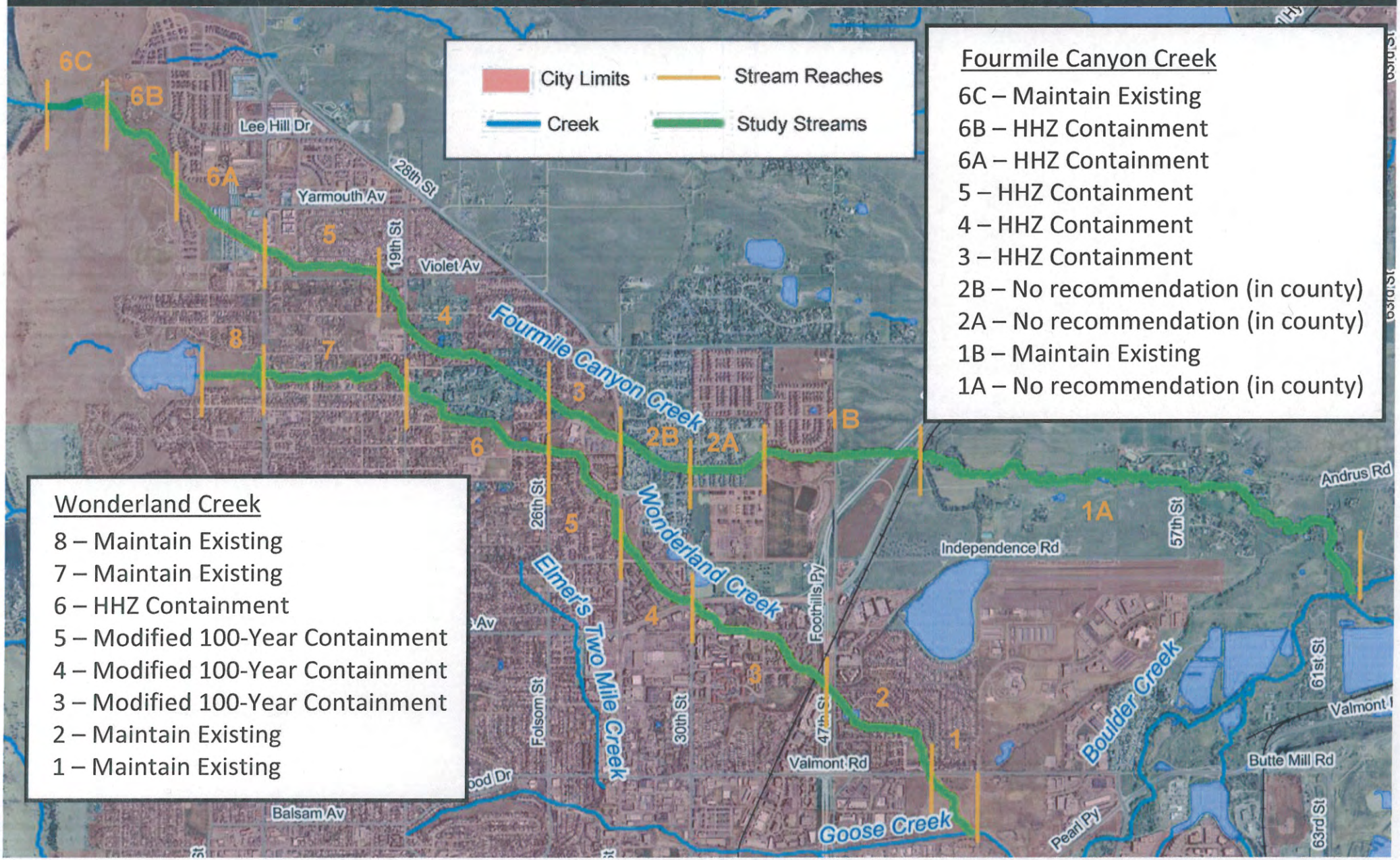
NEXT STEPS:

- Planning Board update memorandum - October 1, 2009
- Public hearing with the City Council - November 10, 2009

ATTACHMENTS:

Attachment 1: Summary of Staff Recommendations
Attachment 2: FEMA Hazard Mitigation Grant Program Guidance

Attachment 1: Summary of Staff Recommendations



DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
FEMA REGION VIII

June 12, 2009

2010 Mitigation Grant Program Guidance
FEMA Encourages Applications for Mitigation Grant Programs

The application period began June 1, 2009, and will remain open until Dec. 4, 2009, for fiscal 2010 grants.

- The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) announces the availability of the FY 2010 mitigation grant guidance and open application period for the Hazard Mitigation Assistance non-disaster programs. These programs allow local communities, state agencies, and federally-recognized tribal governments to apply for mitigation planning grants or project grants based on risks identified in FEMA approved local and state hazard mitigation plans.

- For the six states of FEMA Region VIII – Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming – the grants are managed through the Mitigation Division at the Denver-based regional offices.

  Directors of state emergency management offices and, in some states, directors of natural resources administer the agency's hazard mitigation assistance programs to local communities, state-level agencies and federally recognized tribal governments.

- The purpose of FEMA's hazard mitigation assistance grant programs is to reduce:
  - Loss of life and property,
  - Overall risks to people and structures, and
  - Reliance on funding from disaster declarations.

- Examples of eligible hazard mitigation projects include:
  - Risk analysis planning,
  - Voluntary acquisition or relocation of structures to remove them from the floodplain,
  - Elevation,
  - Construction of safe rooms for public and private structures,
  - Structural retrofitting and non-structural retrofitting,
  - Vegetation management, such as bank stabilization and measures to achieve wildfire mitigation,
  - Protective measures for utilities, water and sanitary sewer systems,
  - Stormwater management projects, and
  - Localized flood control projects.

- The grant programs are explained below and consist of one program that focuses on risk reduction from all hazard types and three that directly address reduction of flood risk:

    - **Pre-Disaster Mitigation** is a nationally competitive program that provides funds for hazard mitigation planning grants and for implementation of mitigation project grants.

    - **Flood Mitigation Assistance** provides grants for cost-effective measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured by the National Flood Insurance Program.

    - The **Repetitive Flood Claims** program provides funding to reduce or eliminate the long-term risk of flood damage to structures insured by the National Flood Insurance Program that have had one or more flood claim payments for flood damages. These funds may only be used for structures that cannot meet all of the requirements of the Flood Mitigation Assistance program.

    - The **Severe Repetitive Loss** program provides funding to reduce or eliminate the long-term risk of flood damage to residential structures insured by the National Flood Insurance Program that meet specific criteria in terms of multiple claims or claims that total an excessive cumulative amount. An insignificant number of severe repetitive loss structures are located in FEMA Region VIII.

    Additional information is available at the following web site:
    http://www.fema.gov/government/grant/hma/grant_resources.shtm#0

FEMA

What are the minimum project criteria?

There are five issues you must consider when determining the eligibility of a proposed project.

- Does your project conform to your State's Hazard Mitigation Plan?
- Does your project provide a beneficial impact on the disaster area, i.e. the State?
- Does your application meet the environmental requirements? FEMA Environmental Program Site
- Does your project solve a problem independently?
- Is your project cost-effective?

Hazard Mitigation Assistance Unified Guidance

Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, Flood Mitigation Assistance Program, Repetitive Flood Claims Program, Severe Repetitive Loss Program

June 1, 2009

Federal Emergency Management Agency
Department of Homeland Security
500 C Street, S.W.
Washington, DC 20472

H.4 Benefit-Cost Analysis Methodologies

FEMA will only consider applications from Applicants and subapplicants that use a FEMAapproved methodology to conduct the BCA. Using FEMA-approved software will ensure that all calculations are prepared in accordance with OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* and FEMA's standardized methodologies. FEMA provides software (BCA Version 4), written materials, and training that facilitate the process of preparing a BCA. BCA Version 4 is the only FEMA-provided software that may be used to conduct a BCA. BCA Version 4 is available from the appropriate FEMA Regional Office (see Part VII) or from the BCA Technical Assistance Helpline (see Part X C.4).

FEMA also allows for the use of the Alternative Determination of Cost Effectiveness for Eligible Insured Repetitive Loss Properties (Alternative BCA Approach). The Alternative BCA Approach allows for a simplified method of conducting the BCA for certain repetitive flood loss properties. This effort provides a framework that allows Applicants and subapplicants to use NFIP-provided data to determine either all or part of the benefits portion of the BCA to demonstrate cost effectiveness of proposed mitigation projects. The Alternative BCA Approach may be used for property acquisition and structure demolition or relocation projects or structure elevation projects in lieu of a traditional BCA for certain properties insured under the NFIP and included in the NFIP Repetitive Loss Database. The list of properties and the guidance for using the Alternative BCA Approach are available from the appropriate FEMA Regional Office (see Part VII) or the BCA Technical Assistance Helpline (see Part X C.4).

FEMA will only consider project subapplications that include a legible, complete, and well documented BCA. Subapplications must include the following information for the cost effectiveness review:

- The exported BCA runs, which must include backup documentation for the input data (for **HMGP** subapplications submitted in hard copy a full print out of the Project Report must be provided); and/or
- If the Alternative BCA Approach is used, a copy of the Pilot NFIP Repetitive Loss Properties List that shows the proposed properties highlighted.

Documentation must be accurate and sufficiently detailed in order for FEMA to thoroughly review the development of the BCR. Documentation that shows how values for each data input were derived must be provided so that the credibility and validity can be evaluated. If FEMA standard values are used, no documentation is required. Documentation can include copies of Web pages, copies of data from FISs, or engineering reports. FEMA recommends obtaining information from credible technical sources, including engineering studies such as an FIS, technical Web sites (e.g., USGS and NOAA), and academic organizations and State agencies.

