City and County of Pueblo
Flood Hazard Mitigation Plan

The June 3, 1994 Flash Flood

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Office of Emergency Management

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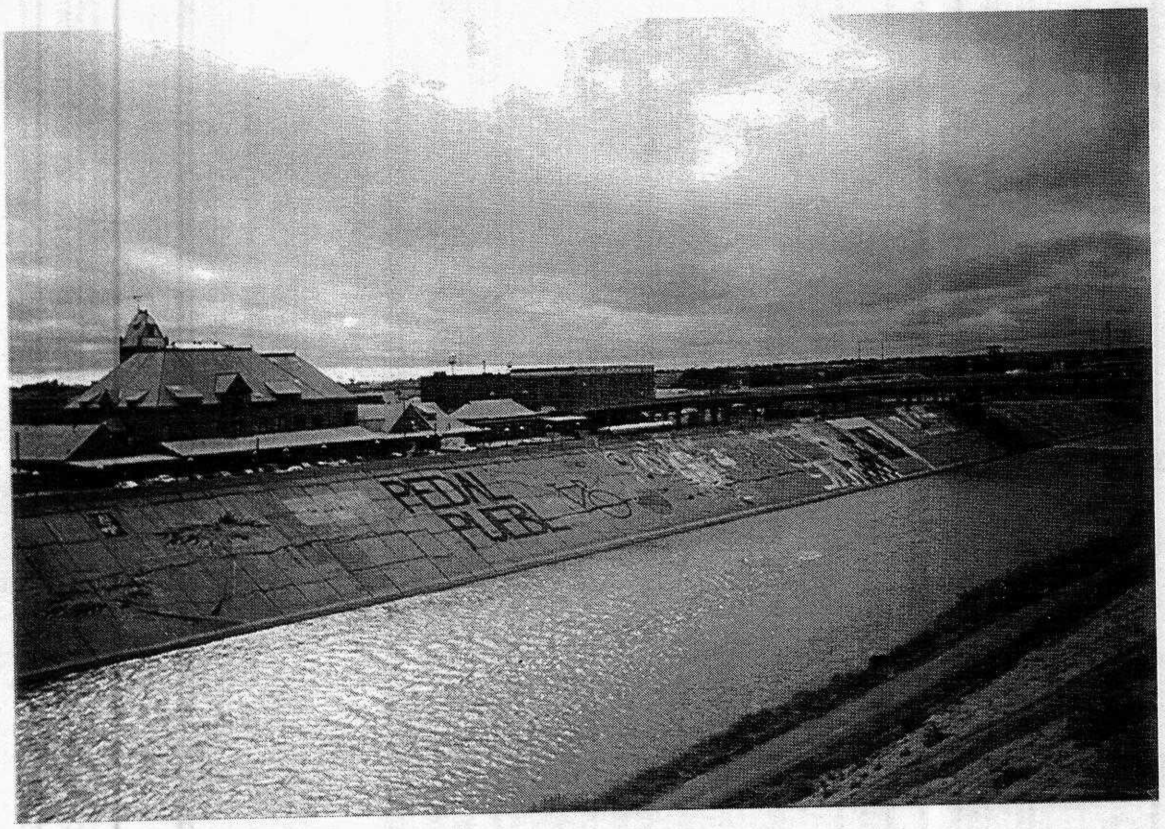
INTRODUCTION



The Arkansas River in the City of Pueblo.

Purpose of Study

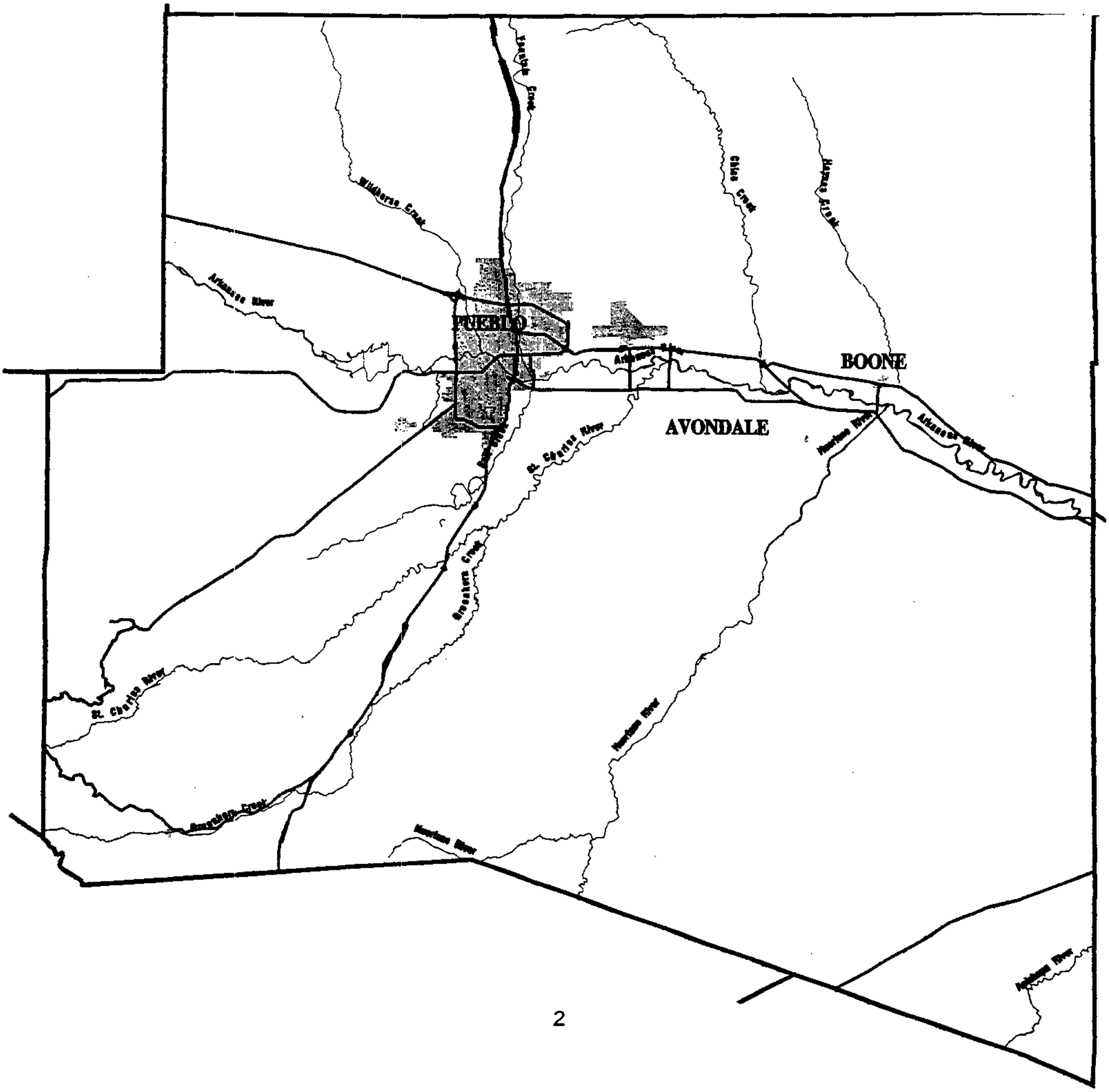
On June 2 and 3, 1994, two intense thunderstorms deluged Pueblo, Colorado in less than ten hours of each other. Puebloans went to bed Thursday, June 2 thinking the worst was over. There was some minor flooding, a few stalled cars in flooded intersections, and some mud in the streets. But just after midnight early Friday morning, the storm dropped up to 4.9 inches of rain in an hour and a half. By daylight parts of the community were stunned at the damage the storm left behind. The thunderstorm of June 3, 1994 was one of the worst storms Pueblo had seen in years.

The purpose of this Flood Hazard Mitigation Plan is first to identify the critical flood hazard issues for the city of Pueblo and the surrounding area. Second, the plan will study the incident and to identify actions that could be taken in the future to help mitigate the effects of a similar event. This Pueblo Flood Hazard Mitigation Plan has been prepared by the Colorado Office of Emergency Management with support from local, county and state personnel.

Scope of Study

This Flood Hazard Mitigation Plan focuses primarily on the City and County of Pueblo, emphasizing the areas most affected by the localized thunderstorm. The hazard analysis will reflect upon historic flooding as well as the June 3, 1994 flood, and will consider future potential floods as well.

Below is a map of Pueblo County. Pueblo lies about 40 miles south of Colorado Springs. Courtesy of Pueblo County Public Safety and Operations, GIS.

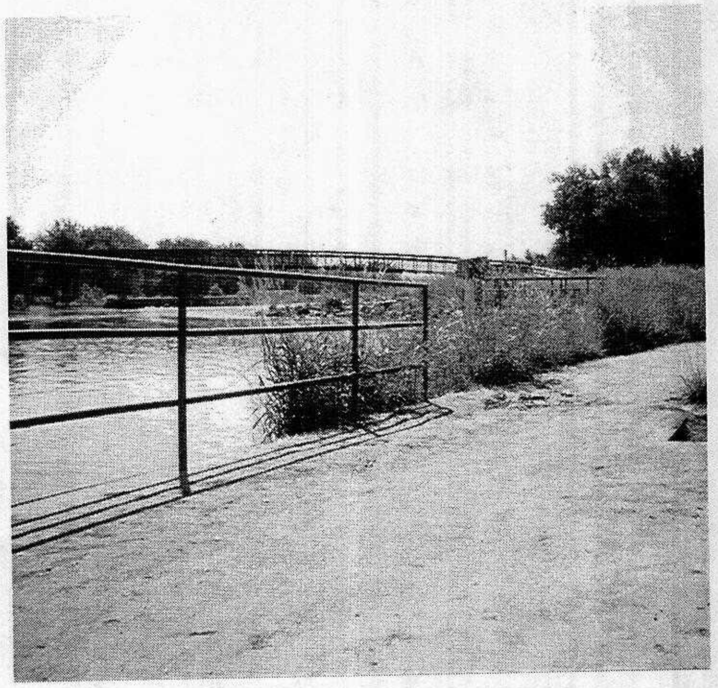


Pueblo and Its Vulnerability

The Pueblo Community

Pueblo, situated at the confluence of the Arkansas River and Fountain Creek, is the county seat of Pueblo County. Pueblo County was one of the original seventeen counties included in the Colorado Territory created in 1861. In the 1840s Fort Pueblo was built by fur traders and the name remained even though the settlers did not. The Fort was abandoned following the Indian Massacre in 1854. The settlers returned, however, with the advent of the gold rush in 1858. By 1880 the Denver & Rio Grande Railroad had found its way to Pueblo, and the Colorado Coal and Iron Company (now the Colorado Fuel and Iron Steel Corporation, or CF & I) was producing steel profitably. By 1900 Pueblo's population reached nearly 35,000, more than half of whom were the families of immigrants who had come to earn their living in the steel mill. The city has continued to grow to its current population of over 98,000.

The incredible growth in Pueblo has increased its potential vulnerability to flooding in areas of the city. The Arkansas River flows through Pueblo and receives flow from many tributaries in the Pueblo area. The city and county have taken, and continue to take, many steps to ensure the safety of Pueblo from damaging floods. These structural (e.g. levees, dam) and non-structural (e.g. zoning) mitigative steps to lessen vulnerability often resulted from planning after a devastating flood. Pueblo has a history of damaging floods and has learned and planned from each of them.



The Arkansas River and a city section of muddy river trail.

Streams in the Pueblo Area

The streams discussed here are major drainages in Pueblo County which flow in or near the city and/or were affected by the June 3, 1994 storm. These waterways consist of the Arkansas River and its tributaries: Fountain Creek, St. Charles River, Wild Horse-Dry Creek, Dry Creek, Goodnight Arroyo, Huerfano River and Salt Creek. The following stream information is taken from U.S. Army Corps of Engineers Flood Plain Information studies. These tributaries lack records from stream gauges on the channels, therefore, the flood history information must be compiled and analyzed from historic records.

These watersheds are similar in that they are subject to the same types of storms and flooding which is due to similar stream channel characteristics and climates. The stream channels in these watersheds are characterized by long, narrow stems and tributaries. Analysis of climatological data and inspection of the flood history for the Arkansas River subbasin above John Martin Reservoir (near Las Animas, Colorado) shows the most severe flood-producing storms occur during the late spring or summer months. Warm, moist air from the Gulf of Mexico mixes with cold, dry air from the polar regions to create increased thunderstorm activity in the area. The runoff from these storms combines with snowmelt in the spring and can create high stream flows. These high flows in the narrow channels can conduct flooding with high peak flows of small volumes and short durations. Valley storage, high infiltration rates, and irrigation diversions cause considerable attenuation of the flood flows moving downstream to the Arkansas River.

Fountain Creek flows south through the northeast sector of Pueblo. Fountain Creek, a north-bank tributary of the Arkansas River, stretches approximately 65 miles long as measured from Palmer Lake to the Arkansas River confluence at Pueblo. The watershed constitutes a drainage area of 927 square miles over several counties. The creek originates about seven miles northwest of Pikes Peak in the mountains of the Rampart Range. Elevations in the watershed vary from 14,109 feet at Pikes Peak to 4,627 feet where it meets the Arkansas River. Fountain Creek headwaters are fed from snowpack and springs of the alpine west slope canyons of Pikes Peak. The creek emerges through the foothills and onto the high plains at Colorado Springs where it enters a drainage area at the Monument Creek junction. Fountain Creek is perennial except for a few days during the summer when irrigation and municipal demands exceed the low summer flows. Some irrigation-return flows are experienced in the plains sector of the creek.

