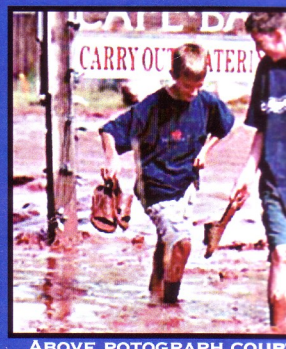
Prepared by URS
March 2002

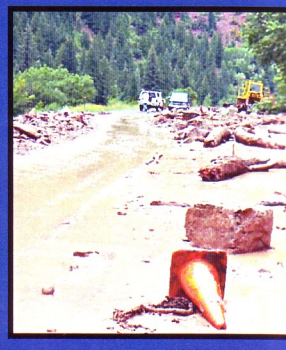
Colorado Water Conservation Board

2001 Colorado Flood Documentation Report

Above photograph co
the Greeley Tri



Above potograph cour
Telluride Daily P



Colorado Department of Natural Resources

Colorado Water Conservation Board

URS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Tables

Figures

Appendices

Attachments

This study was authorized by the Colorado Water Conservation Board (CWCB) under Section 37-60-106 (1) (c) of the Colorado Revised Statutes. Under this statute, the CWCB has the power and duty "to devise and formulate methods, means and plans for bringing about the greater utilization of the waters of the state and the prevention of flood damages therefrom."

The purpose of this study is to summarize specific flood events that occurred throughout Colorado during 2001 by conducting interviews and performing other data collection tasks, performing data analysis, and summarizing this information in a report.

The CWCB initially identified a number of individual flood events during the flood season, July through September of 2001. The identified events are located along the Front Range, in the eastern plains, and in western Colorado. Figure ES-1 shows the identified areas included in this study, and Table ES-1 lists the reported dates and type of storms.

Table ES-1

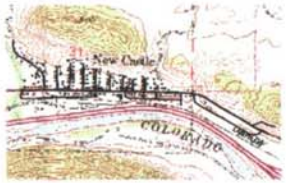
2001 Identified Flood Events

Location	Type of Flooding	Date(s) of Flooding
Colorado Springs	Highway interchange flooded due to pump lift station failure.	August 31, 2001
Greeley	Significant flooding due to severe localized storm.	July 13, 2001
Holyoke	Minimal flooding, but crops damaged from hail.	September 7, 2001
Meeker/Rio Blanco County	Several storms over many weeks caused moderate flooding throughout the County.	mid-July to late August, 2001
New Castle	Significant flooding from mudslides due to a severe localized storm	August 14, 2001
Palisade/Grand Valley	Moderate storm produced mud slide affecting roadways.	September 13, 2001
Telluride to Placerville (San Miguel County)	Significant flooding due to severe localized storm	August 8, 2001

The floods reported in 2001 generally resulted from localized rainstorms consisting of short duration, high intensity cloudbursts. No major flooding Statewide was reported, and, in general, 2001 was a relatively light flood year. Apparent damages include, but are not limited to, street flooding, basement flooding, damage to vehicles, mud/debris accumulation, and other nuisance-type damages. None of the affected communities have received a State or Federal disaster declaration as a result of the flooding conditions.

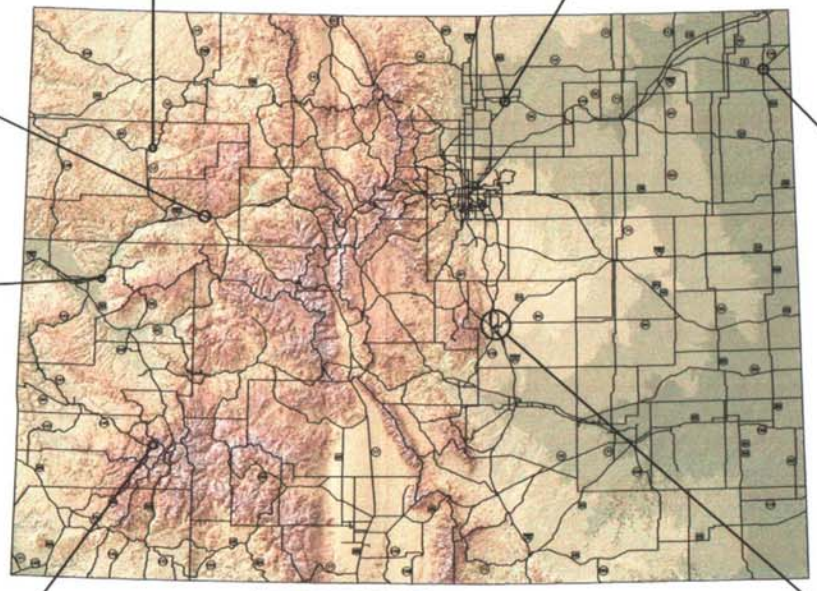
The week between September 9 and September 17, 2001 appears to contain the greatest number of events including 4 of the 7 floods investigated within the State.

New Castle
August 14, 2001
(Section 6 of report)

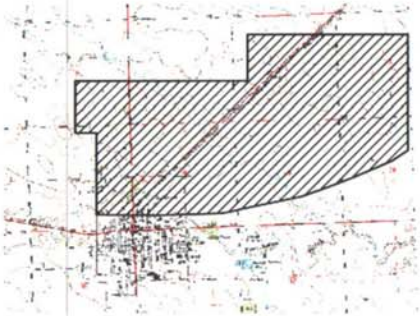


Greeley
July 14, 2001
(Section 3 of report)

Meeker/Rio Blanco County
mid July–late August
(Section 5 of report)



Holyoke
September 9, 2001
(Section 4 of report)



Paliside/Grand Valley
September 13, 2001
(Section 7 of report)

Telluride to Placerville
September 17, 2001
(Section 8 of report)

Courtesy of the Telluride Daily Planet

Colorado Springs
August 31, 2001
(Section 2 of report)

N

Not To Scale

LEGEND

Inundation Area

Impacted Roads

	URS	CWCB 2001 Flood Study Areas	FIGURE ES-1

T:\PROJECTS\...\CWCB_FLOOD_DOC_00\SUB_00\9.0_CAD\FLOODDWGS\SHEET1.DWG(11x17 LAY

The following is a short summary of the flooding that occurred in 2001 for the specific areas within the State of Colorado.

Colorado Springs

- A localized rainstorm and significant flooding were reported for August 31, 2001.
- A NOAA Event Record indicates that more than **5 inches fell in approximately 5 hours, equivalent to a greater than 100-year event locally**. The storm was very localized around the downtown area.
- Flow data for Monument Creek and Fountain Creek for September 1st indicated little impact from the storm.
- As the storm was very localized, only a small area near downtown was affected, and no creeks were reported to have overtopped their banks.
- The primary cause of flooding was associated with lightning, which caused a lift station failure. With the pumps out and a heavy local rainfall, two to three feet of water inundated Interstate 25, which was closed for at least seven hours.
- Damage to the pumps and other electrical equipment cost CDOT approximately **$30,000**. CDOT estimated cleanup costs at approximately **$2,000**.
- A drop structure construction project in Monument Creek was damaged during the event, costing the City approximately **$30,000**.
- No private property damage was reported.

Greeley

- A large localized rainstorm was reported for July 13th, 2001 for the Greeley area.
- Research indicated very significant flooding and property damage from this storm. Three-foot deep water was reported in some areas of Greeley, including downtown areas.
- The National Climatic Data Center indicates that from **3 to 5 inches** of rainfall fell in **less than 2 hours** on July 13th. This event is equivalent to at least a **100-year frequency event locally**.
- Damages and impacts included several flooded basements (among them City Hall), stranded motorists due to inundated streets, and an electrical outage for approximately 2,300 residents. A NOAA Event Record listed an estimated total of **$600,000 in property damages**. Damage at City Hall was estimated to be approximately **$250,000**.

Holyoke

- A storm was reported for September 7, 2001 for the Holyoke area.
- Preliminary data from NOAA indicates that **0.57 inches of precipitation** fell in **less than one hour – less than a 2-year frequency event**.

- This storm produced significant crop damage on farms in the surrounding area of Phillips County. Hail and high winds defoliated sugar beets and corn and shelled beans. Estimated crop losses included 10% to 15% of the corn in the region, and 60% of the irrigated beans. Damage estimates were not available.
- No emergency flood fighting efforts were implemented.

Meeker/Rio Blanco County

- During the latter portion of July and through the majority of August 2001, sizable areas of Rio Blanco County were partially inundated with flash flooding and debris flows as a result of several separate precipitation events. No precipitation data was reported for individual events.
- The majority of the effects of these precipitation events were in the southeastern portion of Rio Blanco County near the Town of Meeker. Lesser effects were also reported near Rangley. Approximately a 50-square-mile area was impacted by flooding. The watersheds most affected by these flood events were the Piceance Creek basin, the White River basin, and the Yellow Creek basin.
- Several County roads and local streets were inundated with mud and debris as a result of flash flooding.
- Most of the flooding seemed to occur along several intermittent streams prone to flash flooding during heavy, short-duration rain events. No flow data is available for these streams.
- Flows in Piceance Creek where actually below normal except for one large spike in the latter portion of August, which was equivalent to approximately a **1.5-year frequency event**.
- Mudslides, as a result of the heavy rainfall and flash flooding, filled and covered drainage ditches, culverts, and roadways with mud and other related debris. Many County roads were inundated and impassable by motorists.
- Most of the private property damaged was agriculture related, as debris from mudslides was deposited on privately owned agricultural land. No reports of residential or commercial building damages were obtained. No private expenditures were reported, and no emergency flood fighting efforts were implemented.
- CDOT Maintenance in Craig, Colorado reported that minimal cleanup activities were required as a result of mudslide debris deposits on State Route 64 just west of Meeker; drainage ditches and culverts required cleanup following the events. The estimated cost to CDOT for these activities was approximately **$20,000**.

New Castle

- On August 14, 2001, a strong thunderstorm over the Town of New Castle produced very heavy rain and small hail. The majority of the affects of this storm were in the eastern portion of Garfield County, in particular in the Town of New Castle. The watershed most affected by these flood events was the Colorado Headwaters-Plateau basin.

- The Town of New Castle reported approximately **1.5 inches in 15 minutes**, and a NOAA event record reported **one inch in less than 20 minutes**. This precipitation event is equivalent to approximately a **100-year frequency event locally**.
- No flow data was collected due to the fact that no gauged streams or creeks were directly affected by the rainfall events.
- The heavy rain triggered a massive mudslide that flooded several homes and businesses in New Castle. Total damages were estimated to be **$32,000**.
- Clearing debris from local roads and storm sewers was the majority of work that resulted from the storm. The storm closed U.S. Highway 6 through town as well as several other local streets. Up to 2 feet of mud and rocks were left behind after the flooding, and it took several days to clear the debris; the cost of these efforts amounted to approximately **$85,000**.

Palisade/Grand Valley

- On September 13, 2001 a slow moving thunderstorm dropped rainfall on the western portion of Mesa County near the Town of Palisade. A NOAA Event Record characterized the rainfall as "heavy," however, the local newspaper reported that **0.07 inch of rain fell within a 12-hour period, less than a 2-year frequency event.**
- No flow data was collected due to the fact that no gauged streams or creeks were directly affected by the rainfall events.
- No public or private property damages or expenditures were reported. However, several cleanup activities were required after the storm, including debris removal from the Interstate 70-Palisade exchange, reshaping drainage ditches, and cleaning storm sewer structures. CDOT reported no serious traffic delays and I-70 remained open throughout the entire time period. Flood related damages incurred by CDOT were estimated to total approximately **$30,000**.

Telluride to Placerville (San Miguel County)

- On August 8, 2001 slow moving thunderstorms over eastern San Miguel County dropped **up to 5 inches of rain in a 2-hour period, equivalent to approximately a 150-year frequency event locally.**
- The majority of the effects of the event were in the southeastern portion of San Miguel County between the Towns of Telluride and Placerville. The two watersheds most affected by these flood events were the San Miguel River basin and the Upper Dolores River basin. Several small streams to the north and south of the San Miguel River were also affected.
- According to USGS data, the San Miguel River discharge peaked at approximately **430 cfs**, approximately equivalent to a **1-year frequency event**. However, according to "The Watershed Connection" the San Miguel River peaked well **over 2,000 cfs, approximately equivalent to a 5-year frequency event**.
- Several smaller streams were more seriously affected, namely Bear Creek, Fall Creek, and Deep Creek. San Miguel County reported that Bear Creek was flowing outside its banks and

was eroding County Road 60M. However, no discharge data from these smaller streams was available.

- Approximately 20 miles of roadway, which were under construction, were impacted by flooding and showed signs of at least partial inundation. This includes areas in both the San Miguel River basin and Upper Dolores River watershed.
- CDOT incurred costs of approximately $2.8 million, including reconstruction of retaining walls, debris removal, traffic control, and other costs.
- Two homes sustained major damage from the floods with several others experiencing minor damages. Several vehicles were damaged as a result of being swept from Highway 145 as mud and rock slid over the roadway surface. One vehicle was pushed into the riverbed. Damages to private property were estimated to be approximately **$400,000**.
- No personal injuries were reported, however some traffic delays were experienced by motorists.

Damages Summary

Estimated damages for the identified areas affected by flooding in Colorado during 2001 are summarized in Table ES-2.