Some mitigation activities may reduce future losses for more than one hazard. In these cases, all benefits resulting from the mitigation activity may be combined to determine the BCR.

FEMA software allows for calculating an aggregate BCR for projects that address multiple structures. An aggregate BCA is calculated by dividing the total net present value of benefits for each structure by the total project cost estimate. Aggregation of benefit and cost values is allowed if the structures are proximate, such as located within a neighborhood or subdivision.

With the exception of the aggregation of property acquisition and structure demolition or relocation and structure elevation within the same subapplication, benefits cannot be aggregated across mitigation activity types.

A non-FEMA BCA methodology may be used only when it addresses a non-correctable flaw in the FEMA-approved BCA methodologies or proposes a new approach that is unavailable using FEMA BCA software. Non-FEMA BCA methodologies may be utilized only if FEMA approves the methodology prior to submission of the application to FEMA. The Applicant/subapplicant must verify that FEMA has reviewed and approved the alternative BCA software or methodology by providing an e-mail or letter signed and dated by FEMA.
For more information on BCA resources, see Part X C.4.

MEMORANDUM

TO: Planning Board
FROM: Bob Harberg, Utilities Planning and Project Management Coordinator
Annie Noble, Greenways Coordinator
Kurt Bauer, Engineering Project Manager
DATE: October 15, 2009
RE: Information Item - Fourmile Canyon and Wonderland Creek Major Drainageway flood mitigation plan update

PURPOSE:

The purpose of this memorandum is to provide an update on the Fourmile Canyon and Wonderland Creek Flood Mitigation Planning process. This issue was considered by Planning Board in March 2008. Since that time, additional analysis has focused on Wonderland Creek between 26th and Foothills Parkway. The primary issue is whether containment of the entire 100-year flood flows, or only that portion creating high hazard conditions should be pursued in this area. Staff is not soliciting a new recommendation from Planning Board since the previous Planning Board recommendation (March 2008) is consistent with the new staff recommendation.

BACKGROUND:

A Major Drainageway Phase A plan, prepared by Love and Associates in June 2007, developed, evaluated, and recommended flood mitigation conceptual-level alternatives along both Wonderland and Fourmile Canyon Creeks. Staff presented plan recommendations to Planning Board in March 2008 and Planning Board passed a motion to recommend City Council accept the proposed flood mitigation plan. A Public Hearing with City Council was conducted on November 10, 2008. Council expressed concern about moving forward on such a complex and costly project and stated the need for taking more time in making this decision. A Council study session was held on April 28, 2009 to present information about the city's flood management and mitigation work program and guiding principles. In addition, staff has conducted a more detailed evaluation of flood mitigation alternatives for Wonderland Creek between 26th Street and Foothills Parkway and presented this information at a public meeting on August 5, 2009 and to the Water Resources Advisory Board on September 21, 2009.

Staff is finalizing the Fourmile Canyon Creek and Wonderland Creek Alternatives Analysis flood mitigation plan for acceptance by City Council and the Urban Drainage and Flood Control District. This evaluation provides a long-range plan that can be used to prioritize capital improvement projects in the context of the overall flood Capital Improvement Program (CIP), as well as provides information that allows staff, private property owners and the development community to plan and coordinate activities in recognition of the flood hazards and potential mitigation strategies.

The Phase A study area includes the Fourmile Canyon Creek floodplain from the mouth of the canyon to its confluence with Boulder Creek and the Wonderland Creek floodplain from downstream of Wonderland Lake to its confluence with Goose Creek (**Figure 1)**.

The study identified reaches of Fourmile Canyon Creek west of 19th Street where flow spills to Wonderland Creek during large events. It was determined to be unfeasible to eliminate the spills and as a result, all future mitigation measures along Wonderland will be sized to convey this increased flow caused by the spill from Fourmile Canyon Creek.

A broad range of alternatives were evaluated along specific reaches of both Fourmile Canyon Creek and Wonderland Creek. The alternatives included do nothing, construction of detention facilities, trans-basin diversions, acquisition of flood prone properties, high hazard zone containment and floodproofing of structures, channel modifications to provide 50-year conveyance capacity, and channel modifications to provide 100-year conveyance capacity. Providing flood water detention and constructing trans-basin diversions were eliminated from further consideration early on because of the cost and legal liabilities associated with these alternatives. For each of the remaining alternatives, estimates of probable construction cost, maintenance requirements, residual flood damage estimates, and a benefit/cost analysis was developed.

The report has gone through an extensive public involvement process including most recently:

- Greenways Advisory Committee (September 19, 2007),
- Public Open House (September 27, 2007),
- Water Resources Advisory Board (October 15, 2007, December 17, 2007, January 28, 2008, August 17, 2009 and September 21, 2009),
- Planning Board (February 21 and March 20, 2008),
- Public Hearing with City Council (November 10, 2008)
- City Council Special Study Session (April 28, 2009)
- Open House August 5, 2009

In January 2008 WRAB passed a motion with a 4-0 vote to recommend approval of the Phase A plan as modified by staff with the following recommendations and guiding principles:

1. Protect life safety by addressing structures in the high hazard zone through:
    a) Acquiring properties from willing sellers
    b) Constructing flood improvements at time of redevelopment of properties along Fourmile Canyon Creek west of Broadway and Wonderland Creek near 30th.
    c) Constructing high hazard zone containment and other improvements as funding is available, including coordinating with the county on expediting improvements located jointly in the city and county.
2. The intent of the overall approach is to minimize disruption to private property and riparian areas. This implies that flooding during 100-year events will not be contained in a channel minimizing impacts to downstream properties. Many properties including schools will experience shallow flooding under this approach.
3. During the next phase all potentially impacted properties and persons including students and parents should be notified of proposed approach and tradeoffs of minimizing property impacts versus the potential for flood damages.

4. Public education of flood risks should be emphasized including signage and flood markers and response plans for impacted schools.
5. Opportunities for facilitating and encouraging private flood proofing should be explored.
6. Continue to maintain high level of public involvement and feedback.
7. This non-structural approach requires active regulatory flood plain management in order to preserve flood conveyance areas.

In March 2008 Planning Board passed a motion on a 5-1 vote recommending City Council accept the proposed flood mitigation plan outlined in the March 20, 2008 staff memorandum including the following recommendations:

1. That City Council approve the staff's recommendation with prioritization, to the extent feasible from an engineering perspective, favoring city improvements over county improvements;
2. That public education on life and safety issues as to flooding, particularly as to critical facilities, be given a high priority;
3. And that discussion with the affected property owners in the Village Center take place with the feasibility of moving forward with flood mitigation.

On November 10, 2008 Council members discussed the Fourmile Canyon and Wonderland Creek Flood Mitigation Plan. Council expressed concern about moving forward on such a complex and costly project and stated the need for taking more time in making this decision. Prior to making its decision, Council requested the following:

- A field trip to the affected properties
- A study session that would focus on the policy level
- That the Water Resources Advisory Board and staff review the overall spending for water utilities and provide that information for Council

On April 28, 2009 staff presented information to City Council during a Study Session to address issues raised during the November 2008 public hearing. Council members generally expressed support for the approach to flood mitigation planning and that existing policies were appropriate, with the following comments relating to the Phase A report:

1. The current approach to flood mitigation should continue and is mostly in the right direction.
2. Consider doing the least amount of work necessary with the structural improvement approach to mitigate flood hazards.
3. Flood mitigation work proposed along Fourmile Canyon Creek east of 28th should be reconsidered and possibly scaled back.
4. Alternatives that leave drainageways in their natural state should be a priority.
5. Mitigation measures should be kept as "green" as possible, i.e. minimize use of asphalt and concrete.
6. The need to disturb natural areas for the benefit of a few homes was questioned.
7. Flood mitigation to reduce the 100-year floodplain was questioned if the mitigation was only to reduce property damage. Focus removal efforts on structures in the high hazard and conveyance zone.

8. City council members requested that proposed mitigation costs be presented to distinguish the cost of containing high hazard flood flows versus containing all 100-year flood flows.

Flood mitigation recommendations presented to WRAB, Planning Board and City Council during 2008 ranged from maintaining existing conditions to containing the 100 year flood. The only reaches located within city bounds where staff recommended containing the 100 year flood was along Wonderland Creek between 26th Street and Foothills Parkway. Based on City Council's direction at the April 29, 2009 Study Session, staff re-evaluated the flood mitigation recommendations for these reaches and presented an evaluation of high hazard containment, floodproofing and 100 year containment at an open house on August 5, 2009 to solicit public input. Invites were sent to all property owners and residents located within the Fourmile Canyon Creek and Wonderland Creek 500-year floodplain (approximately 1,800 invites). Seventeen attended from the public and nine written comments were received. Frequently heard comments included:

- Flood insurance has been a burden and this cost should be considered
- Questioned public's willingness to floodproof

RECENT WRAB RECOMMENDATION:

Based on the high benefit-cost ratio and the community support voiced at the August 5, 2009 Open House, staff made a recommendation to WRAB on September 21, 2009 to approve the staff flood mitigation recommendations including a Modified 100-year Containment alternative for Wonderland Creek between 26th and Foothills Parkway. WRAB passed a motion with a 4-1 vote to recommend to City Council to adopt the Phase A Report as modified by staff and subject to the condition that if a significant portion of grant funding is not awarded to construct various segments of the project, then WRAB recommends adopting only the High Hazard Containment and Floodproofing alternative for the segment of Wonderland Creek between 26th and Foothills Parkway.

ANALYSIS:

Based on feedback from the public involvement process, staff believes there is general concurrence on the flood mitigation approach for all stream areas with the exception of Wonderland Creek between 26th St. and Foothills Parkway (**Figure 1**). In this area there are questions regarding the following two approaches:

1. Containment of the entire 100-year flood flows at public expense, thus mitigating all potential property damage due to the 100-year storm event
2. Containment of the high hazard flood zone at public expense, coupled with voluntary private financing of floodproofing private property owner's structures.