The damaging floods in Pueblo on Fountain Creek normally originate in storms in the Colorado Springs area on the main stem and tributaries. Floods that originate in this area may dissipate to negligible proportions prior to reaching Pueblo, depending upon precipitation events and soil moisture content in the area between Colorado Springs and Pueblo. The Fountain Creek Flood Control Project, designed to control up to a 200 year flood event in the city, helps mitigate against flooding.

The St. Charles River originates near San Isabel, Colorado on the northeast face of the Wet Mountains. This perennial mountain stream follows a 50 mile, northeasterly course, until its waters enter the Arkansas River eight miles east of Pueblo. Elevations in the watershed range from above 9,000 feet to 4,545 feet, and its drainage area covers approximately 482 square miles.

Wild Horse-Dry Creek, an Arkansas River north-bank tributary, conveys the combined streamflows of Wild Horse Creek and Dry Creek (not to be confused with Dry Creek just east of the city of Pueblo). This tributary flows southeasterly through the city's northwest quadrant into the Arkansas River. The watershed is approximately 17 miles long as measured from its headwaters to the Arkansas River confluence at Pueblo. Its drainage area covers 82.8 square miles, starting at an elevation of 6,000 feet near the headwaters to 4,700 feet at the mouth. The separate ephemeral (which often run dry in the summer) streams, Wild Horse and Dry Creek, originate in the foothills of the frontal range northwest of Pueblo.

Dry Creek is a north-bank tributary which flows south just within Pueblo's eastern boundary. This watershed spans a distance of 5.5 miles from the headwaters to the mouth. Its drainage area covers only 5.4 square miles. Dry Creek is an ephemeral stream, which originates at the southern extremity of Baculite Mesa in the high plains northeast of Pueblo. It flows in a southerly direction to discharge into the Arkansas River just east of the city limits.

Goodnight Arroyo is an ephemeral south-bank tributary of the Arkansas River that originates on the high plains southwest of Pueblo. The arroyo is 4.9 miles long, and its longest branch originates just over one mile south of State Highway 78 and then meanders in a northerly direction. Just outside Pueblo's western boundary the arroyo passes under Bessemer Ditch and State Highway 96 (Thatcher Avenue) and turns west toward the Arkansas River. The drainage area covers 5.9 square miles, and elevations range from 5,330 feet at the headwaters to 4,708 feet at the Arkansas River confluence.

The Huerfano River covers a drainage area of 1,876 square miles, stretching 90 miles in length. The headwaters begin at an elevation of about 10,500 feet, where the stream is perennial. Then the river flows north and east through the foothills and onto the plains. Here irrigation diversions dry out the stream in the summer by the time it reaches the Arkansas River near Boone.

Salt Creek is a right bank tributary with the confluence located in the southeast corner of the City of Pueblo. The stream's headwaters originate in the foothills about eight miles south and ten miles west of the city. The Salt Creek watershed contains 37.2 square miles, which is minor in regard to size but it is important in that it flows through the residential and major industrial areas of southeast Pueblo. The stream stretches about 18 miles long, the upper 5 miles of which are considered to be intermittent. At its confluence with the St. Charles River Flood Ditch it receives a maximum flow of approximately 635 cubic feet per second (cfs- see box below) diverted from the St. Charles River. This water provides a base flow in Salt Creek during the spring and summer months. A few miles downstream from its junction with the Flood Ditch, Salt Creek flows into a series of reservoirs (water from the ditch and creek is stored here and used by CF & I in their industrial processes), through CF & I, and finally into the Arkansas. Almost all of the Salt Creek channel is located on land owned by CF &I.

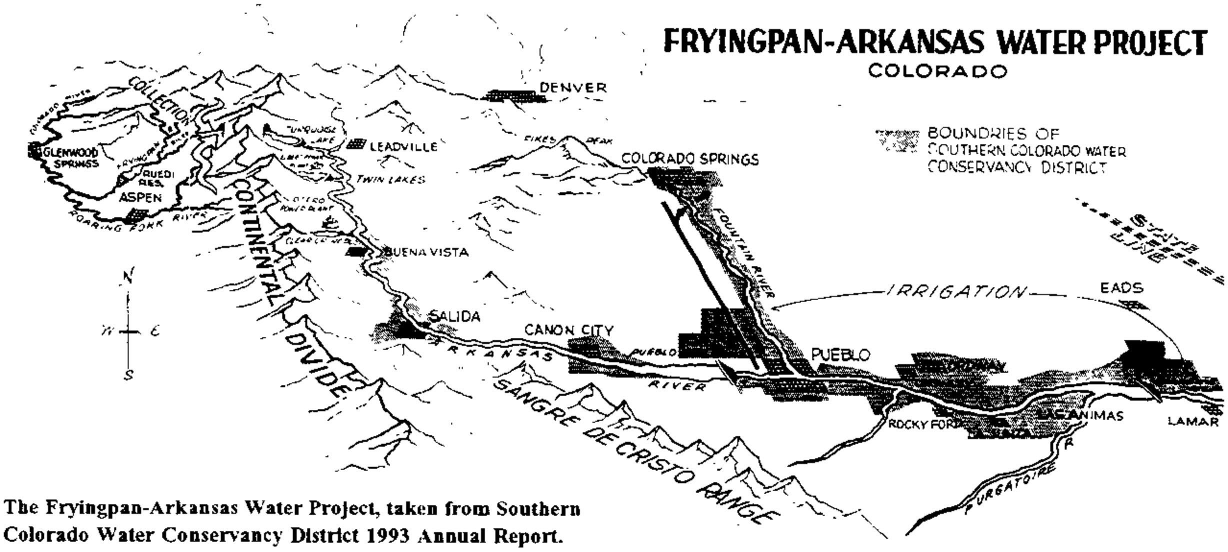
How much is a cubic foot per second (cfs)?

1 cfs = 448.8 gallons per minute

The ***Arkansas River*** originates near Climax, Colorado at an elevation of about 12,000 feet. It flows in a southeasterly direction in the areas of Leadville, Salida, Canon City and through Pueblo. Many streams flow into the Arkansas upstream of Pueblo, all of which are fed primarily through snowmelt.

Pueblo Dam, on the Arkansas River, is part of the Fryingpan-Arkansas Project. The dam was designed in the 1960s to handle a 100-year flood, and the construction was completed in 1975. Although it has the capacity to hold 357,000 acre feet of water, the Corps of Engineers requires that the level not exceed 265,000 acre feet by April 15th until the end of the flood season, to provide sufficient capacity for snowmelt and spring rain. Also a part of Pueblo Dam's role in flood control is an agreement that the flow at Pueblo Dam may be reduced so that by the time the water reaches the Avondale gauge (east of Pueblo), the flow will not exceed 6,000 cubic feet per second- which could potentially flood downstream towns and agricultural areas. At this gage the water is not just coming from the dam but from all the previously mentioned tributaries of the Arkansas, so the dam can help reduce this cumulative flow.

In review it is clear the Pueblo community is aware they must be as prepared as possible for the potential problem of flooding along the many streams in the area. At the present time, there are many different kinds of mitigation in place along these rivers. The Arkansas River underwent channel improvement and levee construction in 1922 following the 1921 flood. Then in 1975 the Pueblo Dam was completed, which helped flood control on the Arkansas River downstream as well as upstream of the dam. The Corps of Engineers authorized the Fountain Creek Flood Control Project in 1986 and by 1990 portions of Fountain Creek consisted of a levee system with a 200 year flood design composed of concrete, rip rap and/or a soil cement mixture. Pueblo also relies on the Satellite Stream Gauging Program under the administration of the Office of the State Engineer, as well as the Early Flood Warning System on Fountain Creek. Aside from natural waterways, Bessemer Ditch built concrete walls on portions of the ditch in 1980 and on other portions in 1990. The ditch runs from Pueblo Dam through the city and east to its owners, mostly farmers, on the St. Charles Mesa. Some of these mitigative measures, including non-structural measures, will be discussed again later in this plan.



The Fryingpan-Arkansas Water Project, taken from Southern Colorado Water Conservancy District 1993 Annual Report.

Explanation of Flood Types

Predicting how floodwaters will flow and how they will affect people's lives is a difficult task requiring careful planning and response. Hydrologists estimate the probability or recurrence interval of future floods by studying the past behavior of a stream and/or surrounding streams. Floods are often categorized according to their return interval (e.g. 10-50-100-year flood). Each flood interval is related to a percent chance that a flood may actually occur within a given year. A recurrence interval is the average frequency with which storms occur. So the 100-year flood is not something that will occur at equal 100-year intervals. It can occur in two consecutive years, or not at all in over 100 years.

There is a 1.0% chance that the 100-year flood will occur in any given year. If it occurred in 1994, there is still a 1.0% chance that it would occur again in 1995. Instead of calling it the 1.0% flood, we call it the 100 year flood, to demonstrate the magnitude of the flood more effectively.

Colorado state law requires that the 100-year flood plain be used for land use regulation, as the flood plain concept provides a national standard for the National Flood Insurance Program. It is critical for flood plain residents to remember that floods greater than the 100-year flood event may occur at any time and may also exceed projected estimates designated by the 100-year flood plain boundary. It is important to realize that it is difficult to plan in a cost-effective manner for a sizable flood; however, risk can be minimized using a combined effort of structural and non-structural mitigation.

Fountain Creek reached a peak flow of approximately 11,000 cubic feet per second (cfs) during the June 3, 1994 storm. This peak can be equated roughly to a flood with a 5 year recurrence interval. A flood on Fountain Creek with a 50 year recurrence interval would reach about 45,000 cfs. Likewise, a 100 year interval would reach about 64,000 cfs.

Other historical peak flows in the Pueblo area:

-St. Charles, 1901- 56,000 cfs
-Arkansas, 1921- 100,000 cfs
-Huerfano, 1923- 19,400 cfs
-Fountain, 1965- 47,000 cfs
-Chico Creek, 1965- 50,900 cfs

Note: Recurrence intervals vary for different streams. Each stream must have its own study to determine flood recurrence intervals.

During a very large flood (about a 500 year flood) these streams can produce velocities of approximately 25 ft/sec. Just 3 ft/sec combined with depths of 3 ft or more are generally considered hazardous to life as well as to property.
Water flowing in excess of 4 ft/sec is capable of transporting sediment and causing severe erosion of stream banks and embankment fill around bridge abutments. When velocities drop below 2 ft/sec, debris and silt deposits occur, which extends flood damage and creates adverse health conditions. The saturation effects of flooding of long duration can effectively weaken bridge abutments, levees, earthen dams, and other embankment works so that they fail.

Flood Types: A river basin is fed by a network of stream channels that convey the normal flow of water from smaller watersheds contained within the basin. Flooding results when the flow of water becomes greater than the carrying capacity of the individual stream channel. Rate of rise, peak discharge (magnitude), and duration of flooding are all physical features and weather conditions which contribute to the characteristics of the water in the river system. The following describe sources of riverine floods:

Snowmelt floods- Snowmelt flooding typically occurs May through June. Generally this occurs when there are warm spring temperatures creating a fast snowmelt and/or a combination of spring runoff and rainfall over the affected watershed. Serious flooding can result when a heavy spring rain accompanies a snowmelt in May and June.

Flash floods- These floods result from intense summer thunderstorms. This flood event is characterized by an intense cloudburst, a sudden rise in stream level, short duration, and little or no warning. Typically the flash flood season in Pueblo stretches between May to September.

General rain floods- These floods are caused by general rainfall events that occur over a wide geographic area for several days, totally saturating the shallow soils. These floods are characterized by a slow, steady rise in the stream level and a peak discharge of long duration. Because of the slow rate of stream rising there is usually time available for warning. The Midwest floods of 1993, and more recently, the Georgia floods of 1994 are good examples of this kind of flooding.

Dam failure- Floods caused from dam failures are rare, but when they occur they can be devastating. Pueblo Dam, a massive buttress-head and earthfill dam, is designed to handle at least a 100-year flood. If Pueblo Dam broke (considering the worst-case scenario of water level at full capacity and a complete breach), the water would inundate nearly all of the downtown area of Pueblo. More specifically, this inundation zone would primarily include the area from the State Hospital in Pueblo south to the Arkansas River, and would have minor impacts out east near Avondale. Inundation maps are required for all dams in higher risk areas and can be obtained from a local emergency manager or the dam owner.