Table ES-2

Summary of Damages

Location	Frequency of Occurrence	Estimate of Total Damages
Colorado Springs	Greater than 100-year (locally)	$62,000
Greeley	100-year	$600,000
Holyoke	Less than 2-year	Unknown
Meeker/Rio Blanco County	1 ½-year	$20,000
New Castle	100-year (locally)	$117,000
Palisade/Grand Valley	Unknown	$30,000
Telluride to Placerville (San Miguel County)	From 5-year to 500-year (locally)	$3,200,000

1.1 PURPOSE OF STUDY

The purpose of this study is to summarize specific flood events that occurred throughout Colorado during 2001 by performing data collection, data analysis, report writing and other tasks.

1.2 AUTHORIZATION

This study was authorized by the Colorado Water Conservation Board (CWCB) under Section 37-60-106 (1) (c) of the Colorado Revised Statutes. Under this statute, the CWCB has the power and duty "to devise and formulate methods, means and plans for bringing about the greater utilization of the waters of the state and the prevention of flood damages therefrom."

1.3 GENERAL STUDY AREA DESCRIPTION

The CWCB initially identified a number of individual flood events during the flood season, July through September of 2001. The identified events were located along the Front Range, in the eastern plains, and in western Colorado. Table 1.3-1 shows the identified areas included in this study, and Figure 1.3-1 provides a map of Colorado showing the identified flood areas investigated for this study.

Table 1.3-1

2001 Identified Flood Events

Location	Type of Flooding	Date(s) of Flooding
Colorado Springs	Highway interchange flooded due to pump lift station failure.	August 31, 2001
Greeley	Significant flooding due to severe localized storm.	July 13, 2001
Holyoke	Minimal flooding, but crops damaged from hail.	September 7, 2001
Meeker/Rio Blanco County	Several storms over many weeks caused moderate flooding throughout the County.	mid-July to late August, 2001
New Castle	Significant flooding from mudslides due to a severe localized storm.	August 14, 2001
Palisade/Grand Valley	Moderate storm produced mudslide affecting roadways.	September 13, 2001
Telluride to Placerville (San Miguel County)	Significant flooding due to severe localized storm.	August 8, 2001

1.4 SCOPE OF WORK

In order to summarize the flooding which occurred in the State during 2001, several tasks were undertaken:

- **Collect existing information**-Appropriate Local, State and Federal agencies as well as private citizens were contacted in order to obtain the necessary data for this study. Data included precipitation amounts, geographic extent of the flood events, reports of estimated flood damages, stream gauge data, photographs, and any other available reports/information.
- **Summarize and inventory collected information**-Databases and files were set-up to organize the collected data.
- **Evaluate data and develop new information**-The data collected was evaluated and estimates were made for the frequency of the flooding/precipitation events.
- **Produce final report**-This report summarizes the above information and the results of the evaluations undertaken.

1.5 2001 FLOOD EVENTS SUMMARY

The floods reported in 2001 generally resulted from localized rainstorms consisting of short duration, high intensity cloudbursts. No major flooding statewide was reported, and, in general, 2001 was a relatively light flood year. Apparent damages include, but are not limited to, street flooding, basement flooding, damage to vehicles, mud/debris accumulation, and other nuisance-type damages. None of the affected communities have received a State or Federal disaster declaration as a result of the flooding conditions.

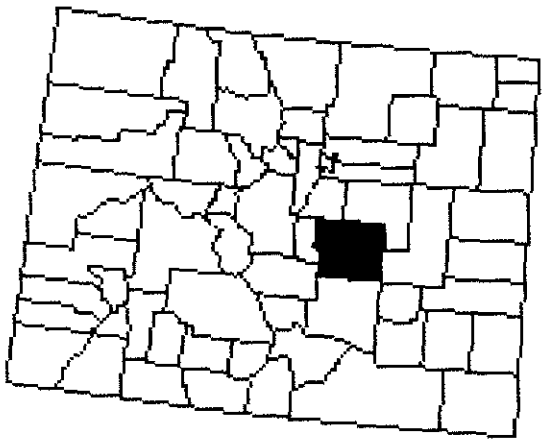
The week between September 9 and September 17, 2001 appears to contain the greatest number of events including 3 of the 7 floods investigated within the State.

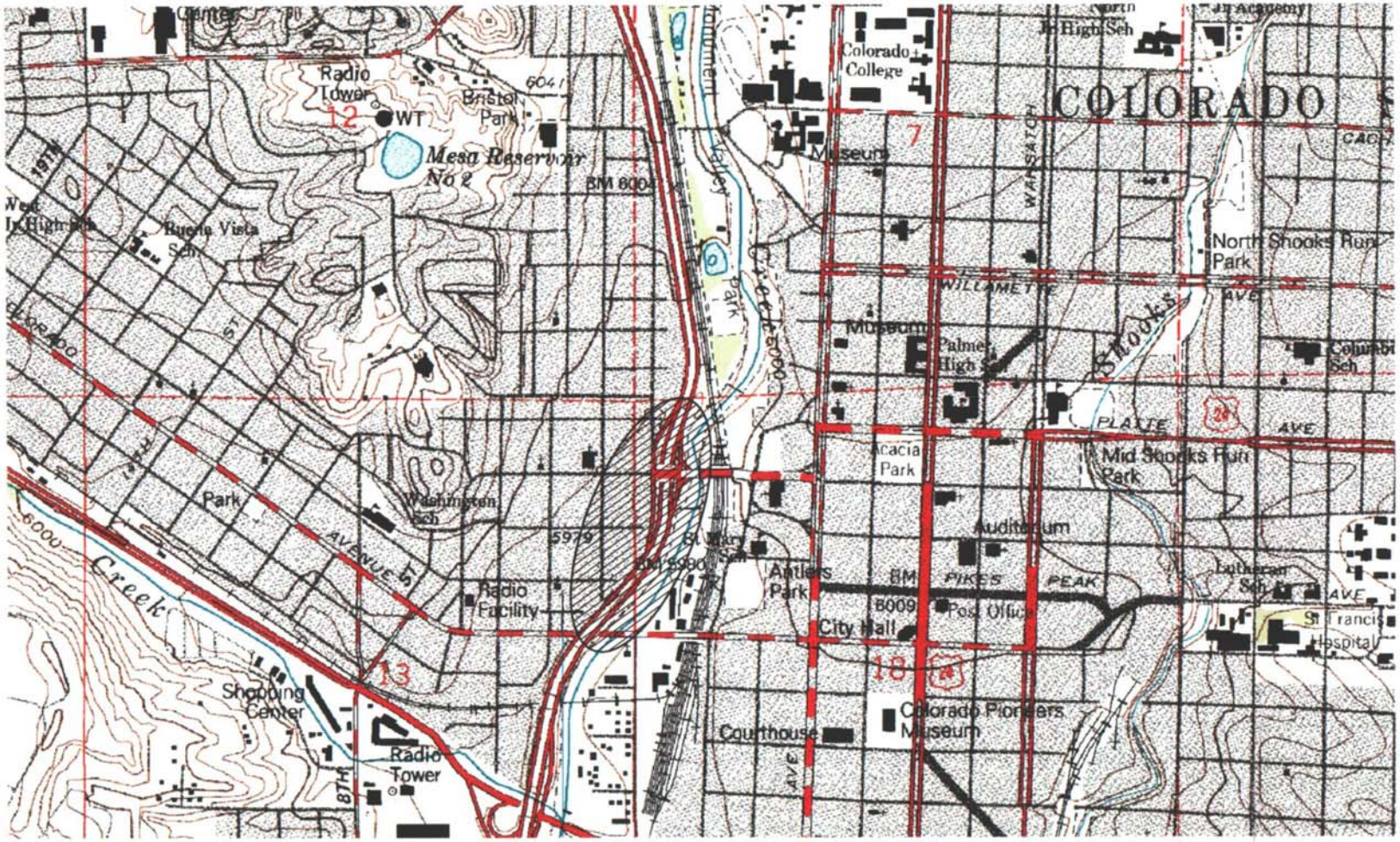
A storm and significant flooding were reported for August 31, 2001 within Colorado Springs. The flooding was associated with a severe localized rainstorm and failure of a pump lift station.

2.1 STUDY AREA DESCRIPTION

Figure 2.1-1 highlights Colorado Springs and El Paso County. Colorado Springs lies in the Fountain Creek watershed, including the watersheds of Monument Creek and Cottonwood Creek, which are two large tributaries to Fountain Creek. The confluence of Fountain and Monument Creeks is near downtown Colorado Springs. Figure 2.1-2 provides a map showing the impacted areas in further detail.

Figure 2.1-1
Study Area Location
Fountain Creek, Colorado Springs, Colorado





URS	Colorado Springs September 16, 2001 Inundation Map	FIGURE 2.1-2

T:\PROJECTS\...\CWCB_FLOOD_DOC_00\SUB_00\9.0_CAD\FLOODDWGS\COLORADO-SPRINGS.DW

The Fountain Creek watershed, shown on Figure 2.1-3, is a 927-square mile watershed that drains south into the Arkansas River at Pueblo. The watershed is bordered by the Palmer Divide to the north, Pikes Peak to the west, and a minor divide 20 miles east of Colorado Springs.

Figure 2.1-3
Fountain Creek Watershed

2.2 STORM EVENT DATA

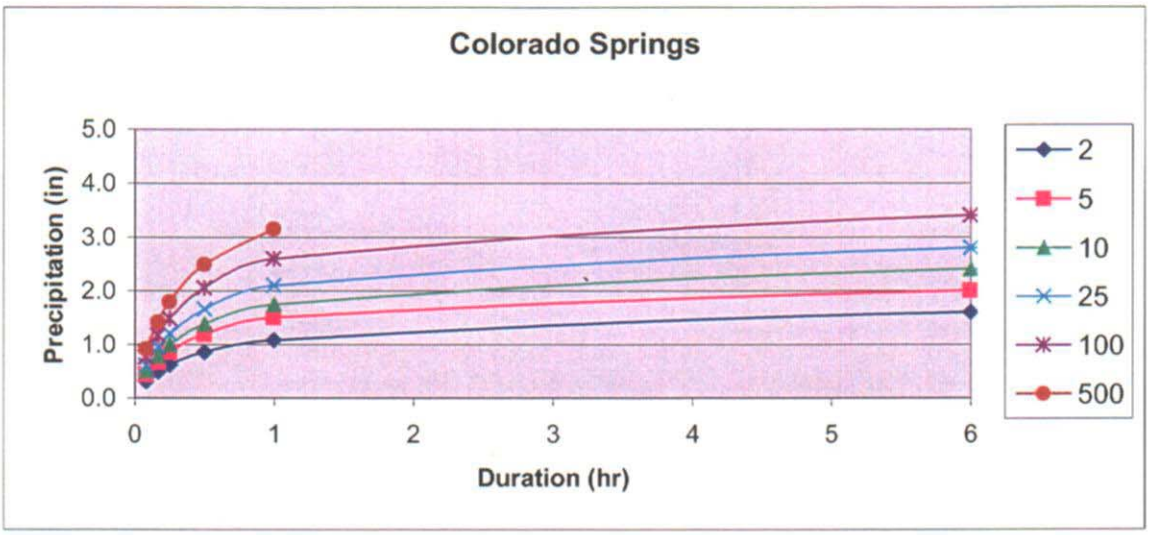
2.2.1 Precipitation Data

Mr. Bruce Thorson, an engineer with the City of Colorado Springs, reported a rainfall total of approximately 5.4 inches at Colorado College; most of the precipitation fell in an 8-hour period from 11 A.M. to 7 P.M. Smaller amounts of rain fell at locations south of the city: 0.41 inches at Pinello Ranch, and 0.27 inches at the Nixon Power Plant.

A NOAA Event Record indicates that more than 5 inches fell in approximately 5 hours. The NOAA web site (http://precip.fsl.noaa.gov/hourly_precip.htm containing "raw" data, which has not undergone Quality Control) does not contain a gage station near downtown Colorado Springs, and it does not indicate that more than 0.6 inches fell on this date at any of the gage sites near Colorado Springs (e.g., in Manitou Springs, near Fountain Creek and Janitell Road). This indicates that the intense storm was very localized around the downtown area.

A comparison between the Event Record data and precipitation-duration-frequency curves (Figure 2.2-1 developed from the U.S. Department of Commerce, NOAA Atlas 2, Volume III-Colorado) indicates that the localized precipitation that occurred in the downtown area is equivalent to a much greater than a 100-year frequency event.

Figure 2.2-1
Precipitation-Duration-Frequency Curves for Colorado Springs, Colorado



2.2.2 Flow Data

Flow data for Monument Creek, Fountain Creek, and Cottonwood Creek for August 31, 2001 was not available from the USGS surface water monitoring program (http://water.usgs.gov). This is possibly due to web site maintenance at the time of this study. Data for September is shown in Figures 2.2-2 and 2.2-3 (this is the latest provisional data and is subject to revision). Data for Cottonwood Creek was not available for September.