The existing floodplain between 26th Street and Foothills Parkway is extensive, with 111 structures (417 dwelling units) located in the 100-year floodplain and 24 structures (181 dwelling units) located in the High Hazard Zone. Annual premiums are just over $154,000 to insure structures within this reach. Estimated potential flood damages averaged on an annual basis

exceed $2.6 million. **Figure 2** graphically presents existing conditions along this segment of Wonderland Creek.

Figure 3 graphically summarizes the HHZ Containment and Floodproofing alternative for this stream segment. This alternative includes:

- Construction of an overflow underpass and associated channel at 28th Street
- Channel modifications to reduce the high hazard zone from Kalmia Street to the Diagonal and upstream from Foothills Parkway
- Four new culvert crossings
- Separation of Wonderland Creek from the Boulder and Whiterock Ditch

The HHZ Containment and Floodproofing alternative for this stream segment would reduce the width of the high hazard zone as required to remove all 24 structures currently in the high hazard zone at an estimated public cost of just over $9.5 million and a private cost of $6.8 million. The private costs reflect the cost of property owners to voluntarily floodproof their structures.

Figure 4 graphically summarizes the 100-year Containment alternative for this stream segment. The alternative includes:

- Channel modifications along the entire reach to provide adequate conveyance for the 100-year flows
- Eight culvert upgrades or replacements
- Construction of a bridge underpass and overflow channel
- Separation of Wonderland Creek from the Boulder and Whiterock Ditch

The 100-year Containment alternative for this stream segment would contain the floodplain as required to remove all 111 structures currently located in the 100-year floodplain at an estimated public cost of just over $19.5 million.

Staff conducted a more detailed evaluation of the alternatives to identify the cost of proposed flood mitigation measures in relationship to the specific benefits of structures and dwelling units removed. Based on this analysis, staff revised its recommendation from 100-year Containment and now recommends a Modified 100-year Containment alternative as described in the next section.

Table 1 presents a comparison between the three alternatives for this section of Wonderland Creek:

Table 1: Wonderland Creek between 26th Street and Foothills Parkway

	100-Year Containment	HHZ Containment and Floodproofing	Modified 100-Year Containment (Staff Recommendation)
Cost	$19.5 million public $0 private	$9.5 million public $6.8 million private	$16 million public $0 private[1]
Damage Reduction (present worth)	$66 million	$3.8 million (HHZ only) $54 million (voluntary floodproofing)	$64 million
Structures	Removes all structures (111) from 100-year flood hazard	Removes all structures (24) from HHZ Zone, 61 structures remain in 100-year floodplain	Removes 110 structures from 100-year floodplain (one remains), removes all structures (24) from HHZ zone
Maintenance Costs	$1 million	$1.7 million	$1.1 million[2]
Insurance Premiums	$154,000 annual savings	$69,000 annual savings	$150,000 annual savings[2]
Benefit / Cost Ratio	3.4	0.4 (HHZ only) 3.6 (HHZ and voluntary floodproofing)	4.0

[1] One commercial property would require floodproofing [2] Estimated based on ratio values

Table 2 presents a summary of recommended alternatives for all reaches along both Fourmile Canyon Creek and Wonderland Creek. **Attachment 1** presents a graphical summary of the recommended alternatives. Changes to recommendations as presented to Planning Board in 2008 are indicated by italicized font.

Table 2: Summary of All Recommended Alternatives

Stream Reach	Recommendation	Estimated Public Cost ($million)[1]
Wonderland Creek		
▪ Wonderland Lake to 19th Street	Maintain existing conditions	$0
▪ 19th Street to 26th Street	High Hazard Containment[2]	$0.9
▪ *26th Street to Foothills Parkway*	*Modified 100-Year Containment[2]*	*$16*
▪ Foothills Parkway to Goose Creek	Maintain existing conditions	$0
	Total for Wonderland:	$16.9
Fourmile Canyon Creek		
▪ City limits to Lee Hill Drive	Maintain existing conditions	$0
▪ Lee Hill Drive to 7th Street	High Hazard Containment	$.1
▪ 7th Street to Broadway	High Hazard Containment[2]	$2.4
▪ Broadway to 28th Street	High Hazard Containment[2]	$4.4
▪ 28th Street to Pleasant View Soccer Fields	No recommendation (in Boulder County)	$0
▪ Pleasant View Soccer Fields to BNSF Railroad	Maintain existing conditions	$0
▪ BNSF Railroad to Boulder Creek	No recommendation (in Boulder County)	$0
	Total for Fourmile Canyon:	$6.9
	Grand Total:	$23.8

[1] Does not include maintenance costs

[2] Recommendations modified by staff from Phase A Report

STAFF RECOMMENDATION FOR CITY COUNCIL:

The Fourmile Canyon and Wonderland Creek Major Drainageway flood mitigation plan is intended to serve as a guide for long-range planning. This plan will be used to:

- Prioritize capital improvement projects in the context of the overall flood Capital Improvement Program (CIP),
- Provide information that allows staff, private property owners and the development community to plan and coordinate activities in recognition of the flood hazards and potential mitigation strategies,
- Support the city's efforts to secure grant money, and
- Secure private funds from developers during redevelopment projects

Funding for planning, design and construction of the proposed mitigation measures would be based on this long-range plan but would be evaluated and refined through the city's CEAP and CIP process. As a result, staff recommends the plan provide enough flexibility to further evaluate all ranges of alternatives without precluding the ability to secure grant funding. Staff therefore will be recommending the following motion to Council:

Staff recommends that the Fourmile Canyon Creek and Wonderland Creek Phase A Plan as modified by staff be approved as a long-term master plan with the understanding that funding for flood mitigation improvements for each stream reach will be evaluated as part of the City's CEAP and CIP process. Staff modifications to the Phase A study include:

- Wonderland Creek 26th Street to Foothills Parkway – Modified 100-year Containment
- Wonderland Creek 19th Street to 26th Street – High Hazard Containment
- Fourmile Canyon Creek 7th Street to 28th Street – High Hazard Containment
- Fourmile Canyon Creek 28th Street to Pleasant View Soccer Fields – No recommendation (in Boulder County)
- Fourmile Canyon Creek BNSF Railroad to Boulder Creek - No recommendation (in Boulder County)

STAFF RATIONALE FOR RECOMMENDATION:

Staff recommends that the Fourmile Canyon and Wonderland Creek Phase A Plan as modified by staff be approved including a Modified 100-year Containment alternative for Wonderland Creek between 26th Street and Foothills Parkway.

The Modified 100-year Containment alternative for Wonderland Creek between 26th Street and Foothills Parkway is essentially the same as the 100-year Containment alternative with the exception that no improvements are recommended along Wonderland Creek from 30th Street/Diagonal Highway to just upstream of Iris. Only one commercial property is located along this segment of the stream and therefore no improvements are recommended for this segment of Wonderland Creek because of the high cost to provide 100-year containment ($3.3 million) or high hazard containment ($1.5 million) for this one commercial structure.

A modified 100-year Containment alternative is recommended for the following reasons. Although at a higher public cost than the High Hazard Containment alternative, the modified

100-year Containment alternative would contain the floodplain as required to remove all but one of the 111 structures currently located in the 100-year floodplain. Containing the 100-year floodplain will result in estimated annual savings of approximately $150,000 on flood insurance premiums and avoid the potential of over $2 million in average annual flood damages ($64 million present worth cost at 3% interest and 50 years.)

In addition, the 100-year Containment alternative does not rely on voluntary actions from the public to implement floodproofing of individual structures. The cost of voluntary floodproofing of individual structures is significant ($25-$50K per property) and will not eliminate mortgage required flood insurance. As a result, staff believes that most homeowners will not choose to implement floodproofing measures.

Another consideration is that the Federal Emergency Management Agency (FEMA) awards hazard mitigation grants up to $3 million per project. In order to be eligible for the FEMA grant, proposed mitigation projects must have a benefit cost ratio greater than 1.0. Selection of the High Hazard Containment Alternative would not qualify for this grant program.

The staff recommendation for flood mitigation along Wonderland Creek between 26th and Foothills Parkway would provide 100-year containment for the majority of this reach. The following bullet items present some additional reasons for this recommendation to spend public funds on flood mitigation that goes beyond protection of life and safety.

- A Boulder Valley Comprehensive Plan policy states the city will protect the public and property from the devastating impacts of flooding in a timely and cost-effective manner. Staff recommendations along Wonderland Creek have a high benefit-cost ratio and would protect a substantial number of residential units.

- The recommendation is supported by the basic policy of the Urban Drainage and Flood Control District that the major drainage system should be capable of conveying water without flooding buildings during the 100-year flood.

- A mitigation strategy goal in the city's Multi-Hazard Mitigation Plan is to reduce vulnerability of people, property and the environment to natural hazards with particular emphasis on new and existing buildings and infrastructure.

- Removing areas from flood hazard reduces the amount of resources required to provide emergency preparedness and emergency response activities.

- Repair of flood damaged public infrastructure serving private properties located within flood hazard areas can be costly.

- A significant flood event could have a major impact on government provided social services like housing and counseling.

- The city could miss federal grant opportunities if lower benefit-cost ratio alternatives are selected.

- Private property damage affects the community as a whole by potentially lowering property values, sales taxes, and property taxes and impacting home purchasing or business location decisions.

- The spill from Fourmile Canyon Creek was not recognized until recently. The resulting increase in downstream flood hazard has increased flood insurance rates for many structures located along Wonderland Creek.