Early Flood Warning System

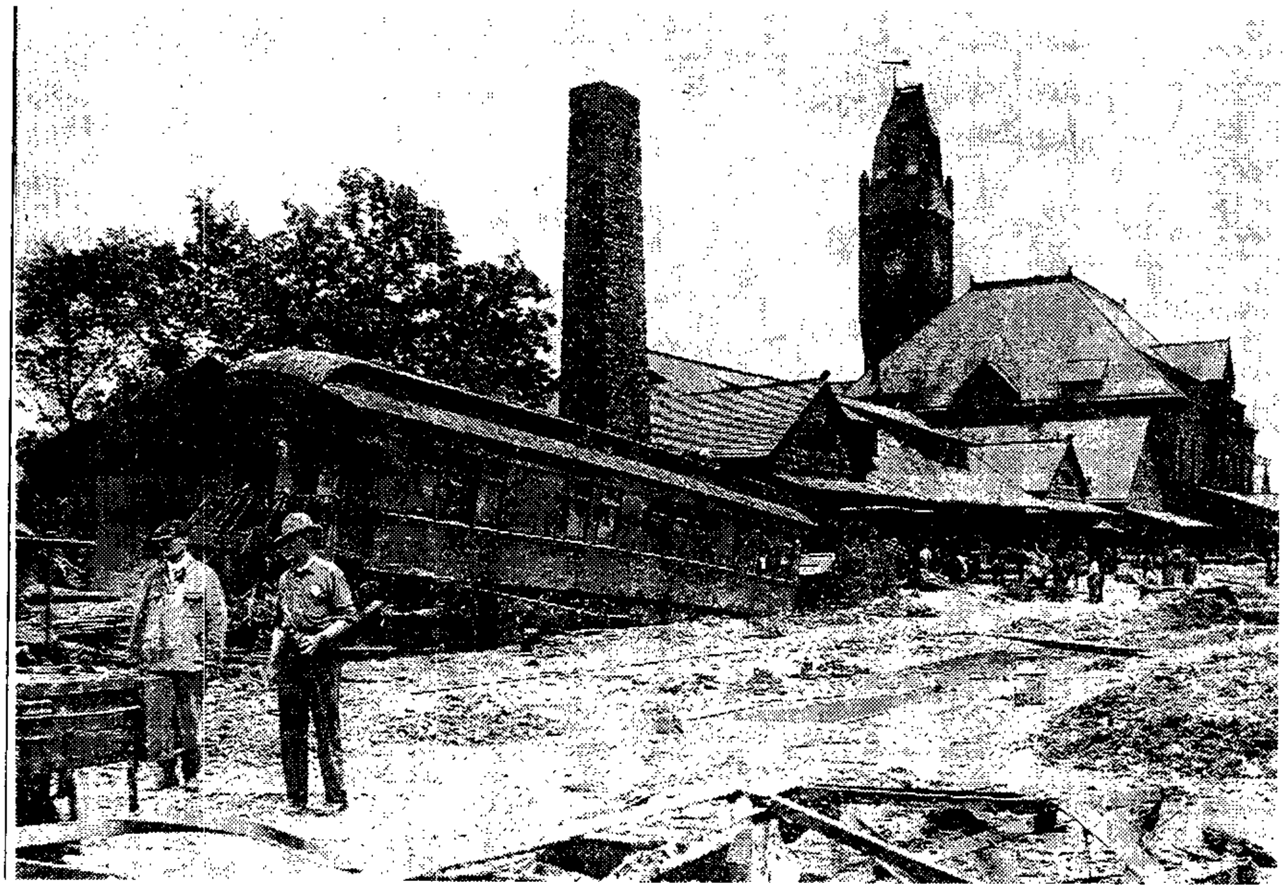
Pueblo uses a flood warning system on Fountain Creek and its tributaries to help monitor stream levels and changes. This kind of warning system helps reduce the risk from riverine flooding. Work toward an early flood warning system started in 1986 and was a positive step toward flood preparedness. It is used and supported by the City and County of Pueblo, El Paso County, Colorado Springs and surrounding communities such as Palmer Lake and Fountain. The system is designed to cover over 1,000 square miles of the Fountain Creek basin and includes 44 sensor sites. These sites may contain a combination of rain and stream gauges and other weather-monitoring equipment (e.g. wind sensors). Data from these sensor sites is relayed by radio to the Pueblo County Emergency Operations Center, the National Weather Service, El Paso County Office of Emergency Management, the City of Colorado Springs, and the Pikes Peak Regional Building Department. Dan Bunting, Regional Floodplain Administrator, maintains and operates the Early Flood Warning System. The system continues to be updated and additional sites to the system are currently being explored.

Please see appendix C for map of the Fountain Creek Watershed

Pueblo Flooding

Pueblo has a history of damaging floods. Floods have been recorded in Pueblo in 1844, 1864, 1867, 1869, 1875, 1880, 1881, 1889, 1893, 1894, 1921, 1935, 1965 and 1994. Following the floods of 1893 and 1894, the people of Pueblo decided to build a levee system to rechannel the Arkansas River through the city and reduce the risk of flooding. Many years passed without damaging floods. However, several regions in Colorado in the summer of 1921 received extremely heavy flooding, including Pueblo. General statewide rainfall, isolated severe thunderstorms and areas of excessive snowmelt contributed to major flooding affecting the North Platte, Yampa, White, Roaring Fork, Uncompahgre, and Arkansas River basins. These areas received floods with recurrence intervals between 25 and 100 years.

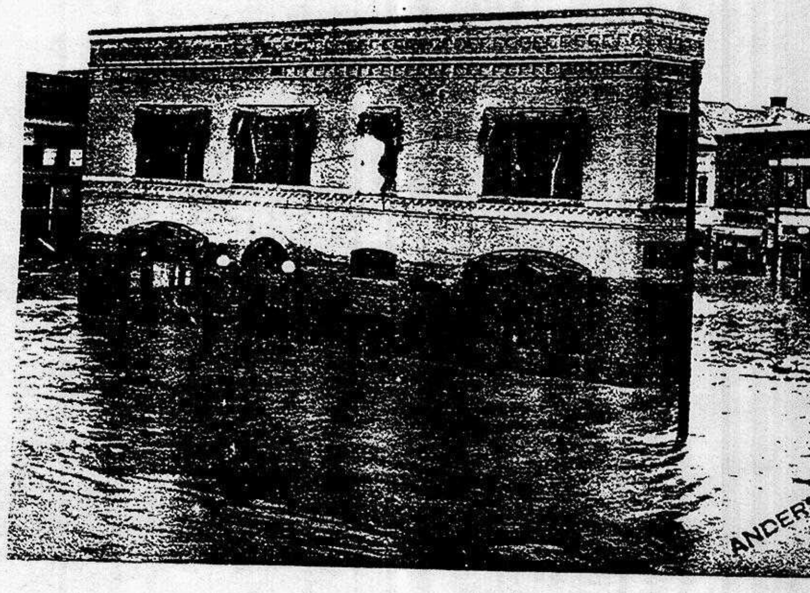
June 3, 1921 Flood



A scene in downtown Pueblo after the June 3, 1921 flood.

The levees built after the 1893 and 1894 floods could not hold the mighty flow of water that came crashing down the Arkansas River on the night of June 3, 1921. The flood demolished the business district. Over the years the community had rechanneled the river, but the floodwaters returned the river to its original course. The community was warned of the flood by curfew sirens, but instead of deterring people, the people came out to watch the flood blast down the Arkansas. By the time the people of Pueblo realized the magnitude of the flood, it was too late. The downtown Union Depot high water mark reached 11 feet.

Bridges and roads were destroyed. The flood cut off all power, telephone service and water pressure. Sheriff Sam Thomas swore in 1,500 deputies to guard the city against looters. The army provided men and heavy equipment for over a month to assist in the cleanup work. The flood claimed over 250 lives, 510 homes, 98 business or industrial buildings, 61 stores, 46 locomotives, miles of track and many animals. Railroad cars were overturned and floated down streets only to crash into buildings. There was an estimated $10 million damage at a time when the city's assessed valuation was $33 million. It took years for the city to recover.



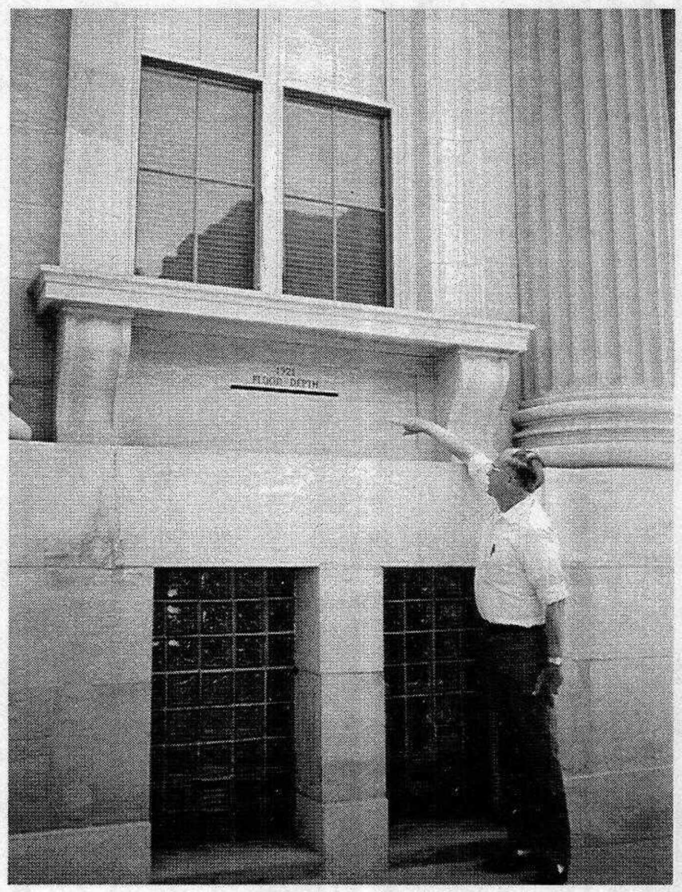
The next year the Pueblo Conservancy District was organized. The river channel was rerouted beneath the bluffs to the south and huge levees were constructed to hold the flow of the stream. The route of Fountain Creek was left unchanged.

The following quotes were published in the Pueblo Chieftain (June 4, 1994) and were taken from Joanne Dodds' upcoming book, "They All Came to Pueblo: A Social History." Mrs. Dodds believes the 1921 flood was probably the most significant event in shaping the future of Pueblo. The community used the flood as a learning experience. They moved the hospital north, completely away from the floodplain, for example.

"A region a mile wide was buried under a swishing, swirling mass of muddy water, averaging 12 feet in depth. Then the lights all over the city went out."

"A husband and wife took refuge in a tree. "Holding his wife in his arms, he shouted again and again for help. His strength finally gave out and his wife slipped from his arms, drowning in the stream."

"Men threw improvised ropes from second-story windows to persons marooned on passing housetops or clinging to floating wreckage, and some were saved."



Top picture: Saturday, June 4, 1921 the high water mark shows the water has receded eight feet. Above: Volunteer for Pueblo County Historical Society Tom Cummins points to the 1921 flood high water mark on City Hall.

June 3, 1994 Flood

A stalled car in a flooded intersection during the June 2, 1994 storm, just before the more intense storm on June 3, 1994. The Pueblo Chieftain, June 3, 1994.

A heavy thunderstorm dropped up to 2 inches of rain on Pueblo early in the evening on Thursday, June 2, 1994. The rain caused localized street flooding and cars were stalled in flooded intersections. Colorado Springs received 2½ inches of rain that day, but stretched out over an entire afternoon. More rain was predicted over the next few days. Early Friday morning, just past midnight, Pueblo received a storm that pounded the city with up to 4.87 inches of rain in just over an hour. Just before the storm, the National Weather Service (NWS) put out warnings of heavy rains which were likely to cause street flooding and possibly small stream flooding.

Once the storm began dropping nearly 4 inches of rain on Pueblo West, the NWS issued urban and small stream flood advisories. Many people did not learn of the flood until the sound of trickling water awakened them, which gave them little time to escape the rising waters in their homes.