Figure 2.2-2

Daily Discharge for Fountain Creek, Colorado – September, 2001

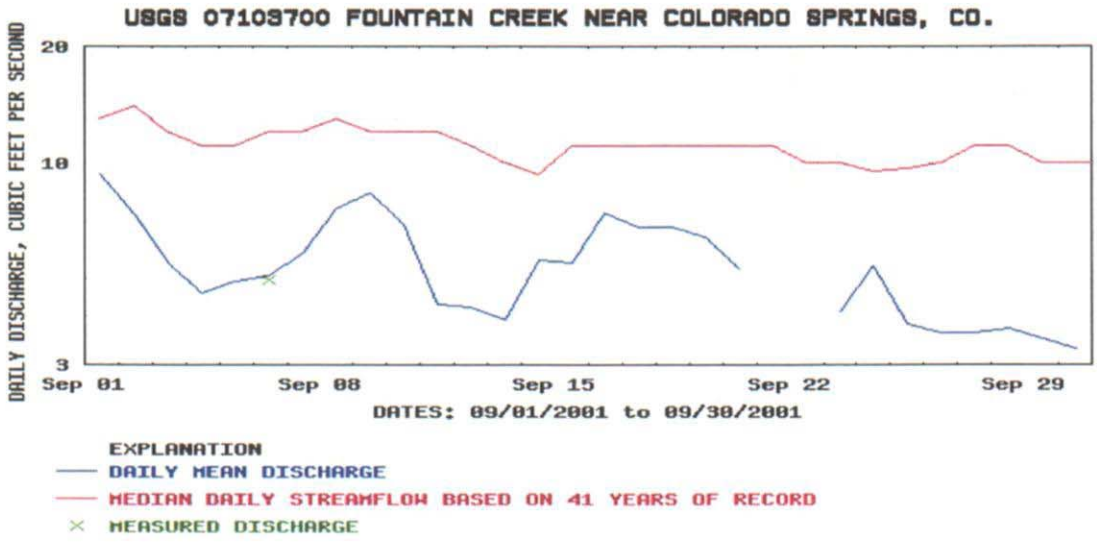
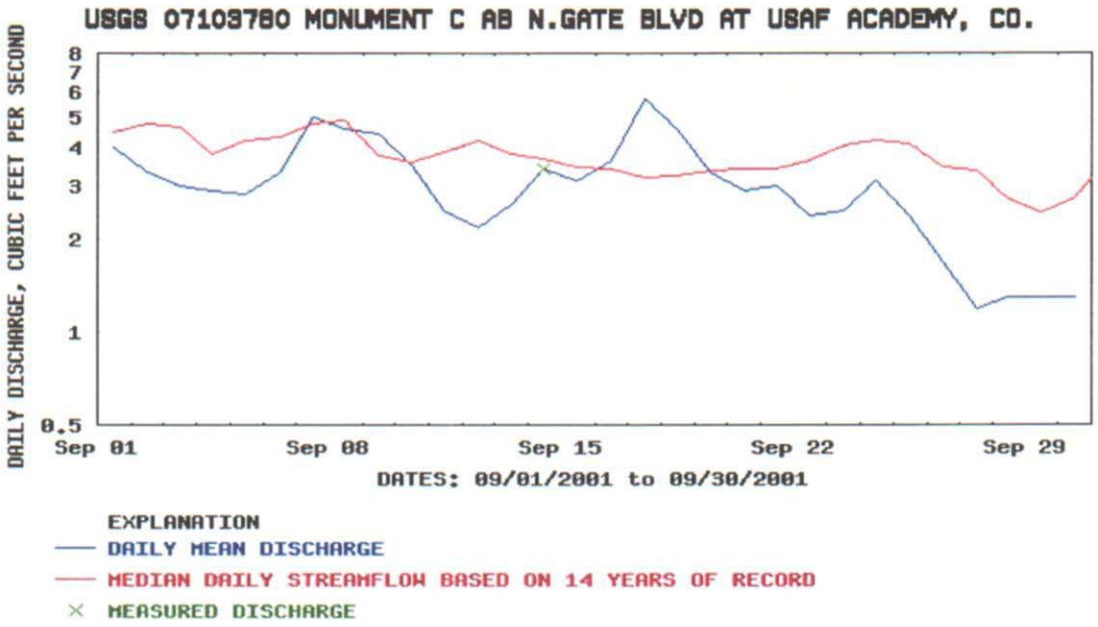


Figure 2.2-3
Daily Discharge for North Gate Blvd. At USAF Academy, Colorado – September, 2001



Figures 2.2-2 and 2.2-3 compare the daily mean discharge and the median daily stream flows based on several years of data. [Note for black and white copies: In Figure 2.2-2 the daily mean discharge data series is beneath the streamflow data series that is based on the 41 years of record. In Figure 2.2-3 the daily mean discharge data series has higher peaks and valleys than the streamflow data series that is based on the 14 years of record.]

A frequency analysis of the data using the USGS software PEAKFQ indicates that based on yearly peak discharges for the period of record (41 years for Fountain Creek and 14 years for Monument Creek), stream flow on September 1st was less than a 1-year frequency event, indicating that this event did not significantly impact the larger creeks in Colorado Springs.

2.3 EXTENT OF FLOODING

2.3.1 Affected Streams and Local Drainage Areas

The most intense part of the storm was very localized, affecting only a small area near downtown. Monument Creek was impacted by the storm, according to Mr. Thorson, but no creeks were reported to have overtopped their banks.

2.3.2 Inundation Limits

Figure 2.1-2 shows two areas impacted by the storm:

1. Interstate 25 at Bijou Street, and
2. Monument Creek at Colorado Avenue.

Of these areas, only Interstate 25 can be characterized as an area that was significantly impacted.

2.3.3 Unique Circumstances Affecting Flooding

According to CDOT maintenance supervisor Phil Breesawitz, rainfall was only a contributing factor to the flooding on Interstate 25 at the Bijou Street interchange. The primary cause of flooding was associated with lightning, which hit an electrical pole, causing a loss of electricity and damage to two pumps at a lift station that it is necessary to keep this interchange dry at all times.

The lift station at the Bijou Street Bridge is necessary because the road is below the bed of nearby Monument Creek at this interchange. (This situation will be remedied with the ongoing improvements of Interstate 25.) With the pumps out and concurrent heavy local rainfall, two feet to three feet of water accumulated on the interstate, which was closed for at least seven hours.

2.4 FLOOD DAMAGES

2.4.1 Public Property Damage

Mr. Breesawitz estimated that damage to the lift station pumps and other electrical equipment cost CDOT approximately $30,000.

A drop structure construction project in Monument Creek was also damaged during the event. Mr. Thorson estimated that loss of topsoil and other costs to the City were approximately $30,000.

2.4.2 Private Property Damage

No private property damage was reported.

2.4.3 Emergency Response, Cleanup, and Repair

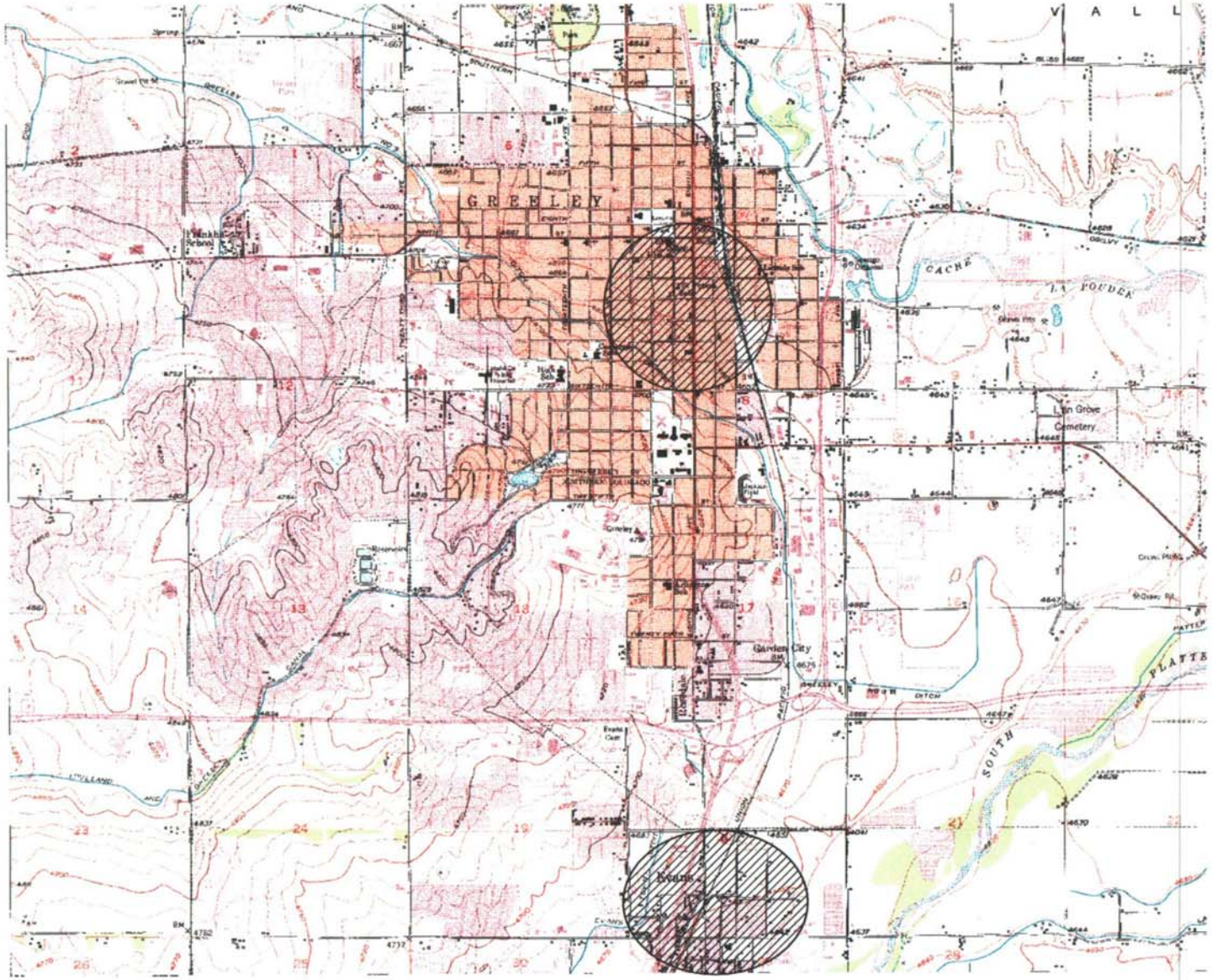
CDOT personnel spent several hours on site placing portable pumps, pumping the water, and then removing mud and other debris before the interstate could be opened. Mr. Breesawitz estimated equipment usage (a loader and street sweeper), labor costs, and pump rental to total approximately $2,000.

A large storm was reported on July 13th, 2001 in the Greeley area. Research indicated very significant flooding and property damage from this storm. During the next two days after the flooding, several related articles appeared in the Greeley Tribune (Appendix B). Appendix A includes photographs of the aftermath of the storm.

3.1 STUDY AREA DESCRIPTION

Greeley and Weld County are highlighted in Figure 3.1-1. Greeley lies near the confluence of the South Platte and Cache la Poudre Rivers. Although no flooding was reported along these major rivers as a result of the July 13th storm, the downtown area and the Town of Evans experienced a large amount of flooding as illustrated in Figure 3.1-2.

Figure 3.1-1
Study Area Location
Greeley, Colorado



URS

Greeley
July 14, 2001
Inundation Map

FIGURE 3.1-2

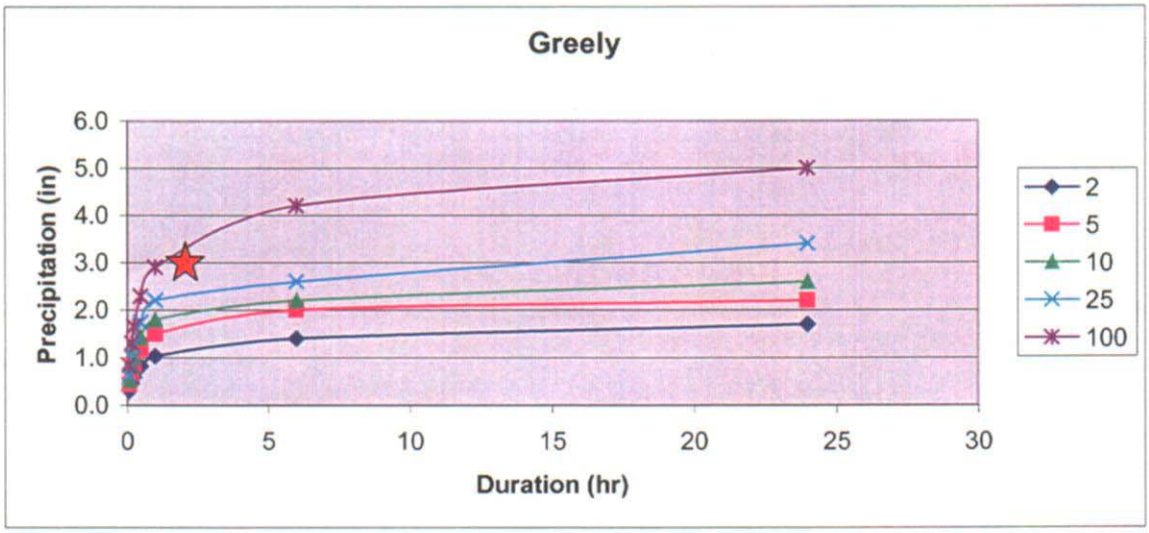
T:\PROJECTS\...\GB_CWCB_FLOOD_DOC_00\SUB_00\9.0_CAD\FLOODDWGS\GREELEY.DWG

3.2 STORM EVENT DATA

3.2.1 Precipitation Data

The National Climatic Data Center indicates that from 3- to 5-inches of rainfall fell in less than two hours on July 13th. The Greeley Tribune reported rainfall amounts of 3.48 inches. A comparison between this data and precipitation-duration-frequency curves (Figure 3.2-1 developed from the U.S. Department of Commerce, NOAA Atlas 2, Volume III-Colorado) indicates that the precipitation that occurred in this area is equivalent to at least a 2-hour, 100-year frequency event.

Figure 3.2-1
Precipitation-Duration-Frequency Curves for Greeley, Colorado



3.2.2 Flow Data

The USGS web site contains no flood data for the Cache la Poudre River, Lonetree Creek, or any other creeks in the Greeley area.

3.3 EXTENT OF FLOODING

3.3.1 Affected Streams and Local Drainage Areas

As mentioned, the reports of flooding focused on the streets of the city rather than particular creeks.