The WRAB recommendation is generally consistent with the staff recommendation except for the issue of funding. The WRAB recommendation would require that significant grant funding (most likely from the Federal government) be made available prior to implementing 100-year containment. Without the significant grant funding WRAB recommends that the city fund only that portion of the project costs needed to secure high hazard containment for the segment of Wonderland Creek between 26th and Foothills Parkway. Staff plans to pursue grant funding for the 100-year containment option consistent with FEMA requirements. However, staff believes that the WRAB recommendation constrains the city's ability to secure flood mitigation improvements through mechanisms such as conditions on future development and the city's ability to fund projects based on project specific analysis presented as part of the city's CIP budget process and CEAP review. For example, land required for containment of the 100-year flood could be secured through easements as a condition of development only if this is indicated through a city master plan. The Planning Board recommendation of March 2008 is consistent with the staff recommendations.

NEXT STEPS:

- Tentative City Council Agenda Item for November 10, 2009

ATTACHMENTS:

Figure 1: Study Streams and Location of Evaluated Reaches
Figure 2: Existing Conditions
Figure 3: High Hazard Containment and Floodproofing Alternative
Figure 4: 100-year Containment Alternative
Figure 5: Modified 100-year Containment Alternative (Staff Recommendation)

Figure 1: Study Stream and Evaluated Reaches

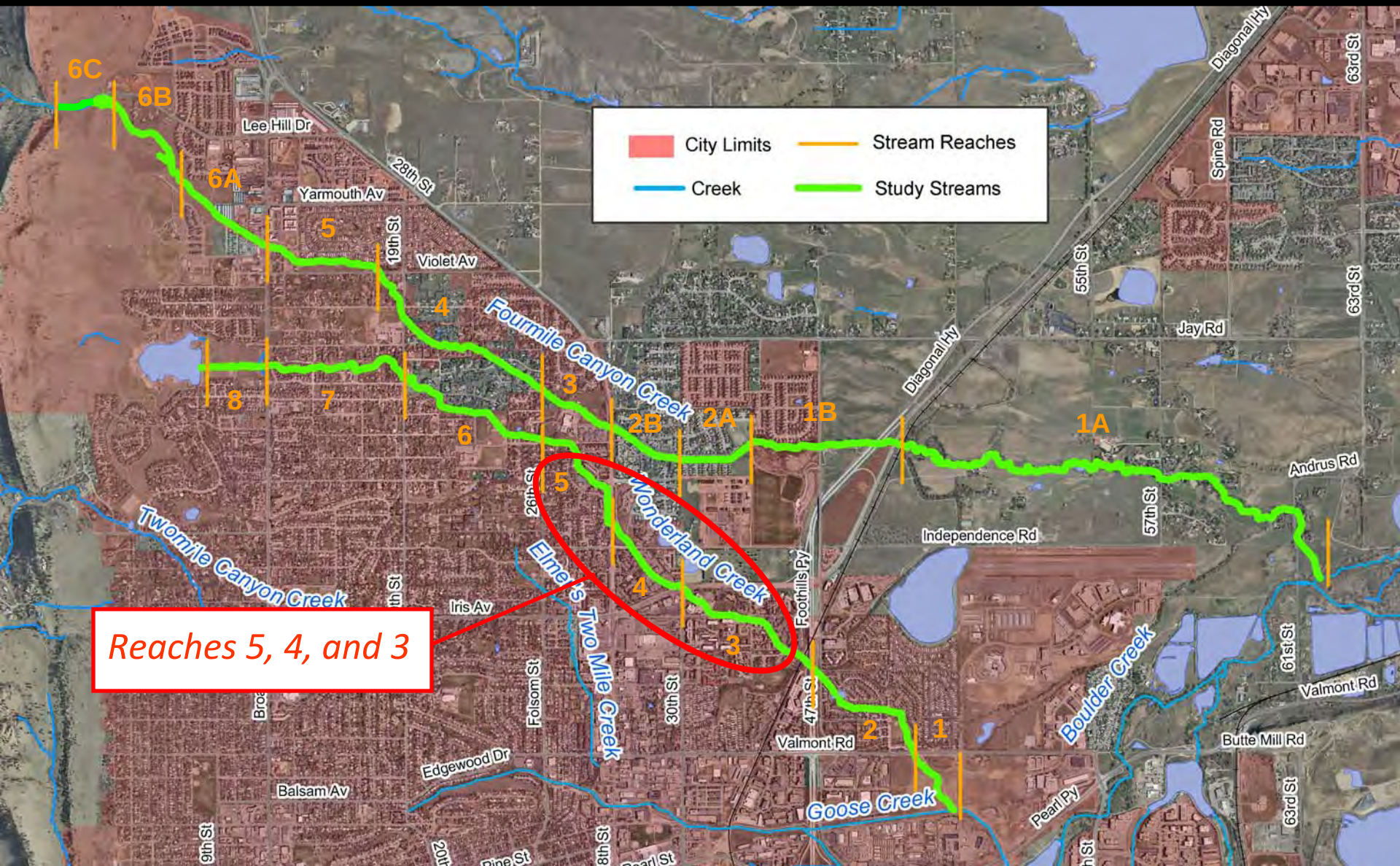
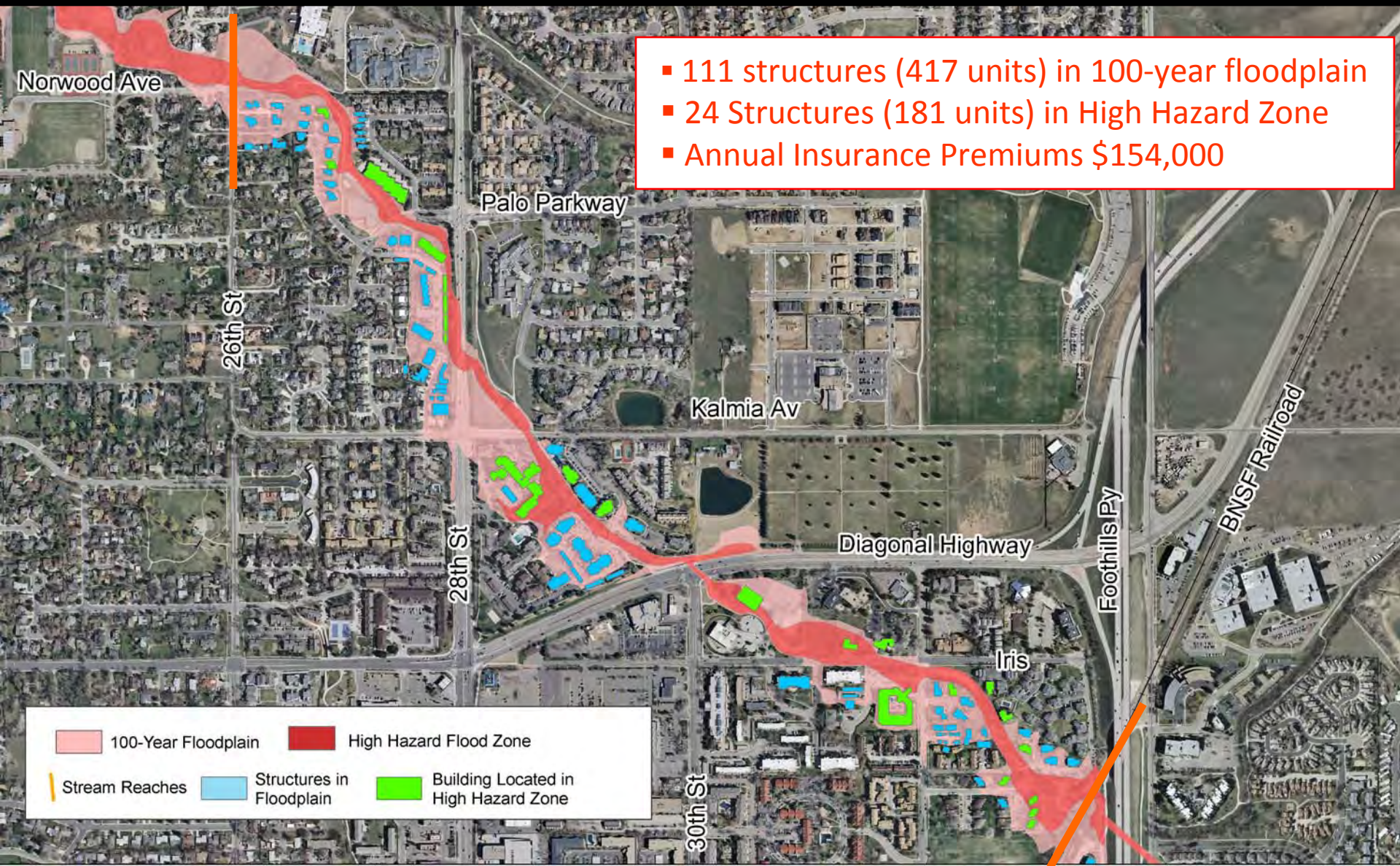


Figure 2: Existing Conditions



- 111 structures (417 units) in 100-year floodplain
- 24 Structures (181 units) in High Hazard Zone
- Annual Insurance Premiums $154,000