"We couldn't get out because the water was so high... my son was hysterical and we had to stand on chairs on the porch to stay out of the water. Then, we just waited for help." -Mrs. Bojorquez --family rescued by Fire Department boat

Map Section

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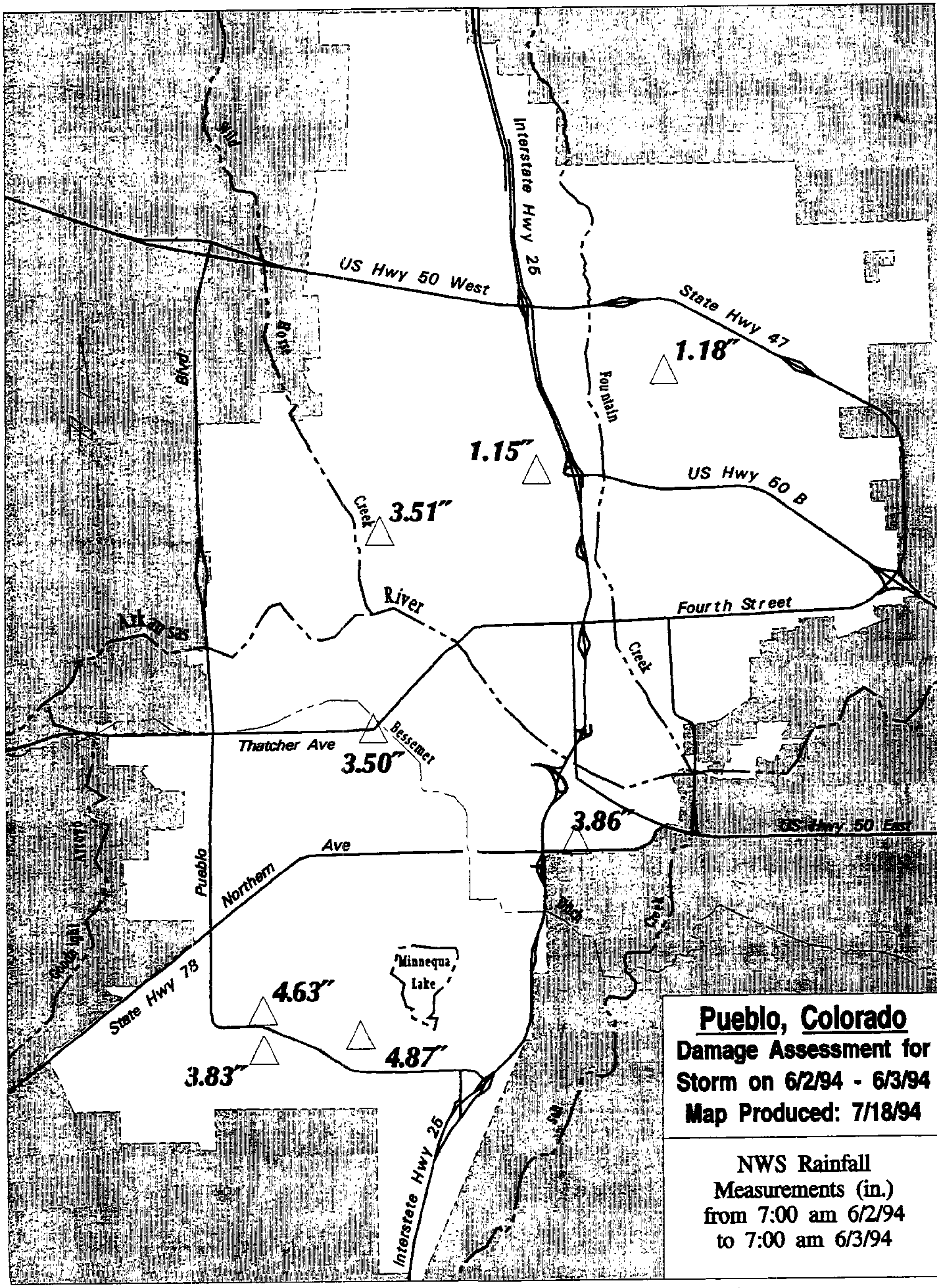
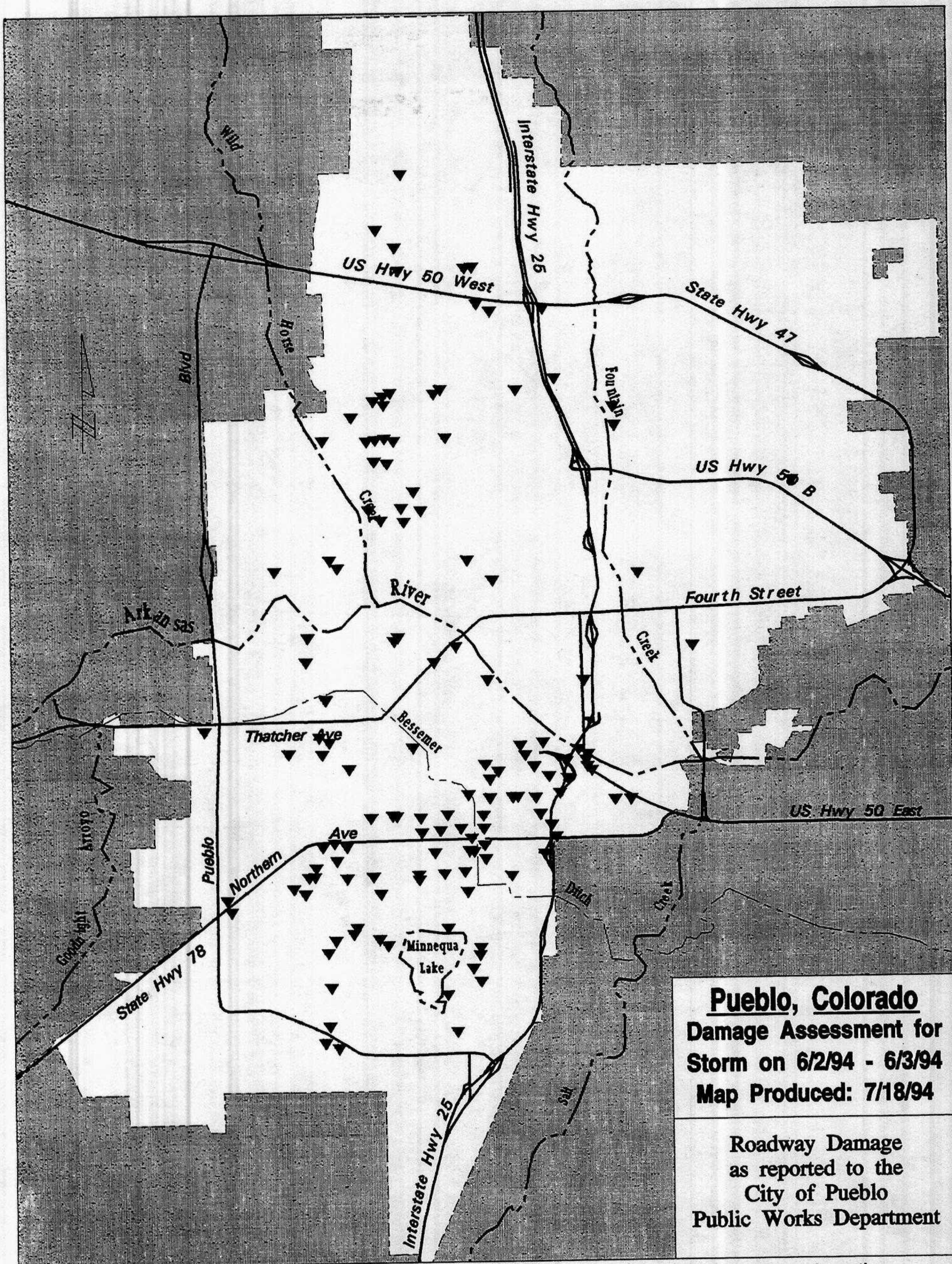
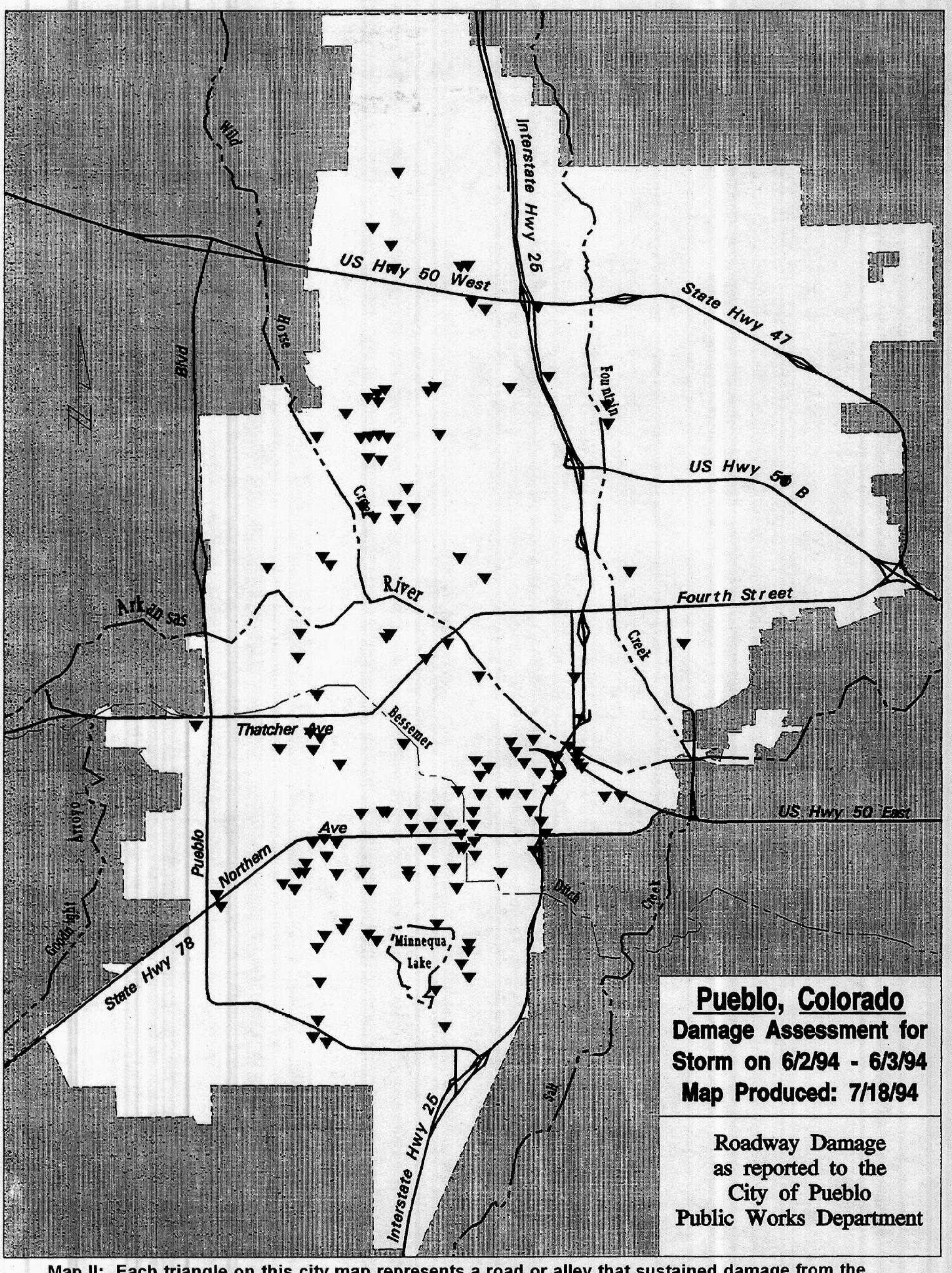
The following maps were prepared by Pueblo County Public Safety and Operations, Geographic Information Systems



Map I: The following rainfall measurements in the City of Pueblo are taken from



Map II: Each triangle on this city map represents a road or alley that sustained damage from the flash flood.