3.3.2 Inundation Limits

Three-foot deep water was reported in some areas of Greeley. The reported areas of flooding are illustrated on Figure 3.1-2.

3.3.3 Unique Circumstances Affecting Flooding

The Number 3 Ditch, which runs through the center of Greeley, ran out of its banks. Clogged storm sewer inlets contributed to the damage at the school administration offices.

3.4 FLOOD DAMAGES

Major flooding occurred throughout Greeley during this event. Damage included several flooded basements (among them City Hall), stranded motorists due to inundated streets, and an electrical outage for approximately 2,300 residents. A NOAA Event Record listed an estimated total of approximately $600,000 in property damages.

3.4.1 Public Property Damage

Flooding occurred at the School District 6 Administration offices, but minimal damage was reported.

Flooding at City Hall (see photographs and news articles in appendices) threatened precious documents and caused approximately $250,000 in damage including replacement of carpeting and wall panels.

3.4.2 Private Property Damage

The following damages were reported in the Greeley Tribune:

- The roof of Larry's Barber Shop collapsed during the deluge. Costs are unknown.
- The Travelodge motel and restaurant incurred significant costs including $20,000 for a brand new air conditioner, $4,000 in food, and unknown costs for carpets, boilers, and other expenses.
- Costs at India's Taj Mahal Restaurant included $6,000 in groceries.

3.4.3 Emergency Response, Cleanup, and Repair

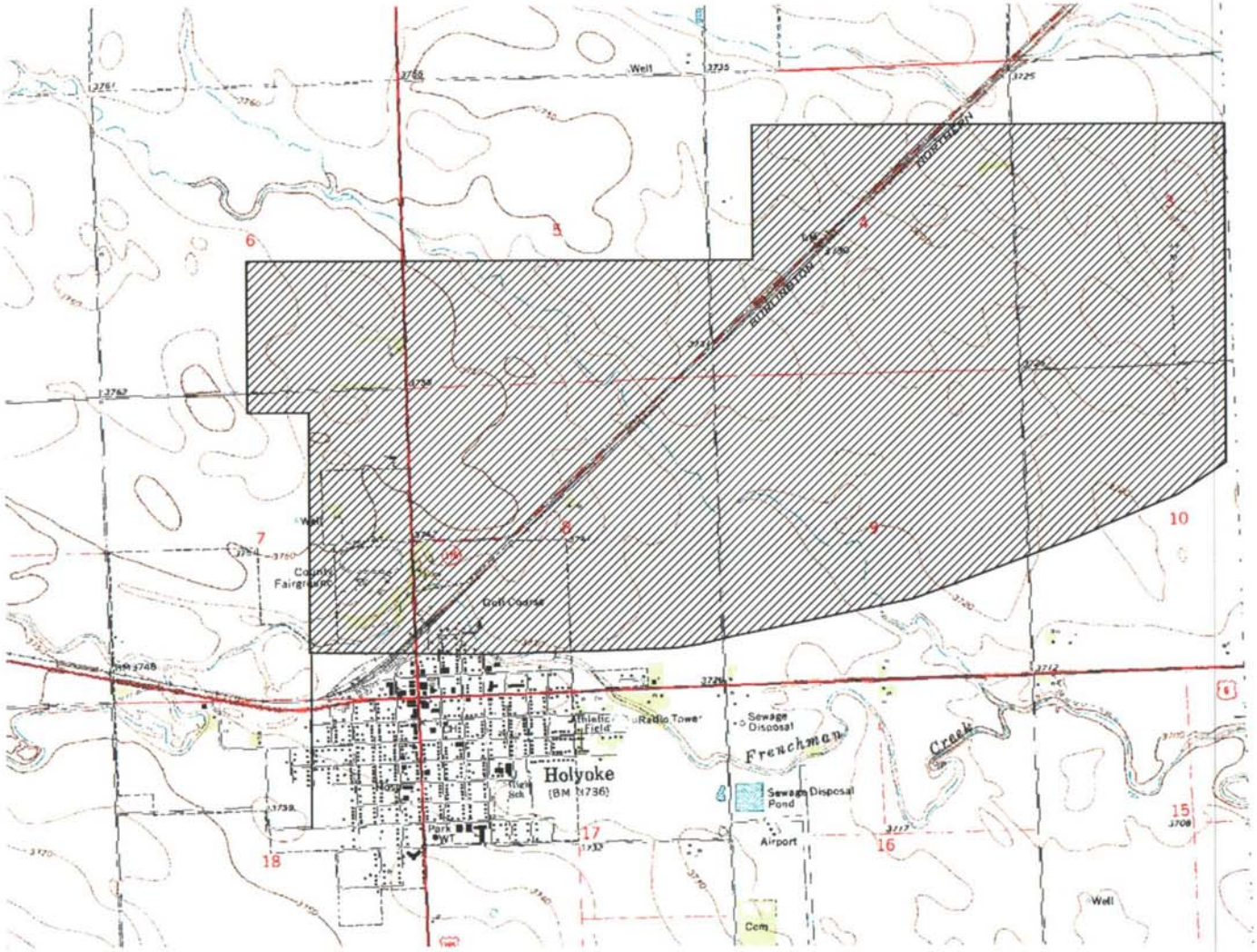
Approximately 2,300 homes and businesses in the city suffered electrical outages. Costs associated with the outages were not reported.

A storm was reported on September 7, 2001 in the Holyoke area. This storm produced significant crop damage on farms in the surrounding part of Phillips County.

4.1 STUDY AREA DESCRIPTION

Phillips County and Holyoke are highlighted on Figure 4.1-1. The storm affected farm land in rural Phillips County northeast of Holyoke as shown on Figure 4.1-2.

Figure 4.1-1
Study Area Location
Holyoke, Colorado



N

Not To Scale

LEGEND

Inundation Area

URS

Holyoke
September 9, 2001
Inundation Map

FIGURE 4.1-2

T:\PROJECTS\...\88_CWCB_FLOOD_DOC_00\SUB_00\9.0_CAD\FLOODDWGS\HOLYOKE.DWG

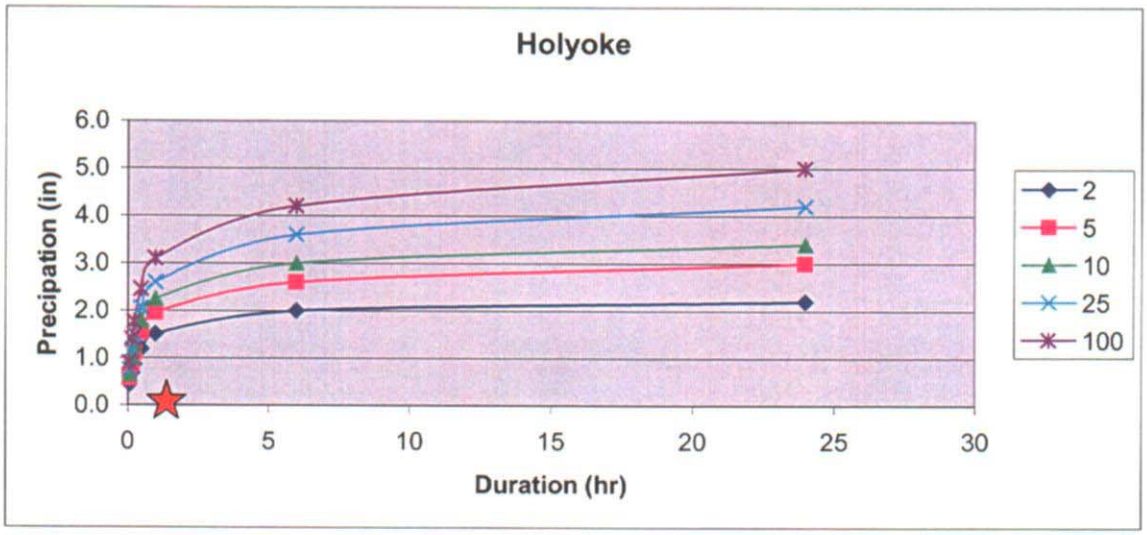
4.2 STORM EVENT DATA

4.2.1 Precipitation Data

Data from the NOAA web site ("raw" data, which has not undergone Quality Control) indicates that 0.57 inches fell on this date in less than one hour (the time frame was reported by Mr. Ron Koberstein with the NRCS).

A comparison between this data and precipitation-duration-frequency curves (Figure 4.2-1 developed from the U.S. Department of Commerce, NOAA Atlas 2, Volume III-Colorado) indicates that the precipitation that occurred in this area is equivalent to less than a 2-year frequency event.

Figure 4.2-1
Precipitation-Duration-Frequency Curves for Holyoke, Colorado



4.2.2 Flow Data

No flow data was found from the USGS surface water monitoring program or other sources along Frenchman Creek or other creeks in the area.

4.3 EXTENT OF FLOODING

Investigations found that no flooding was reported for this event. The damage listed below was caused directly by the precipitation in the form of hail.

4.4 STORM DAMAGES

Hail and high winds from the event defoliated sugar beets and corn and shelled beans. Per a USDA report, the storm damaged crops throughout the indicated area (Figure 4.1-2) of Phillips County. Crop losses were estimated by the Farm Services Agency (USDA):

- 10% to 15% of corn (both dry and irrigated),
- 60% of irrigated beans, and
- sugar beets (not yet determined).

Despite efforts to obtain the monetary damages caused by this storm, the figures were not available from the USDA Farm Services Agency, local insurance agencies, or any other sources contacted at the time of this writing.

No Emergency flood fighting efforts were implemented.

During the latter portion of July and through the majority of August 2001, sizable areas of Rio Blanco County were partially inundated by flash flooding and debris flows as a result of several separate precipitation events. Documentation of the flooding was obtained from Rio Blanco County, CDOT, State and Federal data collection organizations (including the USGS) and from discussions with local residents.

5.1 STUDY AREA DESCRIPTION

The majority of the effects of these precipitation events were in the southeastern portion of Rio Blanco County near the Town of Meeker. Lesser effects were also reported near Rangley. Figure 5.1-1 highlights Rio Blanco County, and Figure 5.1-2 provides a location map of the impacted areas.

Figure 5.1-1
Study Area Location
Rio Blanco County, Colorado

The two watersheds most affected by these flood events were the Piceance Creek Watershed Basin and the White River Watershed Basin (shown in Figures 5.1-3 and 5.1-4). Almost the entire Piceance Creek watershed was affected to some degree by these storm events.

Figure 5.1-3
Piceance Creek Watershed

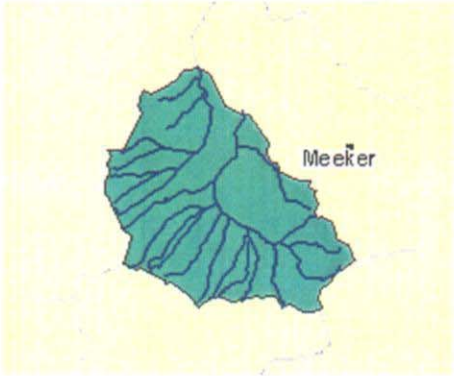


Figure 5.1-4
White River Watershed

Additional reports indicate that Yellow Creek was also affected by the heavy rains during the period under investigation.

5.2 STORM EVENT DATA

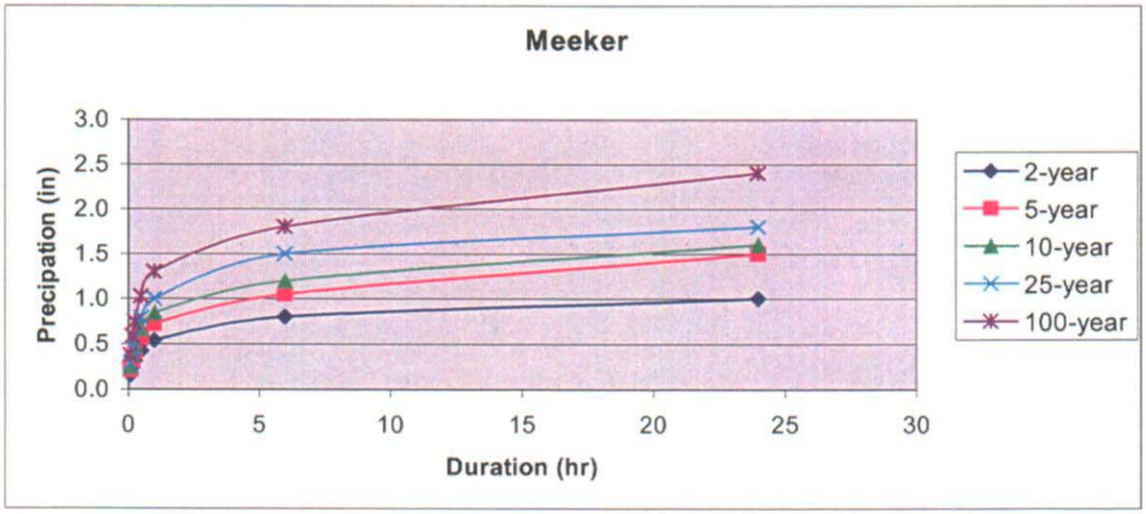
The summer rainfall events investigated were typically of short duration and high-intensity.

5.2.1 Precipitation Data

During the investigation it was found that no precipitation data was available for specific storm events in this area.

Figure 5.2-1 below illustrates precipitation-duration-frequency curves for several return periods in Meeker, Colorado.