Figure 3: HHZ Containment and Floodproofing Alternative

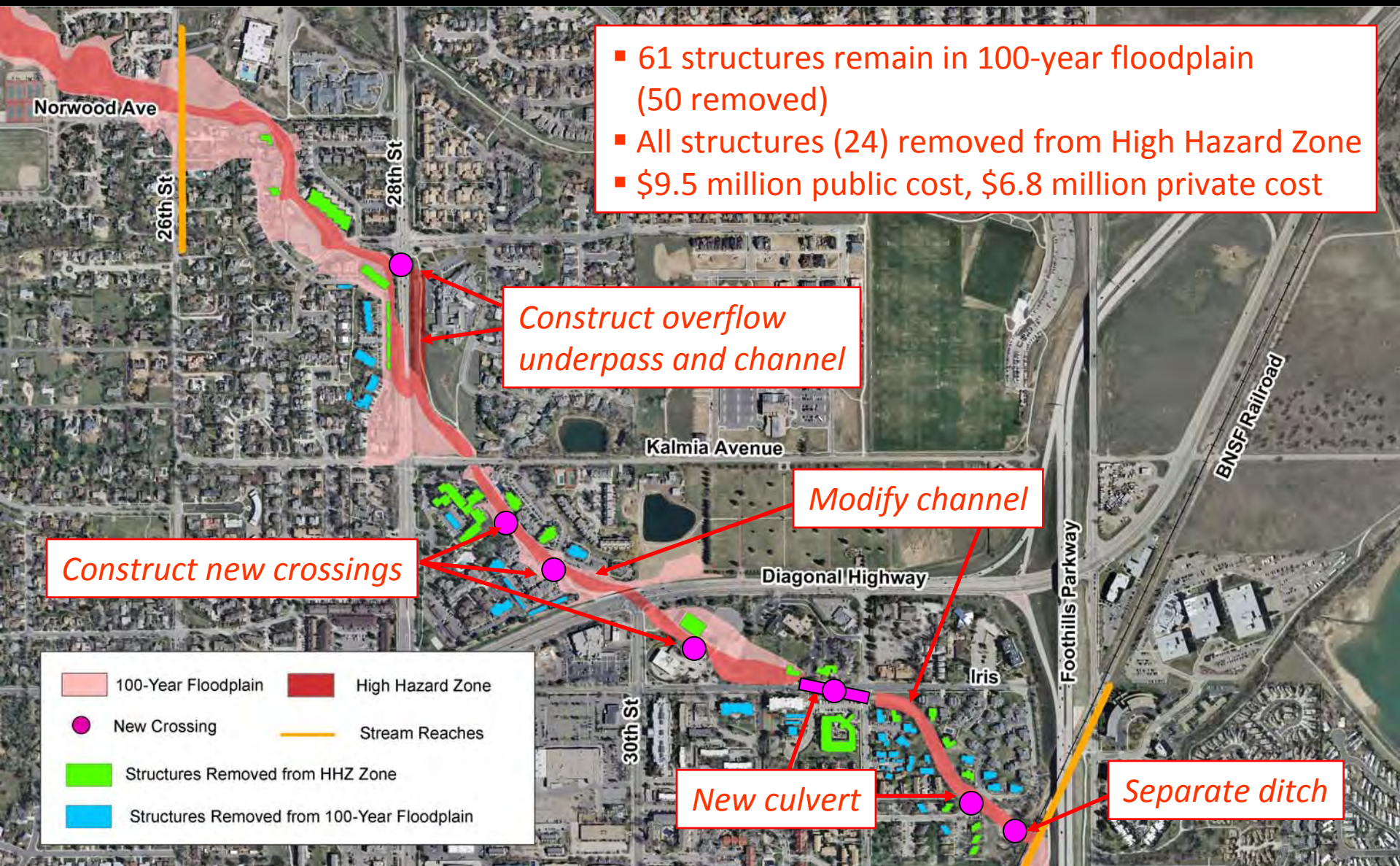
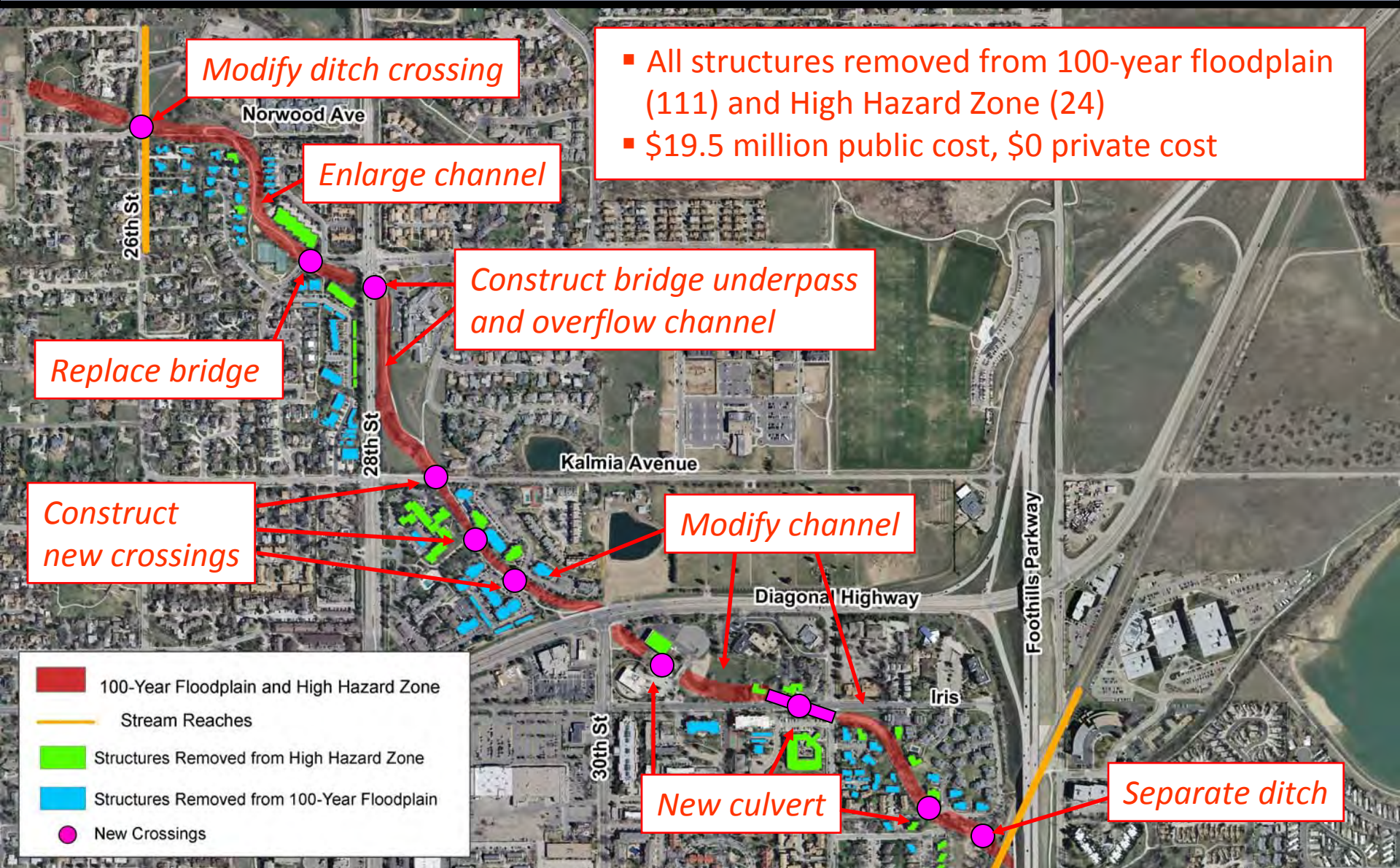
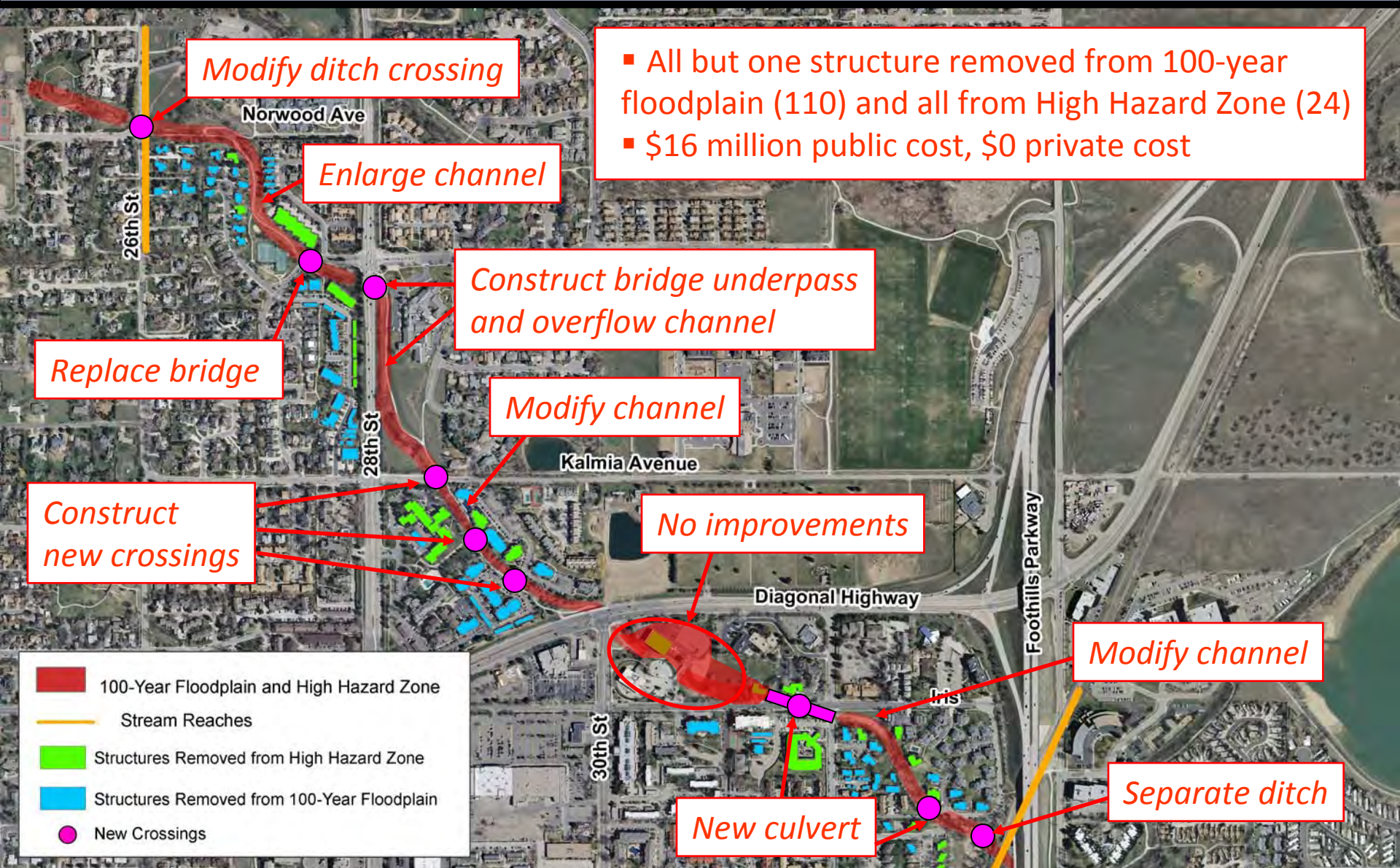