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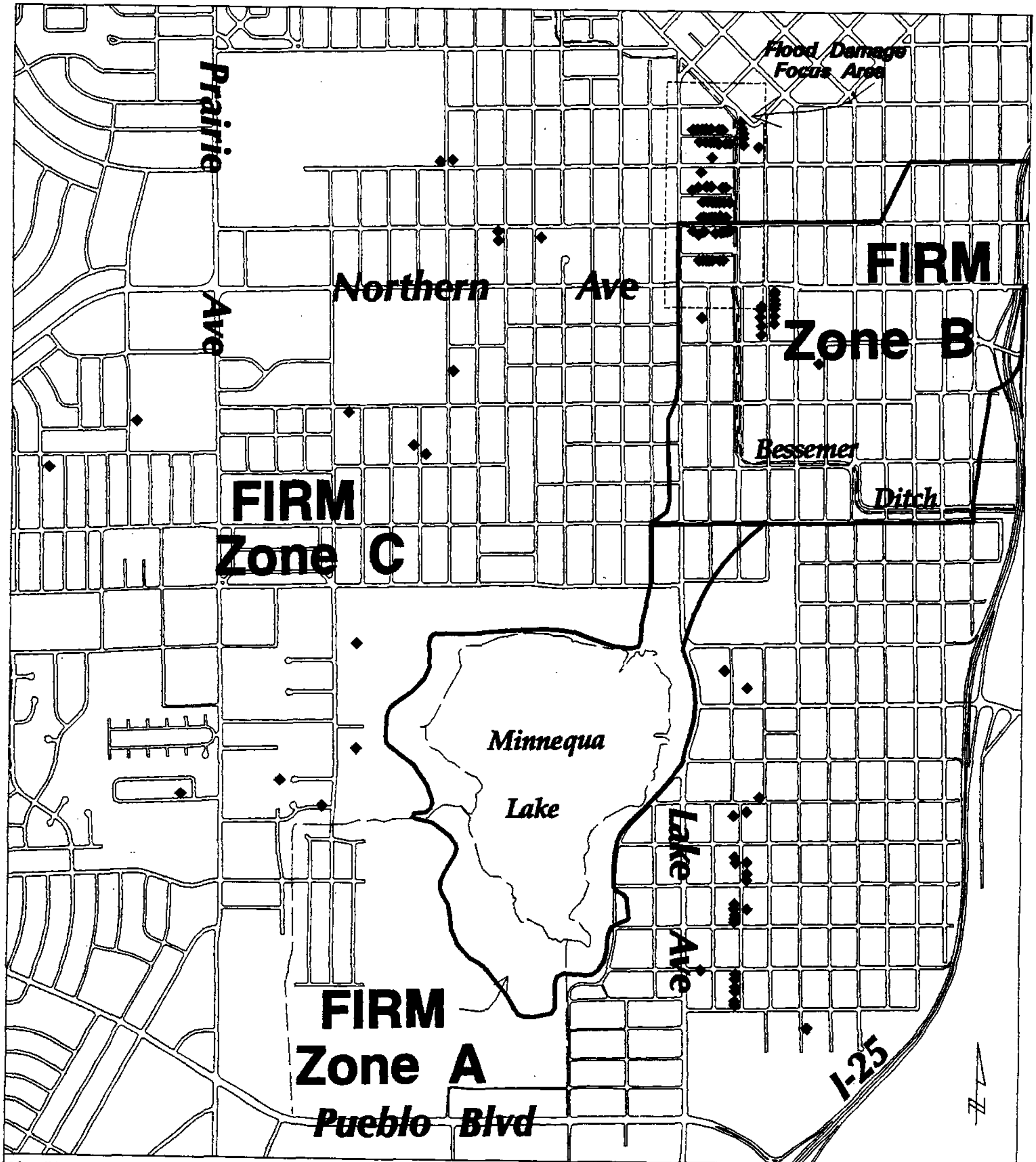
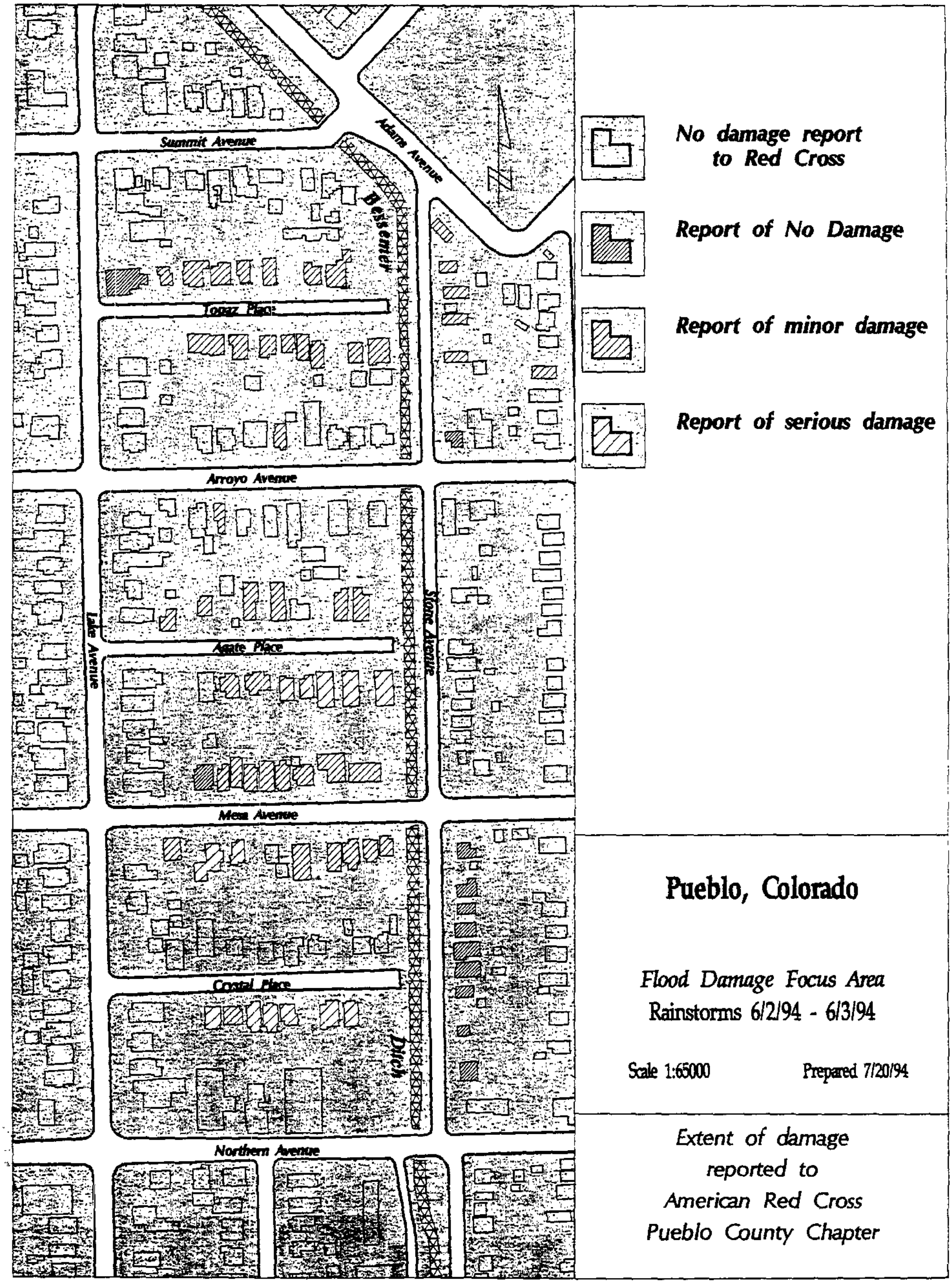
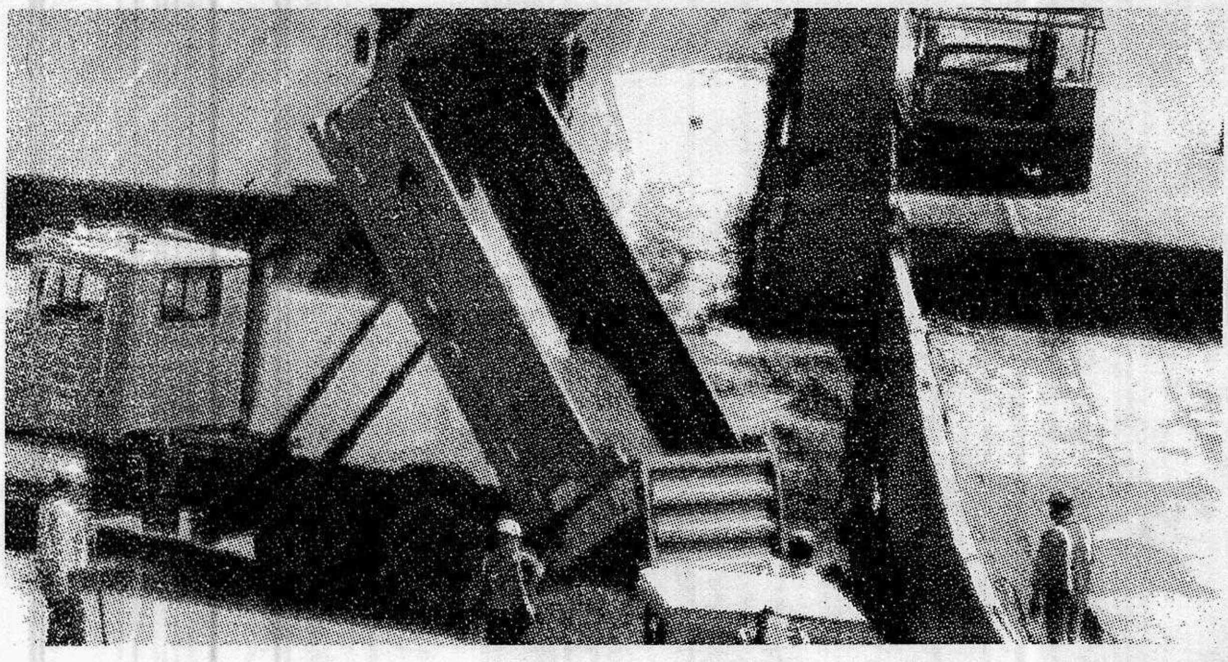


Map IV: This map zooms in on the area with the most reported damage (previous map). Again, the diamonds represent homes or apartments with reported damage. The map also shows Federal Emergency Management Agency (FEMA) National Flood Insurance Map information (the zone boundaries). FEMA provides Flood Insurance Rate Maps (FIRM), from which the zone information on this map is taken. The maps show low to high risk zones for flooding. Zone A is an area of high risk, Zone B is an area of moderate risk and Zone C is an area of low risk in this map. Notice no reports of damage exist in the high risk or A Zone. This shows the importance of flood preparedness (e.g. flood insurance, structural mitigation) even for people who do not live in the flood plain. Many damaging floods along the Front Range occur from flash flooding and urban flooding can become more of an issue than riverine flooding.

Pueblo, Colorado
Damage Assessment for
Storm on 6/2/94 - 6/3/94
Scale 1:18000 Prepared 7/25/94
Damage to homes as reported
to American Red Cross and
City Public Works Dept.
National Flood Insurance Rate Maps



Map V: This map zooms in on the flood damage focus area on the previous map (Map IV). Notice the location of Bessemer Ditch in relation to the flood damage (see Flood Response and Recovery). of the ditch sit lower than the ditch by a few feet or more



Road crews clean mud from I-25. The Pueblo Chieftain, June 4, 1994.

The city received between 1.18 to 4.87 inches of rain. One unconfirmed rainfall report just northeast of the downtown area reported up to 6 inches. The storm cell came from the west at about 5 to 10 miles per hour, dropping heavy rains and hail in some areas. The storm hit just after midnight and lasted for approximately an hour and a half. Several streets in the city and county were closed. Interstate 25 in the city area was covered by 2 feet of water, mud and debris. The Central Avenue underpass at I-25 filled up to about 8 feet deep. The Arkansas River left its low water channel in some places, flooding only river trails and parks, which are part of the flood plain. Some power lines, gas, and phone lines were down. Storm drain inlets were clogged with debris. City, County and State crews worked in the dark that morning, before many people in the community even realized the extent of the storm and the damage it caused.

Fortunately there were no major injuries. Cars floated down streets, along with rail road ties and other pieces of property and debris. Small mudslides covered streets and banks eroded. The Fountain Creek waterway changed its course slightly in some areas. People scrambled to gather a few belongings before their doors buckled from the heavy water. Residents of basement apartments climbed out windows when they could not open their front doors to escape the incoming water. A semi tractor-trailer driver needed the fire department to get his truck out from the I-25 and Central underpass at 4 AM. Many residential streets on Friday afternoon were littered with soaked furniture and randomly dumped cars.

According to City Public Works, a depth of 2.7 inches falling in one hour or a depth of 3.4 inches falling in 6 hours would constitute a rainfall of a 100-year recurrence interval. The rain from this storm reached up to 4.87 inches in approximately an hour and a half.

Flood Response and Recovery

Pueblo dispatch received as many calls early Friday morning as they normally do in one week. Some people called for emergencies, but many called simply because they did not know who else to call. The Rural Fire Department and Emergency Medical Services (EMS) did not receive heavy calls. The City Fire Department did receive many calls and even rescued stranded victims by boat. Firefighters also responded to minor fires caused by electrical shorts. Employees of Pueblo County Public Safety and Operations were paged by Pueblo Dispatch because of alarms from the Fountain Creek Early Flood Warning System. An alarm provides a warning if Fountain Creek rises ½ foot or more in ½ hour. Public Safety was also out early that morning, monitoring response actions and sharing information all day with private, city and county agencies. The National Weather Service, aided with information from Public Safety, State Patrol and others, issued Emergency Broadcast System warnings that morning and later that day. City and County Public Works were out trying to keep roads and culverts from eroding away. The State Department of Transportation was also out very early attempting to clear the mud and eroded embankments off of the highways.

Fortunately, warm weather held despite forecasts for more thunderstorms which helped response and recovery. The response went well because of a cooperative effort by many different agencies. City and County Public Works and the State Department of Transportation, for example, worked together in areas where impacts overlapped jurisdictions.

The County sustained a great deal of damage. One box culvert (Bridge 501B) on Overton Road was closed for several hours because of water flowing over both the north and south approach which washed out parts of the road. Pinon Road was also closed for several hours as Fountain Creek left its banks, which caused some re-routing of water in the flood plain which crossed Pinon Road. A few other major culverts suffered erosion on the outlet side, washing out portions of the roads. A few other roads were damaged, driveways were washed out, basements were flooded, and borrow ditches overflowed. There were some road closures until the damage could be repaired but general maintenance crews were able to handle the majority of the problems by that night.

City Public Works kept busy with similar types of damage. Storm drain inlets clogged with debris, sand and mud filled up streets, and many roads were closed due to high water and debris levels. A major sanitary sewer trunk line was washed out when Fountain Creek floodwaters eroded approximately 500 feet of stream bank. One soccer field, not yet seeded with grass, became saturated with water and caused a slide depositing a few inches of mud and sand into the streets and backyards of neighboring homes. Nearly 500 complaints were answered and completed by the Streets Department of City Public Works. These complaints consisted primarily of requests to clean out storm drain inlets, repair roads and alleys, and sweep bus routes.

The State Department of Transportation called on nearby crews to help repair damage to I-25, Highway 227, Highway 96 and Highway 50. They had to close southbound I-25 and re-rout northbound I-25 for most of the morning. Snowplows were used to clear the mud and sand from the roads. I-25 at Abriendo sustained major damage: a slope washed off into the interstate, chunks of asphalt and debris blocked the road, two feet of mud and water lay on the road in some places, and parts of the interstate were completely undermined. Although they cleared most of the damage very fast, they will still be working on repairing damage from this flood for quite a while, as will the City and County. Some of the damage has turned into long-term repair projects.

The Pueblo Chapter of the American Red Cross also responded to the flood later Friday morning. They called out their disaster assistance, damage assessment and family services volunteers locally and from other areas of the state to assess the situation and help victims recover from the flood. Some volunteers performed damage assessments in order to keep track of who would need certain kinds of assistance. A mass shelter was made ready and an emergency service center was opened near the hard-hit areas to help victims recover what ever losses they could. A few large dumpsters were made available to help victims dispose of flood generated debris.

