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# BOULDER CREEK FLOOD PLAN ANNEX I

## I. INTRODUCTION

A flash flood on Boulder Creek could result in a major disaster for the City of Boulder, Boulder County and the University of Colorado. For example, in 1976 the U.S. Army Corps of Engineers estimated that flood damages within the City of Boulder resulting from a 100-year flood (**a flood having a 1% chance of being exceeded every year**) could exceed \$22,000,000. For a 500-year (**0.2% chance**) flood, they estimated 1976 damages at \$38,500,000. At about the same time, Tom Downing from the University of Colorado estimated that in excess of 90 people could be killed during a 100-year flood on Boulder Creek. Soon after the Corps of Engineers figures were released, they conducted a reanalysis of the flood hydrology for the Boulder Creek drainage basin. This study resulted in increasing the estimated 100-year discharge at Boulder from 7,400 cfs to 12,000 cfs. The State Geologist has listed Boulder Canyon as one of the most dangerous canyons in Colorado as far as the potential for loss-of-life from flash flooding is concerned.

The **Boulder Creek Flood Warning Plan** is designed primarily to reduce the potential for loss of life resulting from flash floods on Boulder Creek, South Boulder Creek and major tributary streams. The procedures contained herein are also applicable to emergency decision making for many tributary streams as mentioned above. This plan has been prepared by the Urban Drainage and Flood Control District, the City of Boulder, Boulder County and the University of Colorado in cooperation with the National Weather Service and Henz Meteorological Services. The District acknowledges the valuable contributions of many individuals that assisted in preparing this plan.

The user should be aware of the area-wide meteorological support provided through the District's Flash Flood Prediction Program, the weather information available via the District's Electronic Bulletin Board (EBB) and FAX communications, the real-time rainfall and stream stage data from the ALERT Flood Detection Networks installed for the Boulder and South Boulder Creek Basin.

The user should read the entire plan carefully; and should be aware of all elements of this plan, its strengths and weakness, and individual responsi-

bilities; not only in the elements of this plan, but specifically as set forth in the following paragraph:

***The local governments participating in this flood warning plan believe that the early flood detection system described herein is a key component of the complete flood warning system. They recognize, however, that the possibility of inadvertent error in design or failure of equipment to function may prevent the system from operating perfectly at all times. Therefore, nothing contained herein may be construed as a guarantee of the system or its operation, or create any liability on the part of any party or its directors, officers, employees or agents for any damage that may be alleged to result from either operating or failing to operate the detection system or any of its component parts.***

## II. DRAINAGE BASIN DESCRIPTION

Originating at the Continental Divide, the Boulder Creek basin encompasses 132 square miles above the City of Boulder. The basin is oriented in a generally west to east direction and includes the major tributaries of North Boulder Creek (45 square miles), Middle Boulder Creek (44 square miles) and Fourmile Creek (24 square miles).

Within the basin, there is scattered development along the streams. Nederland, the largest town, is located on Middle Boulder Creek immediately above Barker Reservoir. Further upstream along Middle Boulder Creek is the town of Eldora and the Lake Eldora Ski Area. The communities of Sunnyside and Silver Spruce are located on Boulder Creek and the communities of Sunset, Wallstreet and Crisman are found along Fourmile Creek. The settlement called Orodell is located at the confluence of Fourmile Creek and Boulder Creek. Transportation routes within the basin include State Highway 119, which follows Middle Boulder and Boulder Creeks between Nederland and Boulder, State Highway 72 runs north and south through Nederland, and County Road 119 extends along Fourmile Creek.

Numerous small lakes, fed by melting snows, occur in the higher portions of the basin. Barker Reservoir, owned by Public Service Company, stores water for electric power generation at a plant further downstream and municipal water for the City of Boulder. A number of glaciers exist at the Continental Divide.

The Boulder Creek basin ranges in elevation from 13,409 feet above mean sea level at Navajo Peak to approximately 5,385 feet at Boulder. The basin is predominantly mountains and foothills, characterized

by steep streams with rock and gravel beds. Fifteen percent of the basin lies above 11,000 feet and 46% above 9,000 feet. Main channel slopes average 2-1/2% - 5% for Boulder Creek, 4% - 8% for North Boulder Creek, 2-1/2% - 8-1/2% for Middle Boulder Creek and 4% - 10% for Fourmile Creek.

Because of the steep slopes and generally elongated basins, Boulder Creek and its principal tributaries are susceptible to flash floods caused by high intensity, short duration thunderstorms occurring in May through September. Rainfall rates from such storms can exceed the infiltration capacity of the surface soil, producing large runoff in short periods of time. When high runoff converges on a stream, it generally exceeds the carrying capacity of the normal channel, resulting in flooding of the adjacent floodplain.