Figure 5.2-1
Precipitation-Duration-Frequency Curves for Meeker, Colorado



5.2.2 Flow Data

Most of the flooding appears to have occurred along several intermittent streams prone to flash flooding during heavy rain events. When these streams flow full, they often carry loose riparian vegetation and soil. The deposit of this debris is what caused the majority of damage during these events. Unfortunately, these intermittent stream flows are not monitored and therefore could not be analyzed, but the major rivers that collect this runoff are gauged and were analyzed.

Flow data along Piceance Creek, White River, and Yellow Creek in the affected areas during the time period discussed above was obtained through the USGS surface water monitoring program (http://water.usgs.gov). The data collected can be seen in Figures 5.2-2 through 5.2-5. Station locations are shown on Figure 5.1-2.

Figure 5.2-2
Daily Discharge for Piceance Creek Below Ryan Gulch, Colorado – May through October, 2001

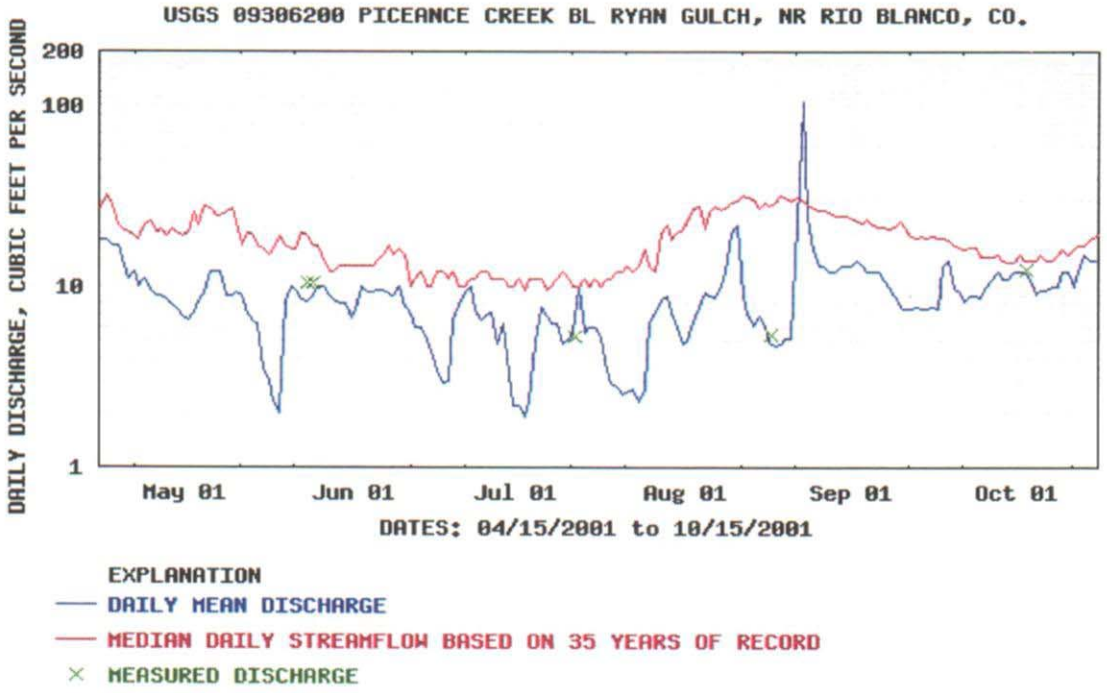


Figure 5.2-2 reveals that during the majority of the storm events in July and August the flows in Piceance Creek where actually below normal except for one large spike in the latter portion of August.

Figure 5.2-3
Daily Discharge for White River Below Meeker, Colorado – May Through October, 2001

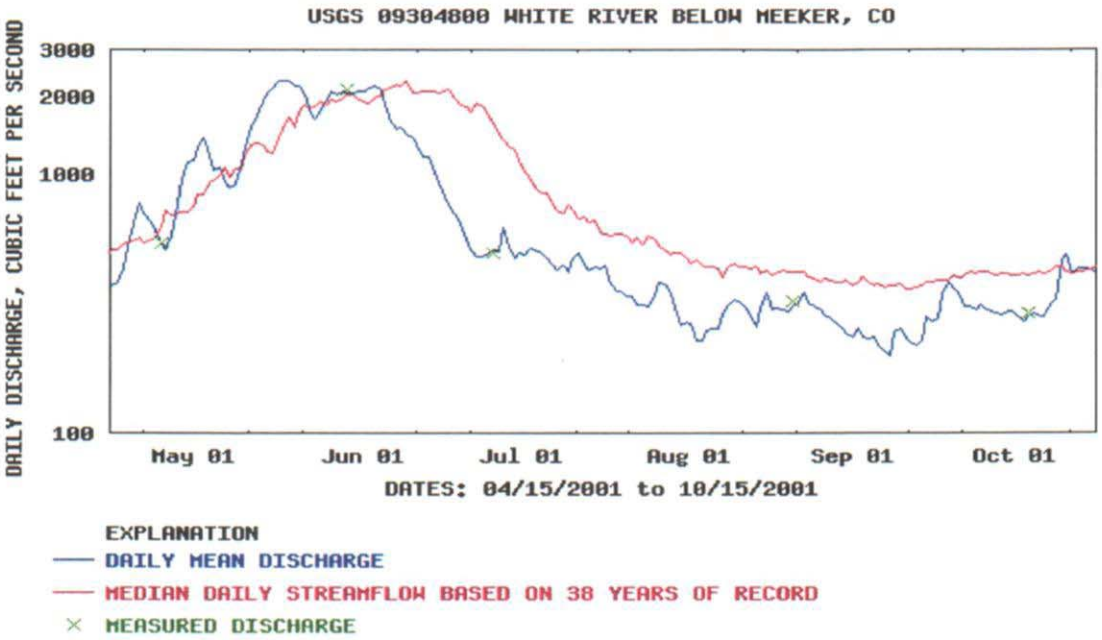
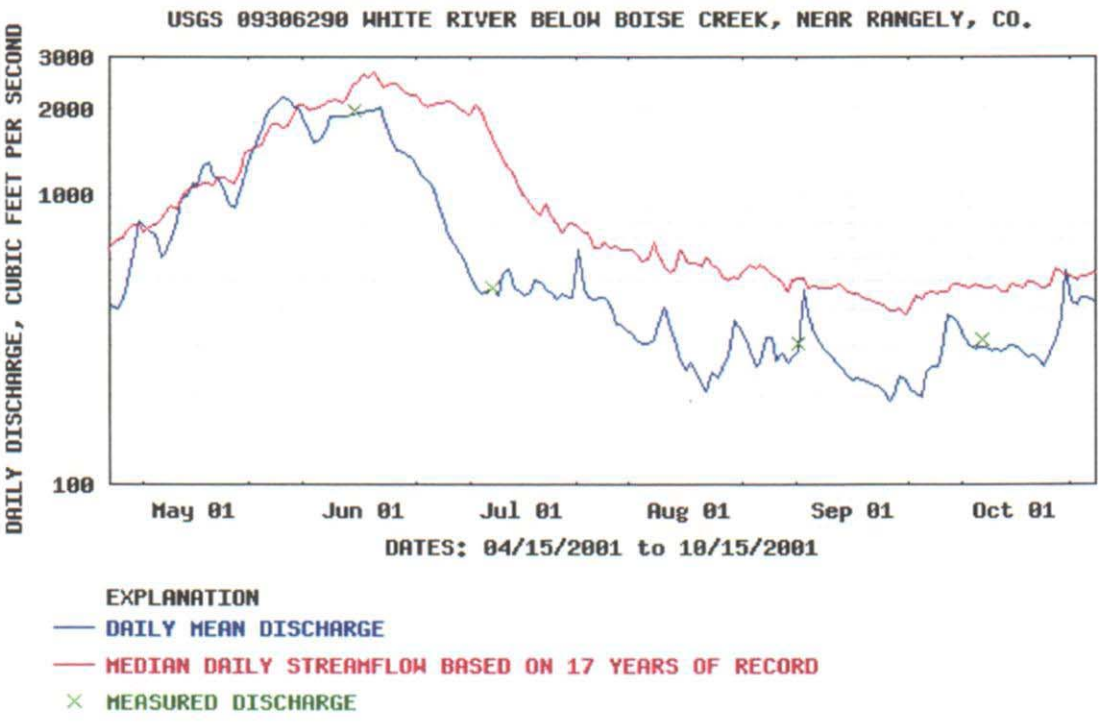
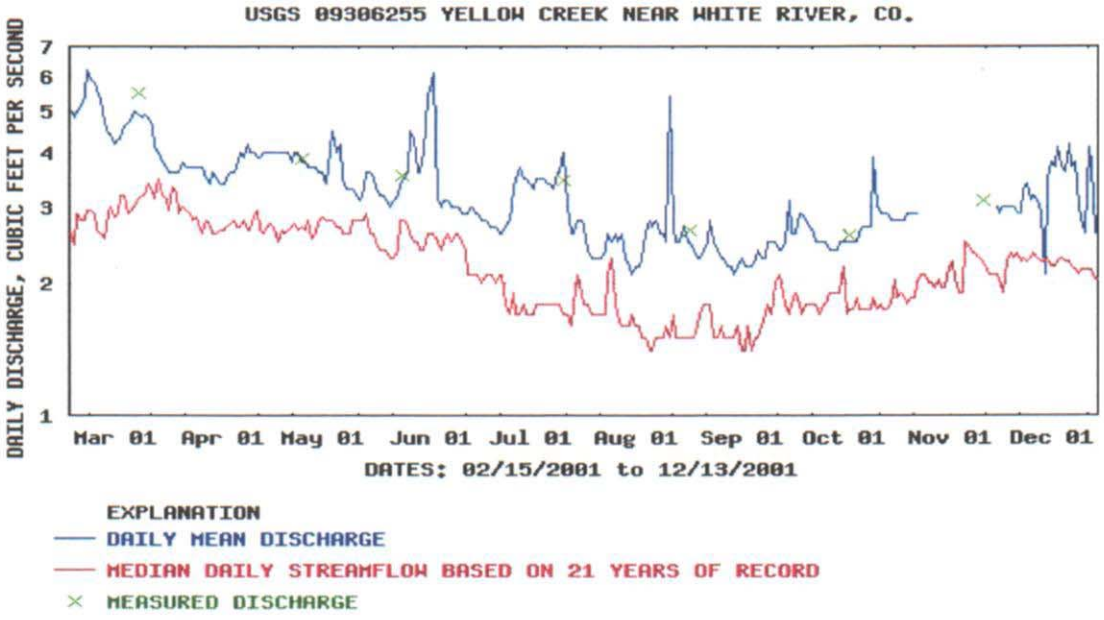


Figure 5.2-4
Daily Discharge for White River Near Rangley, Colorado – May through October, 2001



Data was collected at two locations on the White River: one upstream of Yellow Creek and Piceance Creek (Figure 5.2-3) and one downstream (Figure 5.2-4). Figures 5.2-3 and 5.2-4 illustrate that during these storm events the White River was flowing below normal, which shows that these storm events did not cause significant flooding on the White River.

Figure 5.2-5
Daily Discharge for Yellow Creek Near White River, Colorado
March through December, 2001



The discharge of Yellow Creek near the White River is shown in Figure 5.2-5. This figure reveals that Yellow Creek was flowing above average during the storm events, however, not at peak flood stage.

Figures 5.2-2, 5.2-3, 5.2-4, and 5.2-5 compare the daily mean discharge during the major rainfall events under investigation and the median daily streamflow based on several years of data. [Note for black and white copies: In Figures 5.2-2, 5.2-3, and 5.2-4 the daily mean discharge data series are generally beneath the streamflow data series that are based on the several years of record. In Figure 5.2-5 the daily mean discharge data series is generally above the streamflow data series that is based on the 21 years of record.]

A frequency analysis of the data using the USGS software PEAKFQ indicates that, based on the yearly peak discharges for the periods of record (from 17 to 38 years), the events were approximately on the order of 1.5-year events, suggesting that the localized precipitation events did not significantly affect the surrounding rivers and streams.

5.3 EXTENT OF FLOODING

The following flood information was obtained from Mr. Jeff Devere, Rio Blanco County.

5.3.1 Affected Streams and Local Drainage Areas

Mr. Devere indicated that most of the damages incurred in the County were roadway related. Mudslides, as a result of the heavy rainfall and flash flooding, filled and covered drainage ditches, culverts, and roadways with mud and other related debris. As a result, many County roads were inundated and impassable by motorists. This caused many delays and problems for residents in the area. Mr. Devere relayed that the Piceance Creek Basin is home to a small number of petroleum related industries, and employees were either significantly delayed or unable to get to work due to the affects of the storms.

5.3.2 Inundation Limits

Estimated inundation extents are illustrated in Figure 5.1-2. An approximately 50-square-mile area was impacted by some degree of flooding and showed signs of at least partial inundation. This area includes the entire Piceance Creek Basin and portions of the White River watershed. Several County roads and local streets were inundated with mud and debris as a result of flash flooding.

5.4 FLOOD DAMAGES

5.4.1 Public Property Damage

No damage to public property was reported.

5.4.2 Private Property Damage

Most of the private property damage was related to agriculture. Debris from the mudslides was deposited on privately owned agricultural land. No reports of residential or commercial building damages were obtained, and any that did occur are thought to be minimal. No private expenditures related to flood damage were reported.

5.4.3 Emergency Response, Cleanup, and Repair

No Emergency flood fighting efforts were implemented.

The Colorado Department of Transportation (CDOT) was contacted regarding reported damages. Mr. Paul McCollum with CDOT Maintenance in Craig, Colorado reported that minimal cleanup activities were required as a result of mudslide debris deposits on State Route 64 just west of Meeker. Mr. McCollum also reported that there were no traffic delays incurred by the debris on State highways, however, drainage ditches and culverts required cleanup following the events. Total CDOT expenditures for highway cleanup were estimated at $20,000.