The YWCA made showers available for people who did not have hot water. They also provided mattresses and a large amount of other furniture, such as refrigerators and stoves. The Family Counseling Center helped victims with counseling and financial aid.

City Council members surveyed the damage and spoke with the people about the flood and the clean up process. The Red Cross, together with city council members and city employees, planned a community clean-up that next Saturday. The Red Cross organized about six volunteer groups to go through the affected community and help people dispose of their damaged materials. Waste Management and Pueblo Sanitation together collected approximately 90 compacted yards of trash.

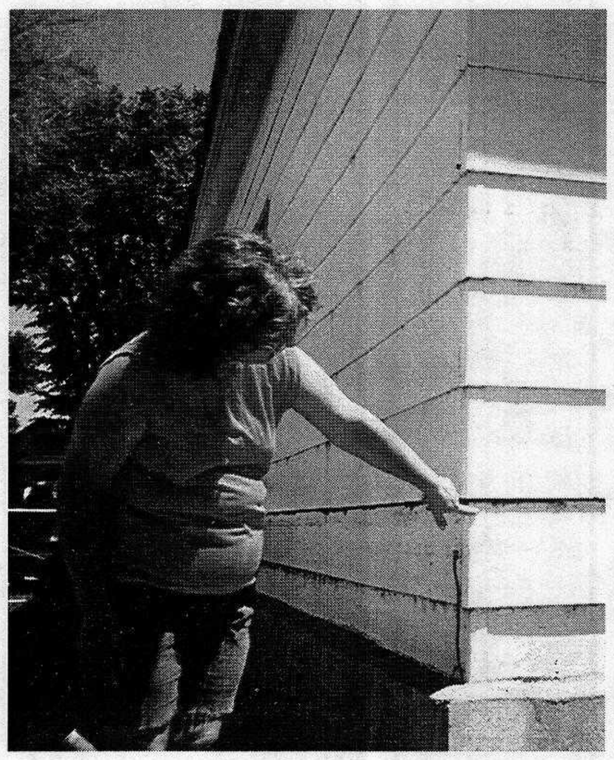
The Colorado State Office of Emergency Management and the Pueblo County Public Safety Office held a flood mitigation workshop in Pueblo on Monday, June 6, immediately following the flood. Twenty-four experts- engineers, building officials, public safety workers and emergency managers- spoke with community members about how to protect their homes from future storms. Nearly thirty citizens came to the workshop and were able to sit down and talk one-on-one with different professionals who would make suggestions on how to help prevent future problems from floods. Representatives from the Department of Local Affairs, Pueblo Field Services Office and from Pueblo County Public Safety and Operations worked on follow-up with a few people from the workshop regarding financial assistance for home improvements.

Public Service Company of Colorado responded immediately by turning meters off. The next day they installed locks to meters to ascertain that repairs would be made before restoring service. They referred people to private contractors to inspect furnaces and water heaters and then turn on pilot lights. Pueblo Regional Building Authority primarily dealt with making sure codes were followed. They estimated that less than 40 homes lost both gas and electricity. Only one or two homes received structural damage to the point where the electric system needed rewiring. Most of the damage included furnaces and water heaters located in basements where most of the substantial flooding resulted. WestPlains Energy was asked to turn off electricity in two homes. WestPlains, Public Service and Regional Building Authority were able to respond without employing emergency techniques such as overtime, and emergency crews.

City Parks and Recreation did not receive immediate calls and were able to respond on regular time. Friday they began cleaning up the trails and parks. Since many of the trails and parks are designed to absorb water in the flood plain, there were major washouts, often because of plugged culverts, and the river trails were covered with mud and water in some areas. City Park was flooded considerably and the storm system there needs to be replaced. An estimated 200 person hours were spent cleaning trails to make them passable.

Bessemer Ditch Company also received damage to the ditch in the south side neighborhood near Lake Avenue between Crystal Place and Adams Avenue. Portions of its banks washed out and caused some of its fencing to be destroyed as well. One response action could have been to close the gate that carries the water from Pueblo Dam through Bessemer Ditch, but it would have taken approximately 6 to 8 hours for the water to recede enough for the ditch to then hold significant runoff and rainfall. After 6 to 8 hours the runoff had already dissipated naturally. The ditch is about 6 feet deep and about 30 feet wide at the top (a little less at the bottom). The flow runs relatively slow, averaging 1½ to 2 miles per hour. The ditch was built in 1891 and extends 34 miles east. Some residents near the ditch reported the ditch overflowed. Others say runoff from Northern Avenue was so great that it ran onto the ditch and down the sides.

Possibly the ditch played a role in some flooding in the south side area because, in this area, the homes are about 4 to 8 feet lower than the ditch. When the rain fell hard and the storm drains could not remove it fast enough, the runoff pooled and the ditch acted as a kind of a dam. Runoff hit the "dam" and either pooled or bounced back into yards and homes. The woman in the picture (next page) lived right next to the ditch and just behind Northern Avenue (which carried quite a flow of water). The only thing between her home and the ditch is a paved parking lot.



Ms. Mascarenas points to the high water mark on her home.

It is important to note that Bessemer Ditch also helped relieve the flooded streets of runoff. The ditch acts as a discharge point for runoff carrying away storm water.

Commercial plumbers were also very busy that weekend. An estimated 50 basements were pumped by local professionals (e.g. Roto Rooter and Cut Rate). Some unconfirmed reports exist of people who pumped their basements too fast and caused foundation damage. ***Please see appendix A***

Flood Damage

By Saturday morning, Red Cross estimated residential and property damage at about $1 million. During their response, they surveyed nearly 160 homes and found about 6 were very heavily damaged, 30 sustained major damage, and approximately 120 received minor damage.

City, County and State roads, as well as parks and trails, sustained heavy damage as stated earlier in Flood Response. Since repair projects are still underway, there are no net cost estimates for damage as of yet. One particularly interesting City Public Works Project is the Fountain Creek (1994) project. The high river waters washed out 500 feet of embankment, which is just one place where it seems Fountain Creek is gradually altering its path. Beginning on June 3, 1994, Public Works has (up to this time) put in 191 worker days to place over 3,600 tons of dirt, over 3,200 tons of concrete rip rap, and over 800 tons of select rip rap to move the stream westward again in one area, and to stabilize the bank and the sewer line that runs through it (see picture). This project should take a few more weeks to complete.

The Pueblo County School District received no damage. Pueblo City School District, on the other hand, received heavy damage to five schools. Columbian Elementary School's basement, which contained the school's air-conditioning and computer wiring systems, was almost completely underwater.

Southern Pacific Rail Road had some main line damage. The Abriendo area north- and south-bound lines were damaged. They lost about 5% of their operating capacity. They estimated they sustained roughly a few hundred thousand dollars of damage. Santa Fe Rail Road did not make a report of damage available. The Transportation Test Center reported no damage.

Regional Building Authority reported one or two homes with subsidence around the perimeter of the house from the flood and two homes which needed the electricity pulled and reworked. Some homes had flooding past the ceilings of their basements and even a foot or more deep on the first floor.

The Fountain Creek floodwaters washed out large sections of the embankment and a sanitary sewer trunk line. Photo courtesy of John Dagenais, City Public Works.

Approximately 19 people brought claims against the city for damage to their homes, but the Colorado Risk Sharing Agency (through Steel City Corporation) denied claims for liability of the city. The claims reported damages within the range of $1,000 to $11,000.

Although the storm was localized, it was very intense and caused severe damage in the City and County of Pueblo. Public Works damage estimates will most likely be very high, as will others that are not yet figured. Now the City and County of Pueblo are both reflecting on and studying this flood to determine appropriate mitigation to help reduce potential future losses from similar floods.

Flood Mitigation Activities

Flood Insurance

There are three types of insurance one should investigate in order to help minimize uninsured losses from floods.

1. ***Sewer Backup Insurance:*** This will cover water damage to your building and contents when the sewer lines backup. It is a commercial insurance policy and details will vary from company to company.

2. ***Sump Pump Insurance:*** Several companies will insure for damages caused if a sump pump fails. Check several companies to see if they carry it and what the policy covers.

3. ***National Flood Insurance:*** This is a federally subsidized program that is available to any property owner whether or not the building is in a flood plain. Insurance is sold through any private insurance agent who wants to sell it in a community who has joined the program. The City and County of Pueblo participate in this program.

More about the National Flood Insurance Program:
The NFIP is based on an agreement between local communities and the federal government which states that if a community will implement measures to reduce future flood risks to new construction in Special Flood Hazard Areas (as mapped by Federal Emergency Management Agency), the federal government will make flood insurance available within the community as a financial protection against flood losses which do occur. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Flood insurance was, until recently, generally unavailable from private-sector insurance companies. These companies were aware of the potential for catastrophic losses and were unwilling to assume the financial risk alone.

Interestingly, one-third of all NFIP claims come from outside high-risk flood areas. The south side neighborhood hit so hard by this flood lies in a moderate to low zone (Zone B and C-- see center section maps), and few if any residents of this area had flood insurance. Many people found out too late that their homeowners' policies did not cover flood losses. At least several people did have comprehensive automobile coverage which insured losses on automobiles from flood damages. The Pueblo flood shows that many people who do not live in high flood risk areas do not think about flood insurance--until it is too late. The areas that were hit with this flood, however, tend to receive at least minor floods relatively consistently. So either flood insurance is unaffordable for many people in these areas, people do not choose to budget for it, or they are unaware of it.

This editorial note was published in the Pueblo Chieftain following the flood. It reflects the general community's confusion regarding exactly what NFIP covers and does not cover. Some people also believe their homeowners' insurance will cover flood damage.

Flood insurance

■ I would like The Chieftain to check out flood insurance. It seems a lot of people have insurance and were told it was good and then they find out later that it was not.

■ As for the insurance companies not paying for this recent storm because of clients not having flood insurance, I disagree. My house sits high on a hill and I have 8-foot extensions from the downspouts. The rain was so intense, it still flooded my basement and garage. That is a direct result of a 5-inch rain. No curbs overflowed, it was just direct out of the sky. I would like to hear others' input on this matter.

Editor's note: As we reported Saturday in an article on the topic, homeowner's policies don't cover floods. The only way to get flood coverage is to buy it from the National Flood Insurance Program, available from local agents.

The Pueblo Chieftain, June 1994, Editorial section

And why not the confusion? Most homeowners' policies cover you if your dog bites the mail carrier! As mentioned earlier, private insurance companies just could not afford to cover flood losses. Still, many people are not sure exactly what kinds of flood damages are covered under NFIP.

Here is some very basic information about what it covers:

NFIP: Flood is defined as a general and temporary condition of partial or complete inundation of normally dry areas, from--
-overflow of inland or tidal waters,
-unusual and rapid accumulation or runoff of surface waters from any source,
-mudslide...
The inundated area needs to cover at least 2 acres. The south side neighborhood's damage would be considered flood damage and would most likely be covered under NFIP.

Structural and Non-structural Mitigation

Many homes subject to occasional flooding in Pueblo have employed some structural mitigative measures such as concrete floodwalls, drainage improvements, high window-well walls, and elevation of property. These simple measures saved many homes. One home in the south side neighborhood sustained no damage, while every one of its neighbors had heavy damage. This house was elevated just high enough to keep the floodwaters out.

Non-structural mitigative measures can prove more effective than structural measures. Examples of nonstructural mitigation include emergency preparedness, public education and awareness, flood insurance, wise land use planning and zoning. It is important to note that a mere 5 or 6 acres, occupied primarily by single family dwellings, still remain in the city's flood plain. The Pueblo Dam and the Arkansas levee system eliminated at least 90% of the existing flood plain. The NFIP attempts to divert growth in floodway and flood-risk areas by flood plain ordinances which participating communities must adopt and enforce. Communities have been suspended from the regular program in Colorado for not enforcing adopted flood plain ordinances. Eliminating all new development in the floodway can be more effective in reducing risk than consistently relying on calculating effective structural measures with appropriate capacities for floods of different recurrence intervals.

The City of Pueblo Public Works Department is also working on structurally mitigating for future floods of this nature on Lake Minnequa. Currently Lake Minnequa (owned by CF & I) restricts operating lake levels to six tenths of a foot below the high water mark to allow for flood peak storage capacity during high risk times (May to September). City Public Works and CF & I have agreed to lower the lake level 2.4 feet below the high water mark. This outlet modification will allow for additional flood storage before runoff will flow through the outlet structure into the storm sewer system.

Pueblo County Public Works is also currently working on ways to structurally mitigate for future storms of this nature. Even before this flood they were working on a drainage basin study for the St. Charles Mesa.This area is flat and difficult to drain. It receives minor flooding consistently and received minor flooding during this storm. The proposal for this plan will be given to Pueblo County in August of 1994 for approval. It includes a 5 year flood capacity in most places (more or less in areas needing modified capacities).