### **HYDROLOGY**

The U.S. Army Corps of Engineers has recently undertaken a hydrologic study of the Boulder Creek basin in connection with a flood management study for the City of Boulder. The Corps' analysis included generation of the 10, 25, 50, 100 and 500 year frequency floods over the whole basin. The 100-year rainfall totaled 2.8 inches over a 6-hour period with about 1.2 inches falling in the first one-half of the fourth hour. While flash flood rainfall can have greater intensities than the maximum of 2.6 inches per hour used in the Corps' Model, it was felt that the model could be used as the basis for estimating lead times. The relation between rainfall and runoff for the five frequency events was obtained from the Corps for 11 design points.

Analysis of the data indicates which portions of the Boulder Creek basin are responsible for generating floods at specific locations, and the amount of warning time available after flood producing rainfall occurs. The elapsed time between rainfall and flood peak is longer for less severe storms and shorter for more severe storms. Barker Reservoir, located on Middle Boulder Creek, delays the flood peak.

During a regional rainfall event, two flood peaks can be expected for Middle Boulder Creek above its confluence with North Boulder Creek. The first peak is smaller and comes from the tributary area below Barker Reservoir. Below the confluence of North Boulder and Middle Boulder Creek, the timing and magnitude of the flood peak is due to the contribution of North Boulder Creek. Boulder Creek between North Boulder Creek and Orodell has several tributary basins that contribute significant amounts of flood water before the peak from the Upper Basin arrives. This causes Boulder Creek above Orodell to peak before it does below the confluence of North and

Middle Boulder Creeks. A similar situation exists at the confluence of Boulder Creek and Fourmile Creek. Fourmile Creek is an elongated basin that contributes a significant amount of flood water ahead of the peak of Boulder Creek above Orodell. Therefore, Fourmile Creek peaks earlier than Boulder Creek above Fourmile Creek.

*(The above was extracted from "Early Flood Warning Planning, Boulder Creek" by Leonard Rice Consulting Water Engineers, July, 1977).*

### **MAPS:**

The five floodplain maps on the following pages represent the approximate outline of the 100-year floodplains for Boulder Creek, South Boulder Creek and major tributaries which impact the City of Boulder. These maps are distributed annually by the Urban Drainage and Flood Control District (UDFCD) to residences and businesses located in or near the respective floodplains.

**Map 1 - Boulder Creek Floodplain:** This map shows the approximate boundary of the 100-year floodplain for Boulder Creek and major north bank tributaries impacting the City of Boulder.

**Map 1A - Boulder Creek Floodplain to the Weld County Line:** This map shows the approximate boundary of the 100-year floodplain for Boulder Creek and major north bank tributaries from 55th Street to the Weld County Line.

**Map 2 - Boulder Creek Floodplain-North of Arapahoe:** This map shows the approximate boundaries of the 100-year floodplain for Boulder Creek and major north bank tributaries impacting the City of Boulder.

**Map 3 - Boulder Creek Floodplain-South of Arapahoe:** This map shows the approximate boundaries of the 100-year floodplain for Boulder Creek and major south bank tributaries impacting the City of Boulder.

**Map 4 - South Boulder Creek Floodplain:** This map shows the approximate boundary of the 100 year floodplain for South Boulder Creek beginning at Eldorado Springs and ending at near its confluence with Boulder Creek.

**Sector Map for City of Boulder:** A Sector Map for City of Boulder evacuation areas of the Boulder Creek Drainage is attached to this plan.

**EMERGENCY OPERATIONS PLAN  
BOULDER COUNTY - CITY OF BOULDER  
BOULDER CREEK FLOOD PLAN  
ANNEX I**

*The Boulder Creek Flood Plan as prepared by Urban Drainage and Flood Control District is not included in its entirety in this annex. Floodplain maps have been extracted from the plan along with an introduction and description of the drainage basin. Copies of the complete plan can be found in the following departments or agencies:*

*Boulder County Transportation Department  
City of Boulder Public Works  
Boulder City/County Office of Emergency Management  
Boulder Police Department  
Boulder Fire Department  
Boulder County Sheriff's Department/Emergency Services  
Emergency Operations Center  
University of Colorado Police Department*

*An Operations Manual for the City of Boulder is separate from this plan (Addendum A). It contains checklists for all City Departments outlining major actions required for responding to a flash flood on Boulder Creek.*

**Prepared by  
Urban Drainage and Flood Control District  
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