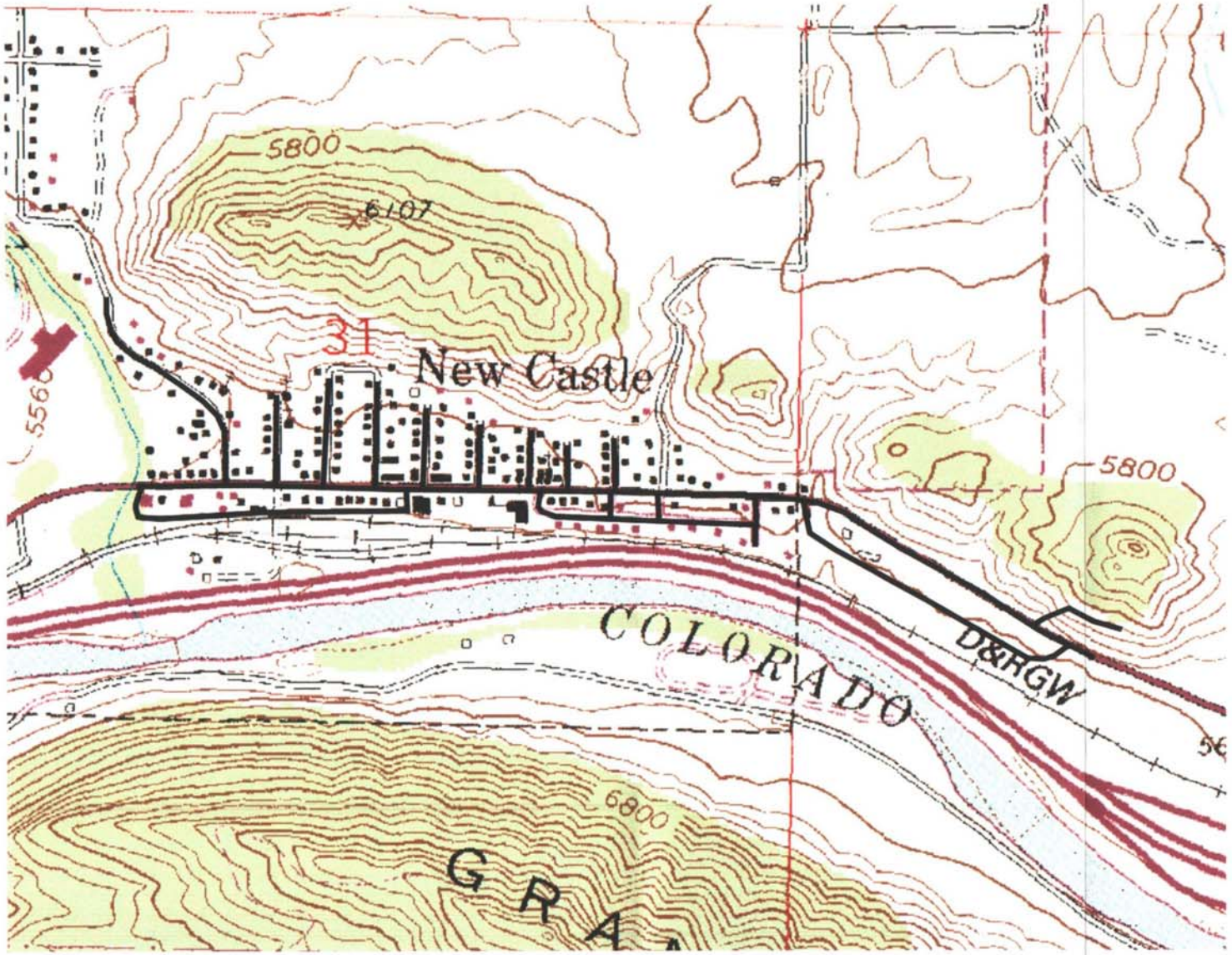
Rio Blanco County sent maintenance crews to clean roads, re-shape ditches, and clean culverts due to the accumulation of debris. Figure 5.1-2 reveals all affected roadways. Costs for county road cleanup have not yet been determined at the date of this writing.

On August 14, 2001, a thunderstorm over the Town of New Castle produced very heavy rain and small hail. This storm was part of a string of storms that were moving slowly south through west central Colorado.

6.1 STUDY AREA DESCRIPTION

The majority of the affects of this storm were in the eastern portion of Garfield County, in particular the Town of New Castle. Figure 6.1-1 highlights New Castle and the County, and Figure 6.1-2 indicates the impacted areas.

6.1-1
Study Area Location
Garfield County, Colorado



URS

New Castle
August 14, 2001
Inundation Map

FIGURE 6.1-2

T:\PROJECTS\...\GR_CWCB_FLOOD_DOC_00\SUB_00\9.0_CAD\FLOODDWGS\New-Castle.DWG

The watershed most affected by these flood events was the Colorado Headwaters-Plateau basin (shown in Figure 6.1-3).

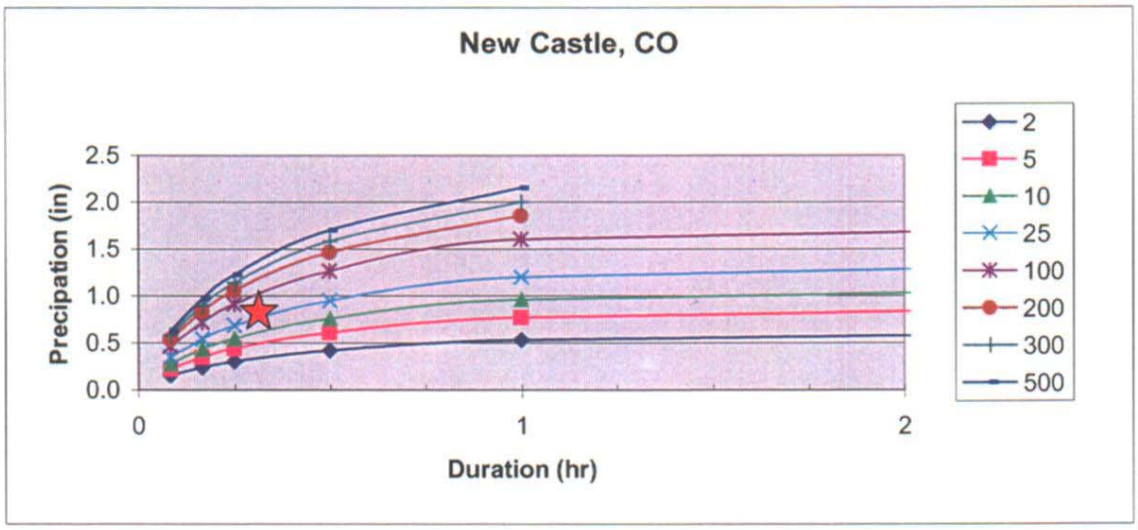
Figure 6.1-3
Colorado Headwaters Plateau Watershed

6.2 STORM EVENT DATA

6.2.1 Precipitation Data

Mr. Steve Rippy, the New Castle Town Manager, reported that approximately 1.5 inches of rainfall fell in approximately 15 minutes and a NOAA event record reported one inch in less than 20 minutes. A comparison of the data mentioned above and the precipitation-duration-frequency curves (developed from the U.S. Department of Commerce, NOAA Atlas 2, Volume III-Colorado) indicates that the August 14, 2001 event was approximately equivalent to a 100-year frequency event. Figure 6.2-1 below illustrates precipitation versus duration for several return periods for rainfall in New Castle, Colorado.

Figure 6.2-1
Precipitation-Duration-Frequency Curves for New Castle, Colorado



6.2.2 Flow Data

No flow data was collected because no streams or creeks were directly affected by the rainfall event.

6.3 EXTENT OF FLOODING

The flood information collected was obtained principally from Mr. Rippy.

6.3.1 Affected Streams and Local Drainage Areas

There were no streams that were affected by the August 14th event. Mr. Rippy indicated that the majority of the rain fell due east of West Elk Creek and was collected in the city's storm sewer system before being discharged into West Elk Creek and eventually into the Colorado River.

Mr. Rippy stated that the majority of the runoff comes from the high point north of town and travels south down local streets to Main Street, where the storm sewers backed up and flooded residential properties. General flow paths are illustrated in Figure 6.1-2.

6.3.2 Inundation Limits

The entire city of New Castle was at least partially inundated.

6.4 FLOOD DAMAGES

6.4.1 Public Property Damages

Other than roadway cleanup (discussed below), the storm produced no damage to public property.

6.4.2 Private Property Damages

The heavy rain triggered a mudslide that flooded several homes and businesses in New Castle. Total damages were estimated to be approximately $32,000.

6.4.3 Emergency Response, Cleanup, and Repair

Clearing debris from local roads and storm sewers was the majority of work required as a result of the storm and the flooding. The storm closed U.S. Highway 6 through town as well as several other local streets. Up to two feet of mud and rocks were left behind after the flooding, and it took several days to clear the debris. Cleanup efforts amounted to approximately $85,000. Figure 6.1-2 shows the affected roadways.

The majority of the effects resulting from the precipitation event on September 13, 2001 were in the western portion of Mesa County near the Town of Palisade.

7.1 STUDY AREA DESCRIPTION

Figure 7.1-1 shows the general location in Colorado and Figure 7.1-2 indicates the impacted areas.

Figure 7.1-1
Study Area Location
Mesa County, Colorado

N

Not To Scale

LEGEND

Inundation Area

URS

Palisade/Grand Valley
September 13, 2001
Inundation Map

FIGURE 7.1-2

T:\PROJECTS\...08_CWCB_FLOOD_DOC_00\SUB_00\9.0_CAD\FLOODDWGS\PALLISADE-GRANDVALL...

The Town of Palisade is located in the Colorado Headwaters-Plateau basin (shown in Figure 7.1-3).

Figure 7.1-3
Colorado Headwaters Plateau Watershed

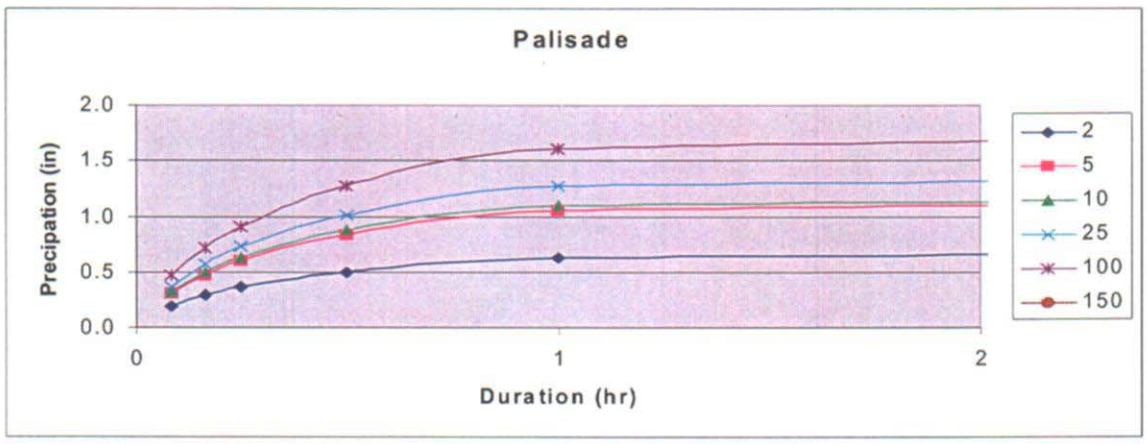
7.2 STORM EVENT DATA

On September 13, 2001 a slow moving thunderstorm dropped rainfall resulting in a mudslide near the Town of Palisade.

7.2.1 Precipitation Data

A NOAA Event Record characterized the rainfall as "heavy," however, the Daily Sentinel, the Grand Junction newspaper, stated that 0.07 inch of rain fell within a 12-hour period. A comparison between precipitation-duration-frequency curves (developed from the U.S. Department of Commerce, NOAA Atlas 2, Volume III-Colorado) and the Daily Sentinel data indicates that the precipitation that occurred in the area on September 13th is equivalent to less than a 2-year frequency event. Figure 7.2-1 illustrates precipitation versus duration for several return periods for rainfall in Palisade, Colorado.

Figure 7.2-1



Precipitation-Duration-Frequency Curves for Palisade, Colorado

7.2.2 Flow Data

No flow data was collected because no streams or creeks were directly affected by the rainfall events.

7.3 EXTENT OF FLOODING

The majority of collected flood information was obtained from Mr. Ed Hill of CDOT.

7.3.1 Affected Streams and Local Drainage Areas

The investigation shows that there were no reports that any streams were significantly affected by the September 13th event.

7.3.2 Inundation Limits

The only inundation from the storm reported by Mr. Hill was at the Interstate 70-Palisade exchange, where approximately 48 inches of debris was deposited. Estimated inundation limits are shown on Figure 7.1-2.

7.4 FLOOD DAMAGES

7.4.1 Public Property Damages

No public property damages or expenditures were reported other than roadway cleanup as discussed below.

7.4.2 Private Property Damages

No private property damages or expenditures were reported.

7.4.3 Emergency Response, Cleanup, and Repair

Several cleanup activities were required after the storm: clearing debris from the Interstate 70-Palisade exchange, reshaping drainage ditches, and cleaning storm sewer structures. Mr. Hill reported no serious traffic delays; I-70 remained open throughout the entire time period. Flood related damages incurred by CDOT were estimated to total $30,000.