Structural and non-structural mitigation techniques have been used and more are being planned. Pueblo Dam, the Arkansas River levee system and the Fountain Creek Flood Control Project all help mitigate against flooding in the city of Pueblo. However, currently there does not seem to be a great deal of coordinated planning for the Arkansas River downstream from Pueblo, with one exception. An agreement exists with Pueblo Dam to attempt to control the waterflow so that the Arkansas River at the Avondale gauge does not exceed 6,000 cfs. Incidentally, the Avondale area and especially Boone did receive flooding from the high river flows from the Arkansas River and its Pueblo area tributaries.

Summary

The June 3, 1994 flood caused damage to property in localized areas, primarily due to intense flash flooding that could not drain fast enough through the storm sewer network. This is an example of urban flash flooding that did not result in river flooding.

Since an Emergency Operations Center (EOC) was not established and the flood was not considered a major disaster, the flood served as an opportunity for city, county and state departments and agencies to respond separately under pressure, while communicating with each other and recalling their identified responsibilities in the plan. Most departments considered activation of the EOC to be unnecessary in this case but some commented it may have helped the recovery stage run smoother and faster. In any case, this event provided an opportunity for each department and agency to practice on a smaller disaster without the aid of an EOC.

Looking back on the incident, response and recovery ran smoothly, primarily because of professionalism in each individual area and because of cooperation among agencies. It has been suggested that a detailed list of action items that reflect lessons learned from this flood would be helpful. It would be especially helpful if a meeting of city and county responders worked cooperatively to generate the list.

APPENDIX A - In The Event of a Flood: Tips to minimize loss of life and property

When the Flood Comes

¤ Be prepared to evacuate before the water level reaches your property.

¤ If you are caught in the house by suddenly rising waters, move to the second floor and, if necessary, to the roof. Take warm clothing, a flashlight, and portable radio with you. Then wait for help... do not try to swim to safety. Rescue teams will be looking for you.

¤ When outside the house, remember... FLOODS ARE DECEPTIVE! Try to avoid flooded areas, and avoid walking through floodwaters that are more than knee deep.

¤ *If, and only if, time permits... there are several precautionary steps that can be taken:*

¤ Turn off all utilities at the main power switch and close the main gas valve if evacuation appears necessary. Do not touch any electrical equipment unless it is in a dry area and you are standing on a piece of dry wood while wearing rubber gloves and rubber soled boots or shoes.

¤ Move valuable papers, expensive articles, clothing, and other contents to upper floors or higher elevations.

¤ Fill bathtubs, sinks and jugs with clean water in case regular supplies are contaminated. You can sanitize these items by first rinsing with bleach.

¤ Board up windows or protect them with storm shutters or tape to prevent flying glass.

¤ Bring outdoor possessions inside the house or tie them down securely. This includes lawn furniture, garbage cans, tools, signs, and other moveable objects that might be swept away or hurled about.

¤ *If it is safe to evacuate by car, you should consider doing the following:*

¤ Stock the car with nonperishable foods, a plastic container of water, blankets, first aid kit, flashlights, dry clothing, and any special medication needed by your family.

¤ Keep the gas tank at least half full since gasoline pumps will not be working if the electricity has been cut off.

¤ Do not drive where water is over the roads. Parts of the roads may already be washed out.

¤ If your car stalls out in a flooded area, abandon it as soon as possible. Floodwaters can rise rapidly and sweep a car (and its occupants) away. Many deaths have resulted from attempts to move stalled vehicles.

After the Flood

¤ If your home has suffered flood damage, call your flood insurance agent immediately. The agent will then submit a loss form to the National Flood Insurance Program. An adjuster will inspect your property as soon as possible.

¤ Prior to entering a building, check for structural damage to make sure it is not in danger of collapsing. Turn off any outside gas lines at the meter or tank, and let the house air for several minutes to remove foul odors or escaping gas.

¤ Upon entering a building, do not use an open flame as a source of light since gas may still be trapped inside; a battery-operated flashlight is ideal.

¤ Watch for electrical shorts or live wires before making certain that the main power switch is turned off. Do not turn on any lights or appliances until an electrician has checked the system for short circuits.

¤ Cover broken windows and holes in the roof or walls to prevent further weather damage.

¤ Proceed with immediate cleanup measures to prevent any health hazards. Perishable items which pose a health problem should be listed and photographed before discarding. Throw out fresh food and previously opened medicines that have come in contact with floodwaters.

¤ Water for drinking and food preparation should be boiled vigorously for 10 minutes (until the public water system has been declared safe). Another method of disinfecting is to mix ½ teaspoon of liquid bleach with 2½ gallons of water...let stand 5 minutes before using. In an emergency, water may be obtained by draining a hot water tank or melting ice cubes.

¤ Refrigerators, sofas, and other hard goods should be hosed off and kept for the adjuster's inspection. Any partially damaged items should be dried and aired; the adjuster will make recommendations as to their repair or disposal. Take pictures of the damage done to your building and contents.

¤ Take all wooden furniture outdoors and dry, but keep it out of direct sunlight to prevent warping. Remove drawers and other moving parts as soon as possible.

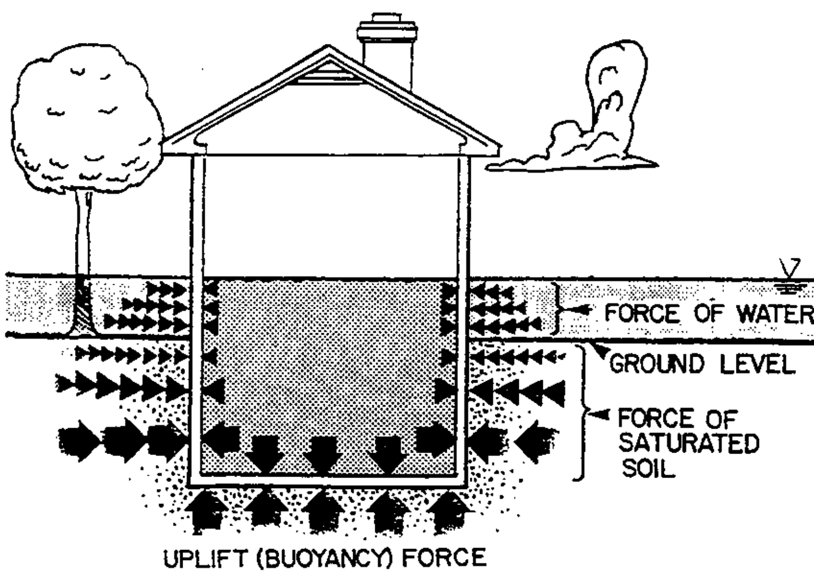
¤ Shovel out mud while it is still moist to give walls and floors a chance to dry. Once plastered walls have dried, brush off loose dirt. Wash with a mild soap solution. Special attention at this early stage should also be paid to cleaning out heating and plumbing systems.

¤ Mildew can be removed from dry wood with a solution of 4-6 tablespoons of tri-sodium phosphate, 1 cup liquid bleach, and 1 gallon water.

¤ Clean metal at once then wipe with a kerosine-soaked cloth. A light coat of oil will prevent iron from rusting.

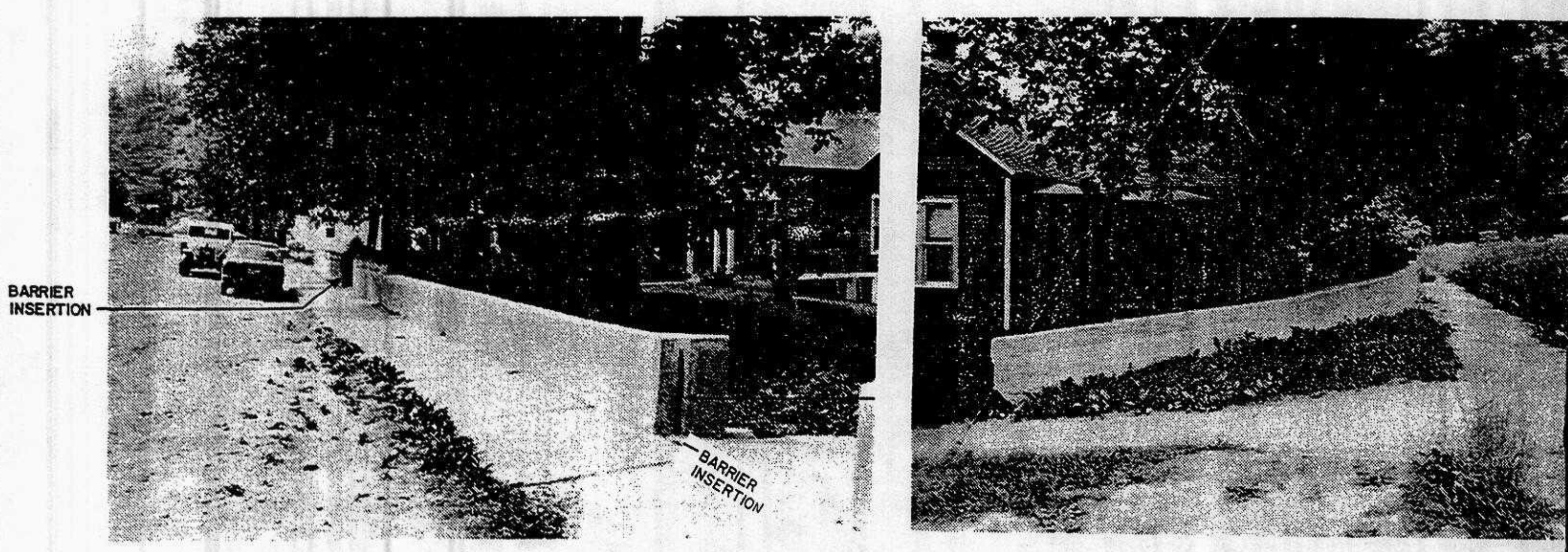
¤ Quickly separate all laundry items to avoid running colors. Allow clothing or household fabrics to dry slowly, away from direct heat.

¤ Flooded basements should be drained and cleaned as soon as possible. However, structural damage can occur by pumping out the water too quickly. After the floodwaters around your property have subsided, begin draining the basement in stages, about one third of the water volume each day. Do not pump the basement dry if the ground is still saturated. The walls could collapse if there is no water inside to counterbalance the pressure of the water on the outside of the walls. *Please see diagram below*

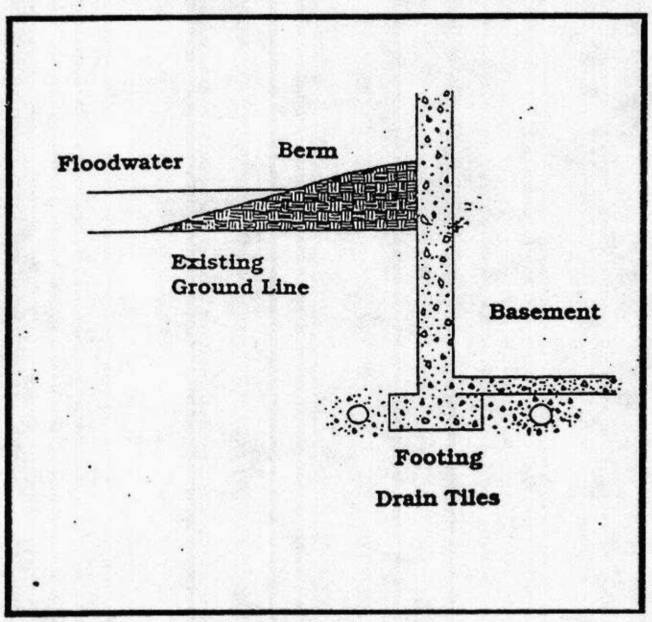


Balanced forces by internal flooding.

APPENDIX B - Forms of Structural Mitigation for Flooding



Floodwalls such as these could prove especially useful in the case of flash flooding as well as riverine or small stream flooding-- all of which Pueblo is susceptible. Some people in Pueblo already utilize floodwalls and berms. Berms (below) can also help protect a structure from rising waters.



Most of Pueblo's damage resulted from flooded basements. Refer to this guide for mitigation of flooded basements. A table of contents is shown here to show what the guide covers. A copy can be obtained from Pueblo County Public Safety and Operations Office or from the State Office of Emergency Management.