Figure 4: 100-Year Containment Alternative



- All structures removed from 100-year floodplain (111) and High Hazard Zone (24)
- $19.5 million public cost, $0 private cost

Figure 5: Modified 100-Year Containment Alternative



- All but one structure removed from 100-year floodplain (110) and all from High Hazard Zone (24)
- $16 million public cost, $0 private cost

C I T Y O F B O U L D E R
CITY COUNCIL AGENDA ITEM

MEETING DATE: November 10, 2009

AGENDA TITLE:
Consideration of a motion accepting the Fourmile Canyon Creek and Wonderland Creek Major Drainageway Planning Phase A Report as modified by the staff recommendations

PRESENTER/S:
Jane S. Brautigam, City Manager
Paul J. Fetherston, Deputy City Manager
Maureen Rait, Executive Director of Public Works
Ned Williams, Director of Public Works for Utilities
Bob Harberg, Utilities Planning and Project Management Coordinator
Annie Noble, Greenways Coordinator
Kurt Bauer, Engineering Project Manager

EXECUTIVE SUMMARY:

The purpose of this agenda item is to present final staff recommendations on the Fourmile Canyon Creek and Wonderland Creek flood mitigation planning effort and request a motion for acceptance of the Fourmile Canyon Creek and Wonderland Creek Major Drainageway Planning Phase A Report as modified by the staff recommendations.

The Major Drainageway Phase A Report, prepared by Love and Associates in June 2007, developed, evaluated, and recommended flood mitigation conceptual-level alternatives along both Wonderland and Fourmile Canyon creeks. The work was jointly sponsored by the Urban Drainage and Flood Control District and the city. This evaluation provides a long-range plan that can be used to prioritize capital improvement projects in the context of the overall flood Capital Improvement Program (CIP), as well as provide information that allows staff, private property owners and the development community to plan and coordinate activities in recognition of the flood hazards and potential mitigation strategies.

At the April 28, 2009 city council study session, council expressed general support for the plan but requested that the mitigation cost of containing the high hazard flows versus containing the 100-year event flows be re-evaluated and presented such that final recommendations for each stream reach could be considered.

The report recommendations have been reviewed through an extensive public involvement process. Based on feedback from the public process and the Water Resources Advisory Board, staff believes there is now general concurrence on the flood mitigation approach for all stream reaches. No stream reaches are recommended for a 100-year flood containment project unless substantial outside funding is provided (probably by federal grants). See **Table 2** for a summary of the staff recommendations.

STAFF RECOMMENDATION:

The Fourmile Canyon and Wonderland Creek Major Drainageway Flood Mitigation Plan is intended to serve as a guide for long-range planning. This plan will be used to:

- Prioritize capital improvement projects in the context of the overall flood Capital Improvement Program (CIP),
- Provide information that allows staff, private property owners and the development community to plan and coordinate activities in recognition of the flood hazards and potential mitigation strategies,
- Support the city's efforts to secure grant money, and
- Secure private funds from developers during redevelopment projects.

Funding for planning, design and construction of the proposed mitigation measures would be based on this long-range plan, but would be evaluated and refined through the city's Community and Environmental Assessment Process (CEAP) and CIP processes. As a result, staff recommends the plan provide enough flexibility to further evaluate all ranges of alternatives without precluding the ability to secure outside funding.

Staff requests council consideration of this matter and action in the form of the following motion:

Motion to accept the Fourmile Canyon Creek and Wonderland Creek Phase A Plan as modified by staff as a long-term plan with the understanding that funding for flood mitigation improvements for each stream reach will be evaluated as part of the city's CEAP and CIP processes. Staff modifications to the Phase A study include:

1. Wonderland Creek from 26th Street to Foothills Parkway – High Hazard Containment unless substantial outside funding can be secured for 100-year Containment
2. Wonderland Creek from 19th Street to 26th Street – High Hazard Containment with safe access to Crestview Elementary School via 19th Street
3. Fourmile Canyon Creek from 7th Street to 28th Street – High Hazard Containment with safe access to Crestview Elementary School via 19th Street and Upland Avenue
4. Fourmile Canyon Creek from 28th Street to Pleasant View Soccer Fields – No recommendation (stream reach located in Boulder County)
5. Fourmile Canyon Creek from BNSF Railroad to Boulder Creek - No recommendation (stream reach located in Boulder County)

COMMUNITY SUSTAINABILITY ASSESSMENTS AND IMPACTS:

- Economic: Removing areas from flood hazards reduces the amount of resources required to provide emergency preparedness and emergency response activities. Repair of flood damaged public infrastructure serving private properties located within flood hazard areas can be costly. In addition, a significant flood event could have a major impact on government provided social services like housing and counseling.
- Environmental: Flood mitigation measures provide the opportunity to reduce the potential for erosion along existing channels and incorporate water quality and habitat enhancement features into the mitigation design.
- Social: Flood mitigation measures along Fourmile Canyon Creek and Wonderland Creek would reduce flood hazards for all residents regardless of their social demographics. Flood mitigation would reduce the flood related hazards for vulnerable populations.

OTHER IMPACTS:

- Fiscal: The recommended improvements for both Fourmile Canyon Creek and Wonderland Creek total approximately $17.5 million in public expenditures. Mitigation measures would be prioritized with other city flood mitigation requirements and implemented in phases when funding becomes available. Staff will also seek outside funding for flood mitigation efforts.
- Staff time: The staff time to implement recommended flood mitigation measures is included in normal work plans.

BOARD AND COMMISSION FEEDBACK:

This study has gone through extensive public process. **Attachment 1** presents a chronology of the process along with motions from the most recent meetings. Staff presented staff analysis to WRAB on Aug. 17 and Sept. 21, 2009. During the September meeting, staff recommended WRAB approve the Fourmile Canyon Creek and Wonderland Creek Phase A Report with staff modifications, including a modified 100-year containment alternative for Wonderland Creek between 26th Street and Foothills Parkway. WRAB passed a motion recommending City Council adopt the Phase A Report as modified by staff and subject to the condition that if a significant portion of grant funding is not awarded to construct various segments of the project, then WRAB recommends adopting only the High Hazard Containment and Floodproofing alternative for the segment of Wonderland Creek between 26th and Foothills Parkway. Motion passed by vote of 4:1 (S. Iott opposed, favors the high hazard containment option only.)

PUBLIC FEEDBACK:

This study has gone through extensive public process. **Attachment 1** presents a chronology of the public process. An open house was held on Aug. 5, 2009 to solicit public input on flood mitigation measures for Wonderland Creek between Foothills Parkway and 26th Street. Seventeen people attended the open house and nine written comments were received. Frequently heard comments included:

- Flood insurance has been a burden and this cost should be considered
- The public's willingness to floodproof their residences is questionable

BACKGROUND:

The Major Drainageway Phase A Plan, prepared by Love and Associates in June 2007, developed, evaluated, and recommended flood mitigation conceptual-level alternatives along both Wonderland and Fourmile Canyon creeks. A broad range of alternatives were evaluated for each of the 18 reaches of Fourmile Canyon Creek and Wonderland Creek. Estimates of probable construction cost, maintenance requirements, residual flood damage estimates, and a benefit/cost analysis was developed for each alternative.

This evaluation provides a long-range plan that can be used to prioritize capital improvement projects in the context of the overall flood Capital Improvement Program (CIP) and provides information that allows staff, private property owners and the development community to plan and coordinate activities in recognition of the flood hazards and potential mitigation strategies.

The public process has resulted in revisions to the Phase A recommendations for seven of the 18 stream reaches along both Fourmile Canyon Creek and Wonderland Creek. In addition, staff is no longer making flood mitigation recommendations for stream reaches located entirely outside city limits. **Table 1** presents a summary of these modifications.

One of the reasons for changes in mitigation recommendations is concern over safe access to Crestview Elementary School. Crestview Elementary School is located between Fourmile Canyon Creek and Wonderland Creek. Under existing conditions, a major storm event would result in flooding of roadways to depths that would likely be unsafe for vehicular access to the school. Staff has coordinated with the Boulder Valley School District to help develop a flood emergency plan (shelter in place and evacuation depending on conditions) for Crestview Elementary School. Staff is also recommending the flood mitigation plan include crossing and channel upgrades that would result in safe access to the school along 19th Street at both Wonderland and Fourmile Canyon Creeks as well as at Upland Ave. at Fourmile Canyon Creek.