On August 8, 2001 there was a considerable rainfall event, which triggered numerous mudslides and rockslides. To document the results of this storm, several sources were researched including local municipalities, CDOT, and State and Federal data collection organizations (including the USGS).

8.1 STUDY AREA DESCRIPTION

The majority of the effects of the precipitation event mentioned above were in a portion of the southeastern portion of San Miguel County between the Towns of Telluride and Placerville. Figure 8-1.1 shows the general location in Colorado, and Figure 8.1-2 indicates the impacted areas.

Figure 8 .1-1
Study Area Location
San Miguel County, Colorado

The two watersheds most affected by these flood events were the San Miguel River Basin and the Upper Dolores River Basin (shown in Figures 8.1-3 and 8.1-4 below). Several small streams to the north and south of the San Miguel River were affected by the event of August 8th.

Figure 8.1-3
San Miguel River Watershed

Figure 8.1-4
Upper Dolores Watershed

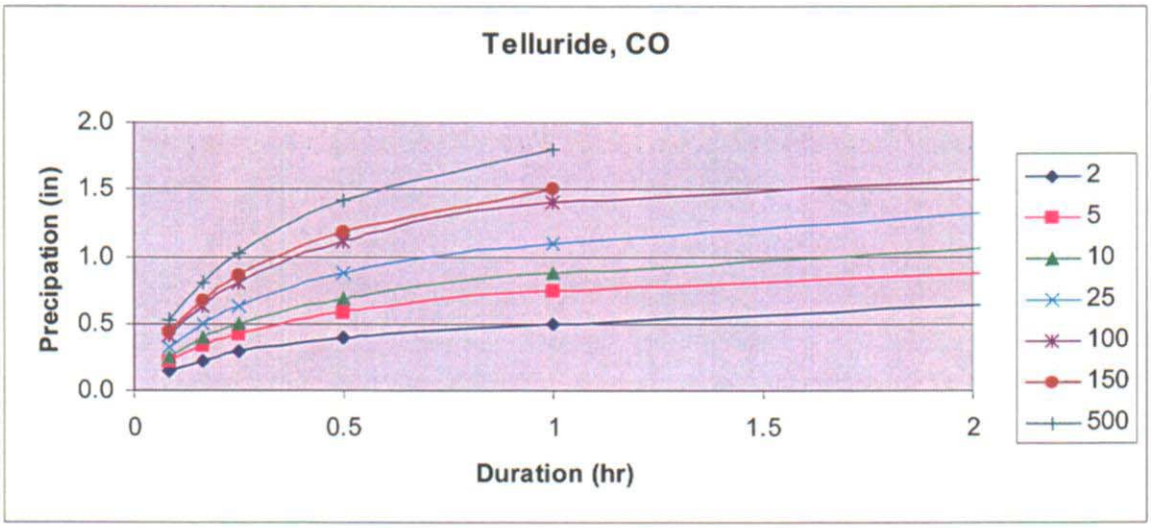
8.2 STORM EVENT DATA

On August 8th slow moving thunderstorms over eastern San Miguel County dropped several inches of rain in a two- to three-hour period between Telluride and Placerville. The heavy rains triggered numerous mudslides and rockslides throughout the eastern portion of the County.

8.2.1 Precipitation Data

A NOAA event record reported that the thunderstorm dropped up to 5 inches of rain in two hours. The National Weather Service estimated 4 inches in 40 minutes for San Miguel Canyon. A comparison between the precipitation data collected from the NOAA event records and precipitation-duration-frequency curves (developed from the U.S. Department of Commerce, NOAA Atlas 2, Volume III-Colorado) indicates that this event was approximately equivalent to a 500-year frequency event. Figure 8.2-1 illustrates the precipitation–duration-frequency curves for several return periods in San Miguel County, Colorado.

Figure 8.2-1
Precipitation-Duration-Frequency Curves for San Miguel County, Colorado



8.2.2 Flow Data

Flow data along the San Miguel River in the affected areas was obtained through the USGS surface water monitoring program (http://water.usgs.gov). The data collected for the San Miguel River can be seen in Figure 8.2-2 and station locations are shown on Figure 8.1-2 and Figure 8.2-2

Figure 8.2-2

Daily Discharge for San Miguel River Near Placerville, Colorado – July through January, 2001

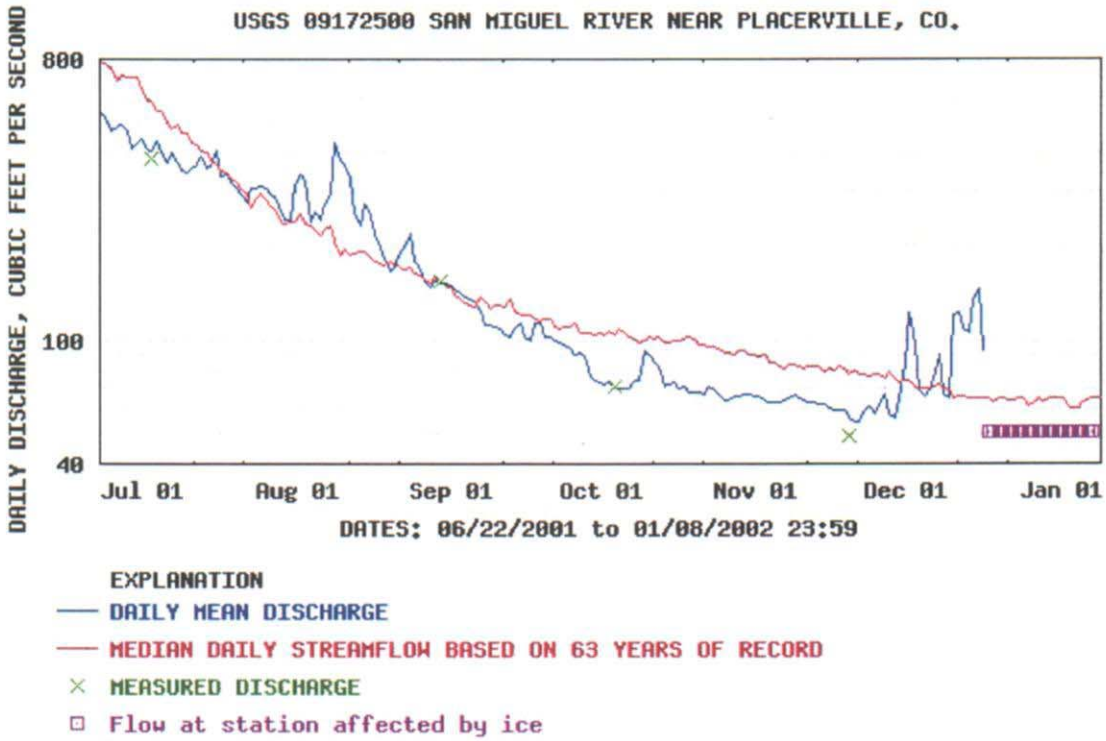


Figure 8.2-2 compares the daily mean discharge during the event and the median daily streamflow based on 63 years of data. As seen in the chart on the day of the event, August 8th, the stream discharge peaked at approximately 430 cfs. [Note for black and white copies: In Figure 8.2-2 the daily mean discharge data series has greater fluctuations than the streamflow data based on the 63 years of record.]

A frequency analysis of this data using the USGS software PEAKFQ indicates that a discharge value of 430 cfs has approximately a 1-year frequency of occurrence. This suggests that these events did not significantly affect the surrounding rivers and streams. However, according to "The Watershed Connection," a publication of the San Miguel Watershed Coalition included in Appendix B, the San Miguel River peaked well over 2,000 cfs, affecting the entire river system for seventy miles downstream. Using the same frequency analysis mentioned above and a 2,000-cfs peak discharge, the event corresponds to approximately a 5-year frequency of occurrence.

There were several smaller streams discussed below that were more seriously affected according to Mr. Mike Horner, San Miguel County. No discharge data from these smaller streams was available, and, therefore, they could not be analyzed.

8.3 EXTENT OF FLOODING

The flood information collected was obtained from CDOT and from Mr. Horner.

8.3.1 Affected Streams and Local Drainage Areas

The streams and rivers that were affected by the August 8th storm event were Bear Creek, Fall Creek, Deep Creek, and the San Miguel River. Mr. Horner relayed that Bear Creek was flowing outside the banks and was eroding County Road 60M.

8.3.2 Inundation Limits

Estimated inundation lists are illustrated in Figure 8.1-2. Approximately 20 miles of roadway were impacted by flooding and showed signs of at least partial inundation. This area includes areas in both the San Miguel River basin and Upper Dolores River watershed.

8.4 FLOOD DAMAGES

8.4.1 Public Property Damages

The mud slides caused damage to retaining walls along Highway 145. Mr. Blair Renfro, CDOT Project Engineer, estimated that the total costs for reconstruction of all of the retaining walls (at seven locations) will total approximately $900,000 when completed.

8.4.2 Private Property Damages

Two homes sustained major damage from the floods with several others receiving minor damages. Several vehicles were damaged as a result of being swept from Highway 145 as mud and rock slid over the roadway surface. One vehicle was pushed into the riverbed.

Private property costs were estimated to be $400,000 according to a NOAA event record (www.ncdc.noaa.com).

8.4.3 Emergency Response, Cleanup, and Repair

No injuries were reported, although rescue workers had to use off-road motorcycles and medical evacuation buggies to rescue a woman in labor across seven mudslides to a waiting ambulance. Other individuals were not in any immediate danger but were required to wait until crews could clear the roadway.

CDOT incurred most of the cost associated with the cleanup efforts. Mr. Jay Carlson of CDOT Region 5 reported that extensive cleanup activities were required as a result of mudslide and rockslide debris deposits on State Highway 145. Highway 145 was closed until cleanup crews from both the County and the State could clear a path for passing motorists. Cleanup and repair

activities included freeing roadway surfaces and culverts of debris and re-shaping drainage ditches. Mr. Carlson estimated total costs to CDOT to be $2,800,000. Per Mr. Renfro, this includes the $900,000 stated above for reconstruction retaining walls, $300,000 for debris removal from the road surface, $150,000 for pipe cleaning, and the remainder for traffic control, project management, slope stability, and other costs.

Mr. Horner indicated that the majority of the damages incurred by the County were roadway related. Mudslides and rockslides, as a result of the heavy rainfall and flash flooding, filled and covered drainage ditches, culverts, and roadways with mud and other related debris. As a result of the slides, many County roads were inundated and impassable by motorists.

Figure 8.1-2 reveals all affected roadways and streams. Table 8.4-1 summarizes an estimate of roadway related costs incurred by San Miguel County and CDOT due to this storm.

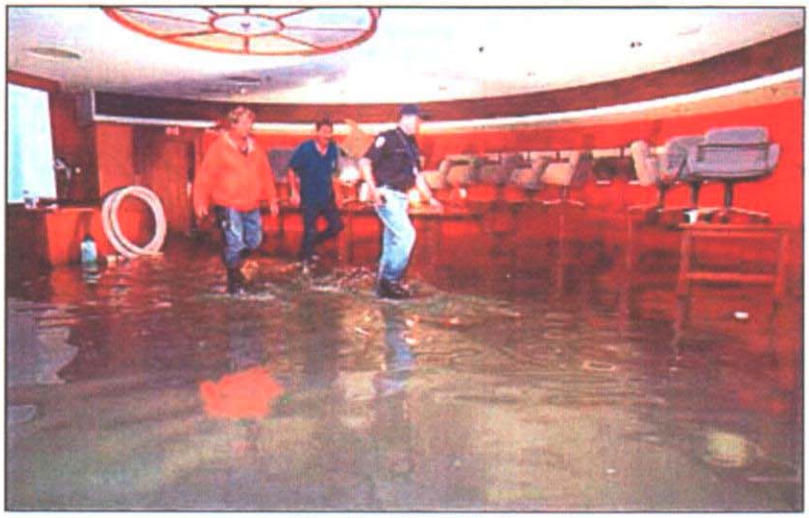
Table 8.4-1

Estimated Flood Damage Expenditures
San Miguel County, Colorado

Agency/Personnel	Estimated Cost
CDOT - State Highway 145	
Reconstruction of retaining walls	$900,000
Debris removal, pipe cleaning	$450,000
Traffic control and other costs	$1.45 Million
CDOT Total	**$2.8 Million**
San Miguel County	
County Road 60M	$5,604
County Road 57P	$6,736
County Road 58P	$1,617
County Road 62L	$85
County Road 63L	$147
Sawpit City Streets	$400
Placerville City Streets	$1,325
San Miguel County Total	**$15,914**
Private Property	**$400,000**
TOTAL	**$3.2 Million**

Appendix A
Photos

Greeley



Greeley City Hall
From Greeley Tribune

Travelodge in Evans
From Greeley Tribune

Travelodge in Evans
From Greeley Tribune

Rio Blanco County

Type of drainage and the resulting overflow along County Road 5 - Rio Blanco County

Further examples of areas along County Road 5 that were impacted - Rio Blanco County