DRAFT

STATE OF COLORADO 1876

Roy Romer
Governor

HOME AND BUSINESS GUIDE for the MITIGATION of FLOODED BASEMENTS

Colorado Department of Local Affairs
Division of Local Government
Office of Emergency Management

&

Pueblo County Department of Public Safety & Operations

Home and Business Owners Guide DRAFT 6/93

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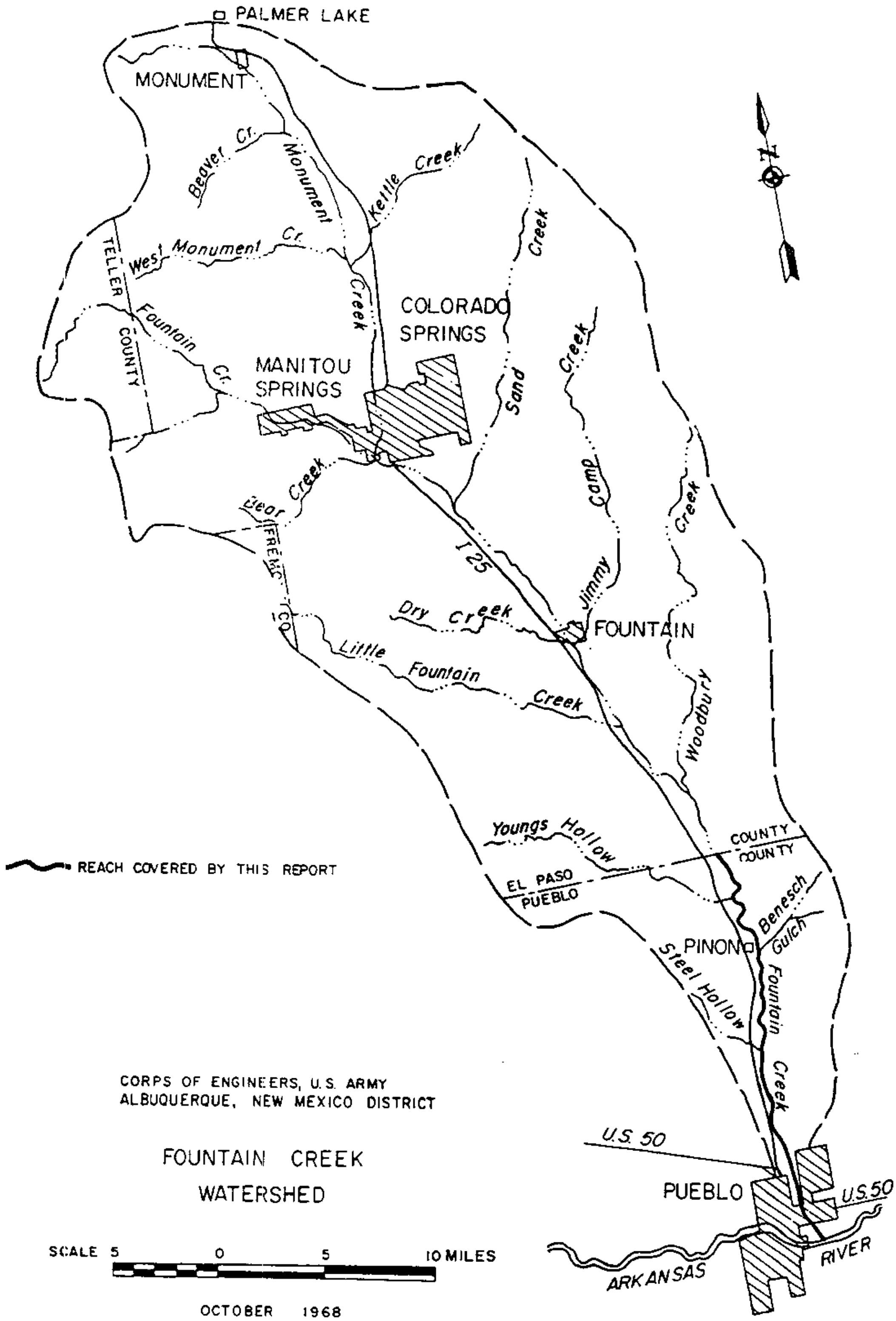
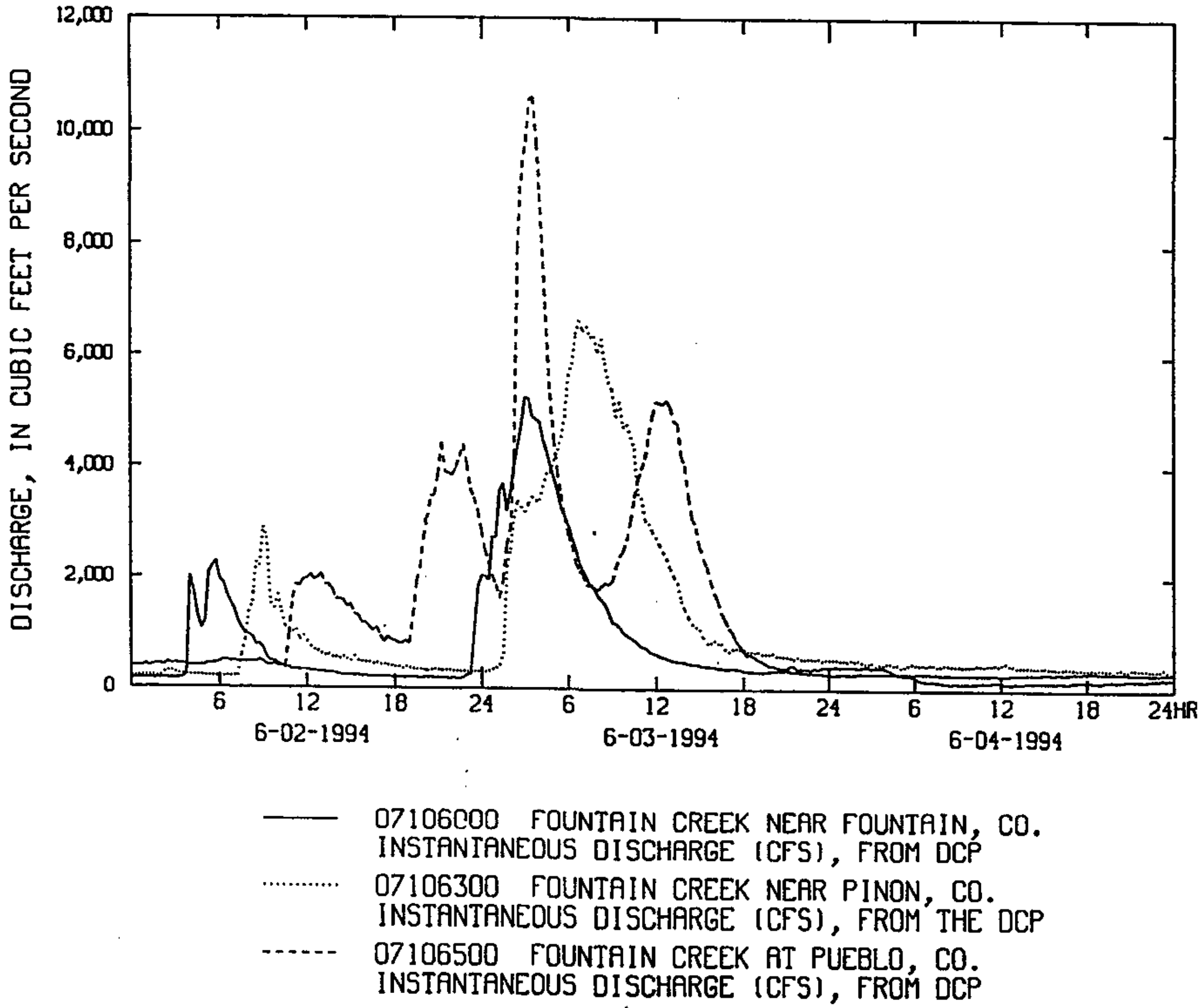
APPENDIX C - Fountain Creek Watershed



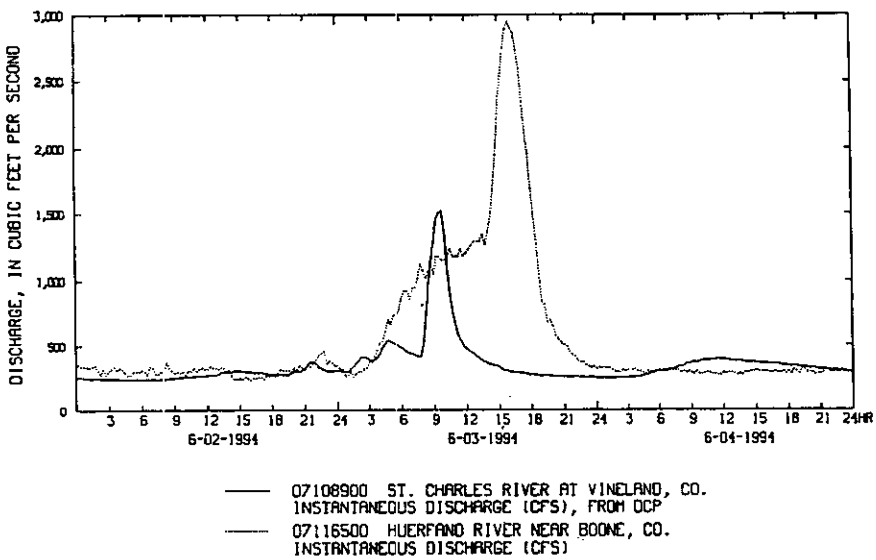
Fountain Creek watershed, taken from Corps of Engineers flood plain study, 1968.

APPENDIX D - Stream Activity During Pueblo Flood

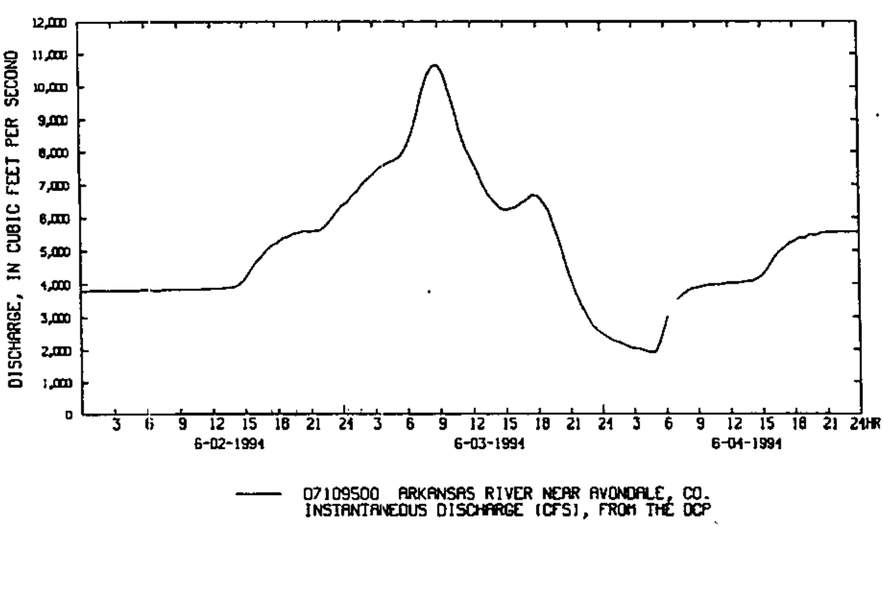
Although certain streams did achieve sizable peak flows, the overall stream levels do not reflect the magnitude of the event; however, the impact on the community did. The impact on the community from this flash flood should not be underestimated because of the relatively low flood recurrence intervals on the streams.



As you can see from the hydrograph, Fountain Creek at Pueblo reached approximately 11,000 cfs immediately following the June 3, 1994 storm. This magnitude is equivalent to about a 5-year flood on Fountain Creek. A 50-year flood on this stream would require the stream to run at 45,000 cfs. During the 1965 flood in Pueblo, Fountain Creek reached 47,000 cfs.



The tallest peak on this hydrograph shows the Huerfano River peaking at nearly 3,000 cfs near Boone (east of Pueblo). The Huerfano River flooded Highway 209 near Boone and pastureland in that area. The river peaked at 19,400 cfs during the 1923 flood. The St. Charles reached nearly 1,500 cfs during the June 3, 1994 flood, but peaked at 56,000 cfs during an incredible 1901 flood.



This hydrograph of the Arkansas River near Avondale reflects both the Thursday, June 2 and the Friday, June 3, 1994 storms. The Arkansas River reached approximately 100,000 cfs during the 1921 flood.

These hydrographs, from United States Geological Survey, Water Resources Division in Pueblo, Colorado, reflect peak flows of June 2-4 from several gauging installations in the Pueblo vicinity.

References

June 1994. United States Geological Survey, Water Resources Division, Pueblo, Colorado. Hydrographs

June 3, 1994. National Oceanic and Atmospheric Administration National Weather Service, Pueblo, Colorado. River and rainfall reports and advisories.

June 1994. The Pueblo Chieftain. several articles from issues including: June 3, 4, 5, 7, 9, 11, 12, 15, 17, 20, 21, 24, 25, 27, 28, 29, 30, 1994.

June 1993. Office of Emergency Management and Pueblo County Department of Public Safety Operations. Home and Business Guide for the Mitigation of Flooded Basements, Draft

September 1993. Wehner, George and Carol Foster, Office of Emergency Management City of Colorado Springs Flood Hazard Mitigation Plan: The Flood of June 17th, 1993.

1993. Southeastern Colorado Water Conservancy District. 1993 Annual Report.

April 1976. United States Army Corps of Engineers- Albuquerque, New Mexico, District Flood Plain Information of Salt Creek in the Vicinity of Pueblo, Colorado.

March 1970. United States Army Corps of Engineers- Albuquerque, New Mexico, District Flood Plain Information of St. Charles River in the Vicinity of Pueblo, Colorado.

April 1969. United States Army Corps of Engineers- Albuquerque, New Mexico, District Flood Plain Information of Goodnight Arroyo, Dry Creek and Wild Horse-Dry Creek, in Pueblo, Colorado.

October 1968. United States Army Corps of Engineers- Albuquerque, New Mexico, District Flood Plain Information of Fountain Creek in the Vicinity of Pueblo, Colorado.

brochure. Federal Emergency Management Agency, Federal Insurance Administration, National Flood Insurance Program. FLOOD: Are You Protected From the Next Disaster?