Table 1: Summary of Changes to Phase A Study

Stream Reach	Reach ID	Phase A Recommendation	Revised Recommendation
Wonderland Creek			
▪ Wonderland Lake to Broadway	8	Maintain Existing	No revisions
▪ Broadway to 19th Street	7	Maintain Existing	Safe Access to Crestview Elementary School via 19th Street [2]
▪ 19th Street to 26th Street	6	HHZ Containment / Floodproofing	HHZ Containment / Floodproofing[1]
▪ 26th Street to 28th Street	5	100-year Containment	HHZ Containment / Floodproofing unless substantial outside funding is provided for 100-year Containment
▪ 28th Street to Diagonal Hwy	4	100-year Containment	
▪ Diagonal Hwy to Foothills Parkway	3	HHZ Containment / Floodproofing	
▪ Foothills Parkway to Valmont Road	2	Floodproofing	No revisions
▪ Valmont to Goose Creek	1	Maintain Existing	No revisions
Fourmile Canyon Creek			
▪ City limits to Lee Hill Drive	6c	Maintain Existing	No revisions
▪ Lee Hill Drive to 7th Street	6b	HHZ Containment / Floodproofing	No revisions
▪ 7th Street to Broadway	6a	Floodproofing	HHZ Containment / Floodproofing
▪ Broadway to Violet Avenue	5	HHZ Containment / Floodproofing	No revisions
▪ Violet Avenue to 26th Street	4	100-year Containment	HHZ Containment with Safe Access to Crestview Elementary School via 19th Street and Upland Avenue [2]
▪ 26th Street to 28th Street	3	HHZ Containment / Floodproofing	No revisions
▪ 28th Street to 30th Street	2b	100-year Containment	No recommendation (reach in Boulder County)
▪ 30th Street to Pleasant View Soccer Fields	2a	Maintain Existing	No recommendation (reach in Boulder County)
▪ Pleasant View Soccer Fields to BNSF Railroad	1b	Maintain Existing	No revisions
▪ BNSF Railroad to Boulder Creek	1a	HHZ Containment / Floodproofing	No recommendation (reach in Boulder County)

[1] Revised method for high hazard zone (HHZ) containment that reduces the estimated cost by approximately $600,000 from Phase A HHZ containment alternative

[2] Channel modifications at 19th Street required to provide safe access to Crestview Elementary School

ANALYSIS:

Flood mitigation recommendations presented to WRAB, Planning Board and City Council during 2008 and 2009 ranged from maintaining existing conditions to containing the 100-year flood. Based on feedback from the public process, staff believes there is general concurrence on mitigation of high hazard flood risk. The only reaches located within the city where staff considered flood improvements greater than mitigating for high hazard was along Wonderland Creek between 26th Street and Foothills Parkway. In this area the following two approaches were considered:

1. Containment of the entire 100-year flood flows at public expense, thus mitigating all potential property damage due to the 100-year storm event
2. Containment of the high hazard flood zone at public expense, coupled with voluntary private financing of floodproofing private property owner's structures.

The 2009 WRAB recommendation would require that significant outside funding (most likely from the Federal government) be made available prior to implementing 100-year containment. Without significant grant funding, WRAB recommends that the city fund only that portion of the project's costs needed to secure high hazard containment for the segment of Wonderland Creek between 26th Street and Foothills Parkway.

Staff concurs with this recommendation and will pursue outside funding. One major source of funding is the Federal Emergency Management Agency (FEMA) Hazard Mitigation grant program. FEMA awards hazard mitigation grants up to $3 million per project. In order to be eligible for the FEMA grant, proposed mitigation projects must have a benefit-to-cost ratio greater than 1.0.

The following items present policy, planning goals and other rationale supporting the expenditure of public funds on flood mitigation that goes beyond protection of life and safety.

1. A Boulder Valley Comprehensive Plan policy states the city will protect the public and property from the devastating impacts of flooding in a timely and cost-effective manner. The Phase A report indicates high benefit-to-cost (B/C) ratios for the 100-year containment alternative for certain reaches along Wonderland Creek. However, the B/C ratios will need to be confirmed through the federal grant application process.
2. The recommendation is supported by the basic policy of the Urban Drainage and Flood Control District that the major drainage system should be capable of conveying water without flooding buildings during the 100-year flood.
3. A mitigation strategy goal in the city's Multi-Hazard Mitigation Plan is to reduce vulnerability of people, property and the environment to natural hazards with particular emphasis on new and existing buildings and infrastructure.
4. Removing areas from flood hazard reduces the amount of resources required to provide emergency preparedness and emergency response activities.
5. Repair of flood damaged public infrastructure serving private properties located within flood hazard areas can be costly.

6. A significant flood event could have a major impact on government provided social services like housing and counseling.
7. Private property damage affects the community as a whole by potentially lowering property values, sales taxes and property taxes and impacting home purchasing or business location decisions.
8. The spill from Fourmile Canyon Creek was not recognized until the late 1990s. The resulting increase in downstream flood hazard has increased flood insurance rates for many structures located along Wonderland Creek.

Table 2 presents a summary of recommended alternatives for all reaches along both Fourmile Canyon Creek and Wonderland Creek, with this information shown on a map as **Attachment 2**. Changes to recommendations as presented to City Council in 2008 are indicated by italicized font.

Table 2: Summary of All Recommended Alternatives for Fourmile Canyon Creek and Wonderland Creek

Stream Reach	Recommendation	Estimated Public Cost ($ million)[1]
Wonderland Creek		
▪ Wonderland Lake to Broadway	Maintain existing conditions	$0
▪ *Broadway to 19th Street*	*Channel Modifications upstream of 19th Street*	$0.2
▪ 19th Street to 26th Street	High Hazard Containment[2]	$0.9
▪ *26th Street to Foothills Parkway*	*High Hazard Containment unless substantial outside funding is available for 100-Year Containment[2]*	*$9.5[3]*
▪ Foothills Parkway to Goose Creek	Maintain existing conditions	$0
	Total for Wonderland:	$10.6
Fourmile Canyon Creek		
▪ City limits to Lee Hill Drive	Maintain existing conditions	$0
▪ Lee Hill Drive to 7th Street	High Hazard Containment	$.1
▪ 7th Street to Broadway	High Hazard Containment[2]	$2.4
▪ Broadway to 28th Street	High Hazard Containment[2]	$4.4
▪ *28th Street to Pleasant View Soccer Fields*	*No recommendation (reach in Boulder County)*	$0
▪ Pleasant View Soccer Fields to BNSF Railroad	Maintain existing conditions	$0
▪ *BNSF Railroad to Boulder Creek*	*No recommendation (reach in Boulder County)*	$0
	Total for Fourmile Canyon:	$6.9
	Grand Total:	$17.5

[1] Does not include maintenance costs
[2] Recommendations modified by staff from Phase A Report
[3] Cost reflects HHZ Containment alternative (100-year Containment estimated to cost $16 million)

Approved By:

_____
Jane S. Brautigam,
City Manager

ATTACHMENTS:
Attachment 1: Public Process Chronology and Summary of City Advisory Board and Council Motions
Attachment 2: Map of Recommended Alternatives

ATTACHMENT 1
Public Process Chronology
and
Summary of City Advisory Board and Council Motions

Fourmile Canyon and Wonderland Creek Flood Mapping and Mitigation Planning Chronology

1981-1987 - Original Flood Mapping and Mitigation Studies by Greenhorne and O'Mara

1981 – Flood Mapping Study and Letter of Map Revision by Greenhorne & O'Mara
1984 – Urban Drainage and Flood Control District (UDFCD) Flood Mapping and Major Drainageway Planning - Phase A – Alternatives Analysis by Greenhorne and O'Mara
1987 - Urban Drainage and Flood Control District (UDFCD) Major Drainageway Planning - Phase B – Preliminary Design by Greenhorne and O'Mara

1987 - 1997 – City of Boulder and Boulder County Implement Flood Management Program Consistent with Greenhorne & O'Mara Mapping and Mitigation Studies

1997 – 1999 – Identification of Fourmile Canyon Creek Flood Mapping Problem and New Flood Mapping Study by Love & Associates

1997 - Problems with existing Fourmile Canyon Creek flood maps first identified as part of Foothills Housing site development proposal (west of Broadway and south of Fourmile Canyon Creek)
February 11, 1999 – City Council Information Item regarding Fourmile Canyon Creek flood mapping problems
May 18, 1999 – Draft Fourmile Canyon Creek flood mapping study by Love & Associates
June 1, 1999 – City Council Agenda Item and consideration of approaches to deal with the Fourmile Canyon Creek flood mapping problems
August 2, 1999 – Public Meeting regarding Fourmile Canyon Creek Flood Mapping Problem and New Flood Mapping Study by Love & Associates
September 13, 1999 – Public Meeting regarding Fourmile Canyon Creek Flood Mapping Problem and New Flood Mapping Study by Love & Associates

1999-2000 - Fourmile Canyon Creek Major Drainageway Planning - Phase A – Alternatives Analysis by Love & Associates

June 1999 – UDFCD and the city initiated the Fourmile Canyon Creek Major Drainageway Planning - Phase A – Alternatives Analysis
July 15, 1999 – City Council Information Item regarding the Phase A – Alternatives Analysis project
September 29, 1999 – City Council Information Item regarding the Phase A – Alternatives Analysis project by Love & Associates

January 18, 2000 – Independent Review Panel (IRP) meeting regarding the Phase A Alternatives Analysis project by Love & Associates
January 28, 2000 – Independent Review Panel (IRP) meeting regarding the Phase A Alternatives Analysis project by Love & Associates
March 8, 2000 – IRP meeting regarding the Phase A Alternatives Analysis project by Love & Associates
March 10, 2000 – Draft Fourmile Canyon Creek Major Drainageway Planning – Phase A Report by Love & Associates
March 15, 2000 – City Council Information Item regarding Fourmile Canyon and Wonderland Creeks Flood Mapping project
April 10, 2000 – Public Meeting regarding Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
April 24, 2000 – IRP meeting regarding the Phase A Alternatives Analysis project by Love & Associates
May 2, 2000 – IRP opinion and recommendations regarding the Phase A Alternatives Analysis project by Love & Associates
June 9, 2000 – Final Fourmile Canyon Creek Major Drainageway Planning – Phase A Report released by Love & Associates
July 10, 2000 - Transportation Advisory Board consideration of the Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
July 17, 2000 - Water Resources Advisory Board consideration of the Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
July 24, 2000 - Parks and Recreations Advisory Board consideration of the Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
July 26, 2000 - Open Space Board of Trustees consideration of the Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
August 27, 2000 – IRP meeting regarding the Phase A Alternatives Analysis project by Love & Associates
September 27, 2000 – Public Meeting regarding Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
September 28, 2000 - Planning Board consideration of the Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
October 17, 2000 – City Council consideration of the Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives
October 18, 2000 – Public Meeting regarding Fourmile Canyon Creek and related North Boulder flood hazard mitigation alternatives

2001-2002 - Fourmile Canyon Creek Major Drainageway Planning - Phase B– Preliminary Design by Love & Associates

March 7, 2001 – Draft Selected Plan for the Fourmile Canyon Creek Major Drainageway Planning Study released by the UDFCD and the city, Fourmile Canyon Creek Major Drainageway Planning - Phase B - Preliminary Design by Love & Associates initiated
May 3, 2001 - City Council Information Item regarding Fourmile Canyon Creek Flood Mitigation Planning

October 10, 2001 - City Council Information Item regarding Fourmile Canyon Creek Flood Mitigation Planning
November 2001 – Draft Fourmile Canyon Creek Major Drainageway Planning – Phase B Report released by Love & Associates
February 1, 2002 - City Council Information Item regarding Fourmile Canyon Creek Flood Mitigation Planning
March 13, 2002 – Public meeting regarding Fourmile Canyon Creek Flood Mitigation Planning
March 21, 2002 – IRP Meeting regarding Fourmile Canyon Creek Flood Mitigation Planning
April 10, 2002 – WRAB Information Item regarding Fourmile Canyon Creek Flood Mitigation
June 26, 2002 - City Council Information Item regarding Fourmile Canyon Creek Flood Mitigation Planning
November 21, 2002 – IRP Meeting regarding Fourmile Canyon Creek Flood Mitigation Planning, South Boulder Creek Flood Mapping Study and the CFS Master Plan
May 2002 – Love & Associates commissioned to supplement Fourmile Canyon Creek and Wonderland Creek flood mitigation alternatives based on IRP recommendations and other public input

2003-2009 - Fourmile Canyon and Wonderland Creeks Flood Mapping and Mitigation Studies

March 21, 2003 – IRP Meeting regarding Fourmile Canyon and Wonderland Creeks Flood Mitigation Planning
February 26, 2003 – IRP Meeting regarding Fourmile Canyon and Wonderland Creeks Flood Mitigation Planning
April 2003 – High resolution aerial photos taken by Merrick & Company
2003 - UDFCD and the city initiated the Fourmile Canyon and Wonderland Creeks flood mapping and mitigation studies by Love & Associates
2004 - High resolution aerial photos and digital terrain model completed by Merrick & Company
May 2005 – Draft Fourmile Canyon and Wonderland Creeks flood mapping study completed by Love & Associates
July 2005 - Direct mailing notification of affected property owners
July 20, 2005 – Public meeting regarding the draft Fourmile Canyon and Wonderland Creeks flood mapping study completed by Love & Associates
August 15, 2005 - Water Resources Advisory Board (WRAB) review and recommendation regarding Fourmile Canyon and Wonderland Creeks flood mapping study submittal to FEMA
October 2005 – Newsletter mailed to property owners with updated information regarding Fourmile Canyon and Wonderland Creeks flood mapping study submittal to FEMA
November 17, 2005 - Planning Board review and recommendation regarding regarding Fourmile Canyon and Wonderland Creeks flood mapping study submittal to FEMA
December 20, 2005 - City Council review and recommendation regarding Fourmile

Canyon and Wonderland Creeks flood mapping study submittal to FEMA
March 2006 – City submits Fourmile Canyon and Wonderland Creeks flood mapping study to FEMA for review
March 2007 – FEMA approves and adopts Fourmile Canyon and Wonderland Creeks flood mapping study submitted by the City
June 2007 – Final Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
September 19, 2007 – Greenways Advisory Board meeting regarding Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
September 27, 2007 - Public meeting regarding Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
October 15, 2007 - Water Resources Advisory Board (WRAB) discussion of Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
December 17, 2007 - Water Resources Advisory Board (WRAB) discussion of Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
January 8, 2008 - Water Resources Advisory Board (WRAB) discussion of Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
February 21, 2008 – Planning Board discussion of Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
March 18, 2008 – Public meeting regarding Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
March 20, 2008 – Planning Board discussion of Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love & Associates
November 10, 2008 – Public Hearing and City Council discussion of Fourmile Canyon / Wonderland Creek Flood Mitigation Report by Love and Associates and Staff Recommendations
April 28, 2009 – City Council Study Session regarding Flood Management and Fourmile Canyon / Wonderland Creek Flood Mitigation Issues
August 5, 2009 – public open house to solicit input on flood mitigation alternatives for Wonderland Creek between 26th Street and Foothills Parkway
August 17 and September 21, 2009 – Water Resources Advisory Board (WRAB) discussions of mitigation alternatives for Wonderland Creek between 26th Street and Foothills Parkway

Meeting Motions 2008 - 2009

January 2008 WRAB passed a motion with a 4-0 vote to recommend approval of the Phase A plan as modified by staff with the following recommendations and guiding principles:

1. Protect life safety by addressing structures in the high hazard zone through:
    a) Acquiring properties from willing sellers
    b) Constructing flood improvements at time of redevelopment of properties along Fourmile Canyon Creek west of Broadway and Wonderland Creek near 30th.
    c) Constructing high hazard zone containment and other improvements as funding is available, including coordinating with the county on expediting improvements located jointly in the city and county.
2. The intent of the overall approach is to minimize disruption to private property and riparian areas. This implies that flooding during 100-year events will not be contained in a channel minimizing impacts to downstream properties. Many properties including schools will experience shallow flooding under this approach.
3. During the next phase all potentially impacted properties and persons including students and parents should be notified of proposed approach and tradeoffs of minimizing property impacts versus the potential for flood damages.
4. Public education of flood risks should be emphasized including signage and flood markers and response plans for impacted schools.
5. Opportunities for facilitating and encouraging private flood proofing should be explored.
6. Continue to maintain high level of public involvement and feedback.
7. This non-structural approach requires active regulatory flood plain management in order to preserve flood conveyance areas.

In March 2008 Planning Board passed a motion recommending City Council accept the proposed flood mitigation plan outlined in the March 20, 2008 staff memorandum including the following recommendations:

1. City Council approve the staff's recommendation with prioritization, to the extent feasible from an engineering perspective, favoring city improvements over county improvements.
2. Public education on life and safety issues as to flooding, particularly as to critical facilities, be given a high priority.
3. Discussion with the affected property owners in the Village Center take place with the feasibility of moving forward with flood mitigation.

The motion passed 5-1, A. Sopher opposed. The dissenting vote from Sopher was based on his request that the report contain additional physical flood protection for access and egress to Crestview Elementary and Waldorf Elementary school.

On November 10, 2008 Council members discussed the Fourmile Canyon and Wonderland Creek Flood Mitigation Plan. Council expressed concern about moving

forward on such a complex and costly project and stated the need for taking more time in making this decision. Prior to making its decision, Council requested the following:

- A field trip to the affected properties
- A study session that would focus on the policy level
- That the Water Resources Advisory Board and staff review the overall spending for water utilities and provide that information for Council

On April 28, 2009 staff presented information to City Council during a Study Session to address issues raised during the November 2008 public hearing. Council members generally expressed support for the approach to flood mitigation planning and that existing policies were appropriate, with the following comments relating to the Phase A report:

1. The current approach to flood mitigation should continue and is mostly in the right direction.
2. Consider doing the least amount of work necessary with the structural improvement approach to mitigate flood hazards.
3. Flood mitigation work proposed along Fourmile Canyon Creek east of 28th should be reconsidered and possibly scaled back.
4. Alternatives that leave drainageways in their natural state should be a priority.
5. Mitigation measures should be kept as "green" as possible, i.e. minimize use of asphalt and concrete.
6. The need to disturb natural areas for the benefit of a few homes was questioned.
7. Flood mitigation to reduce the 100-year floodplain was questioned if the mitigation was only to reduce property damage. Focus removal efforts on structures in the high hazard and conveyance zone.
8. City council members requested that proposed mitigation costs be presented to distinguish the cost of containing high hazard flood flows versus containing all 100-year flood flows.

Staff presented to WRAB on August 17, 2009 and on September 21, 2009. During the September meeting, staff recommended WRAB approve the Fourmile Canyon Creek and Wonderland Creek Phase A Report with the staff modifications including a Modified 100-year Containment alternative for Wonderland Creek between 26th and Foothills Parkway.

On September 21, 2009 WRAB passed a motion recommending City Council adopt the Phase A Report as modified by staff and subject to the condition that if a significant portion of grant funding is not awarded to construct various segments of the project, then WRAB recommends adopting only the High Hazard Containment and Floodproofing alternative for the segment of Wonderland Creek between 26th and Foothills Parkway. Motion passed by vote of 4:1 (S. Iott opposed, favors the high hazard containment option only.)

Attachment 2: Summary of Recommendations