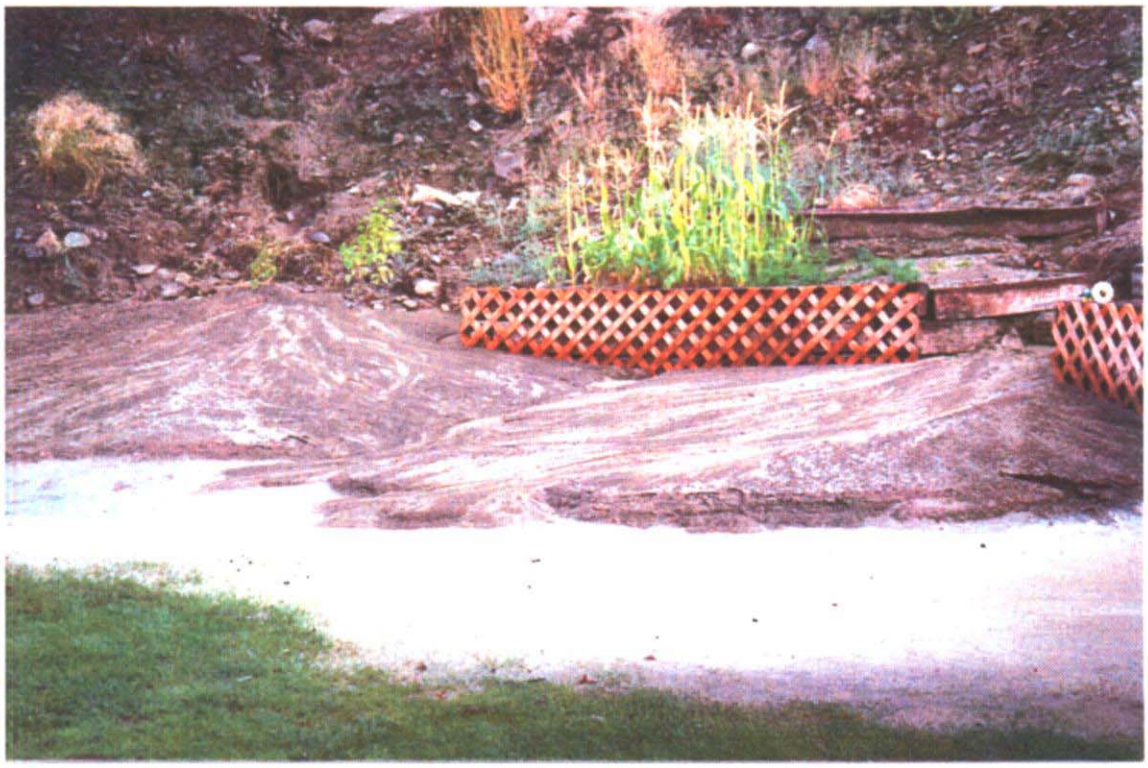
Further examples of areas along County Road 5 that were impacted - Rio Blanco County

New Castle

Example of residential flood damage in the City of New Castle

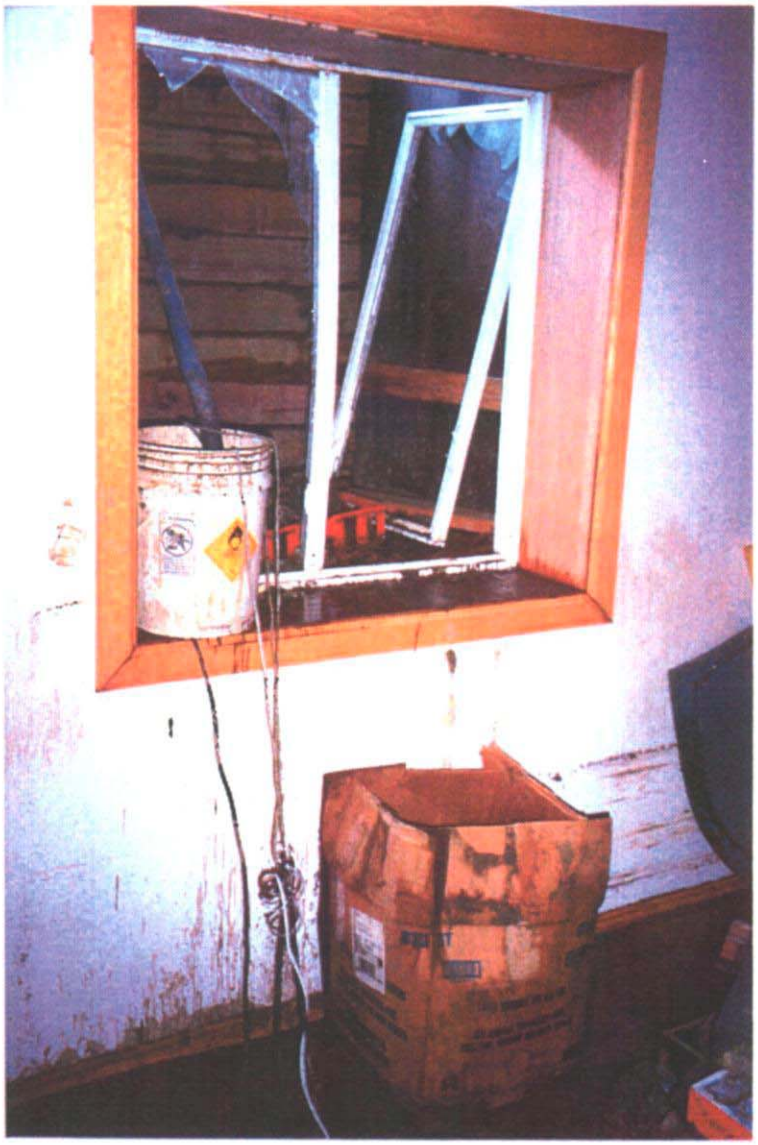
Further examples of residential flood damage in the City of New Castle

Further examples of residential flood damage in the City of New Castle

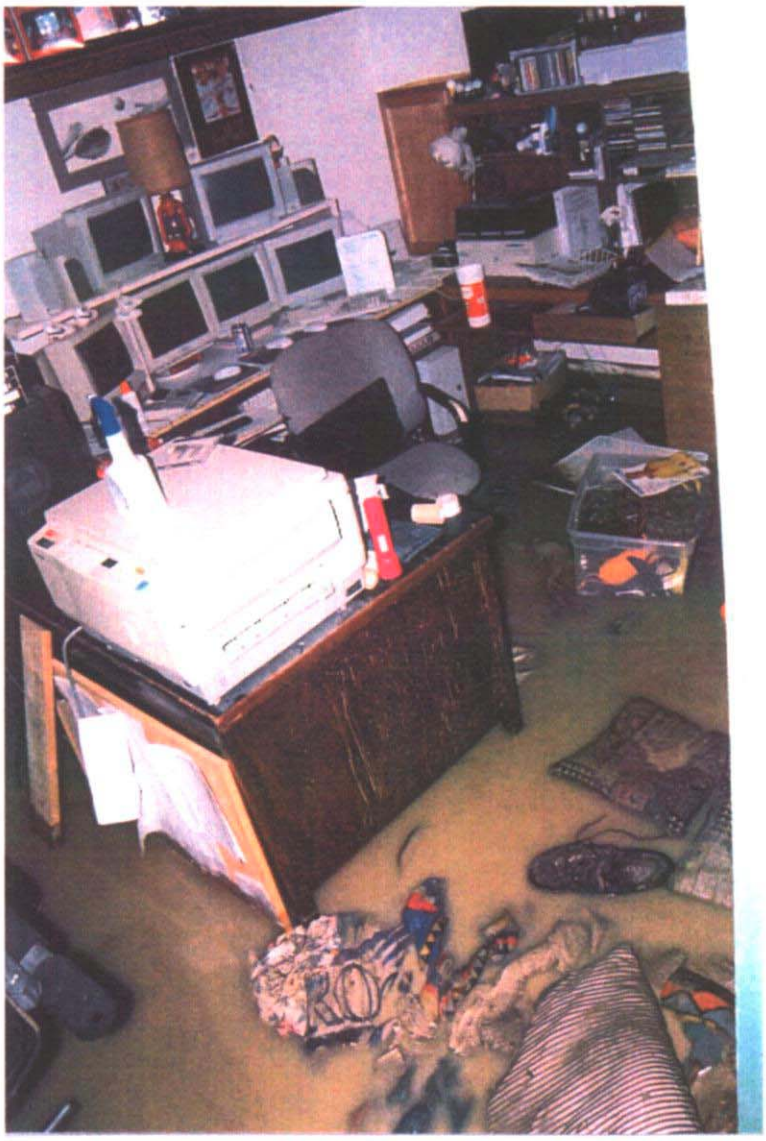


Further examples of residential flood damage in the City of New Castle

Further examples of residential flood damage in the City of New Castle



Further examples of residential flood damage in the City of New Castle

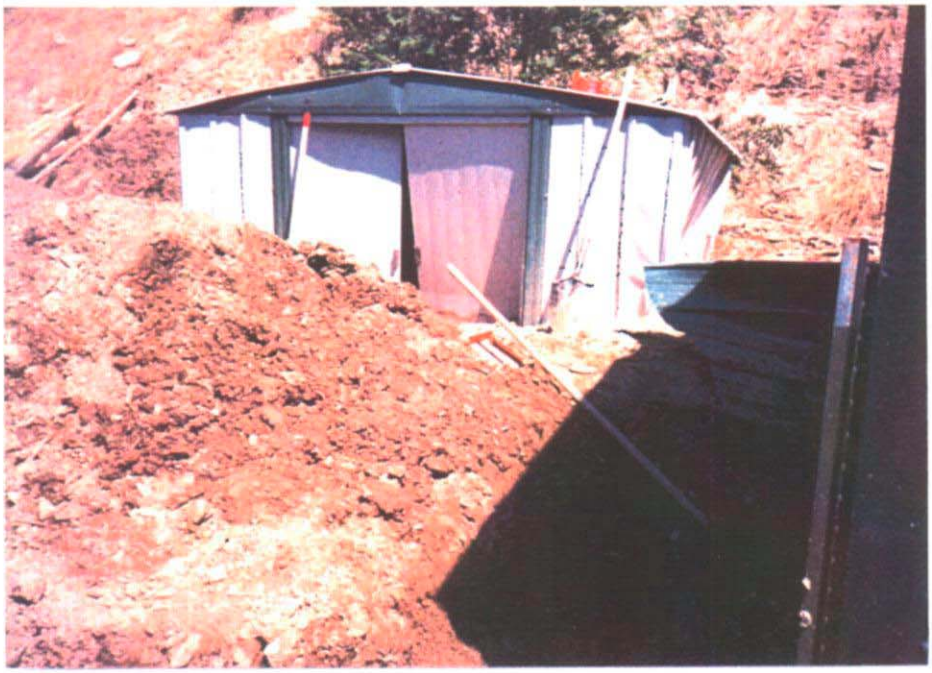


Further examples of residential flood damage in the City of New Castle

Further examples of residential flood damage in the City of New Castle

Further examples of residential flood damage in the City of New Castle

Further examples of residential flood damage in the City of New Castle



Further examples of residential flood damage in the City of New Castle

Further examples of residential flood damage in the City of New Castle

Areal photograph of the City of New Castle

Telluride

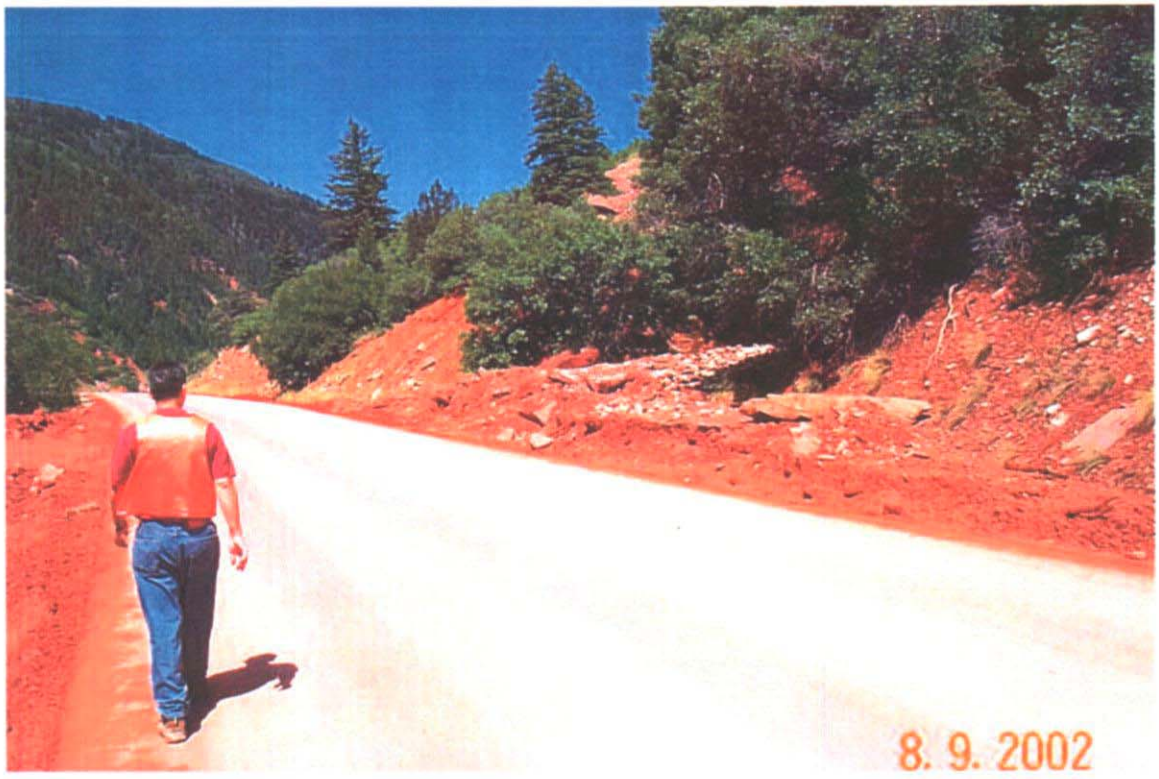
Types of drainage and the resulting overflow along State Route 145 near the City of Telluride

Drainage and the resulting overflow along State Route 145 - Telluride Vicinity

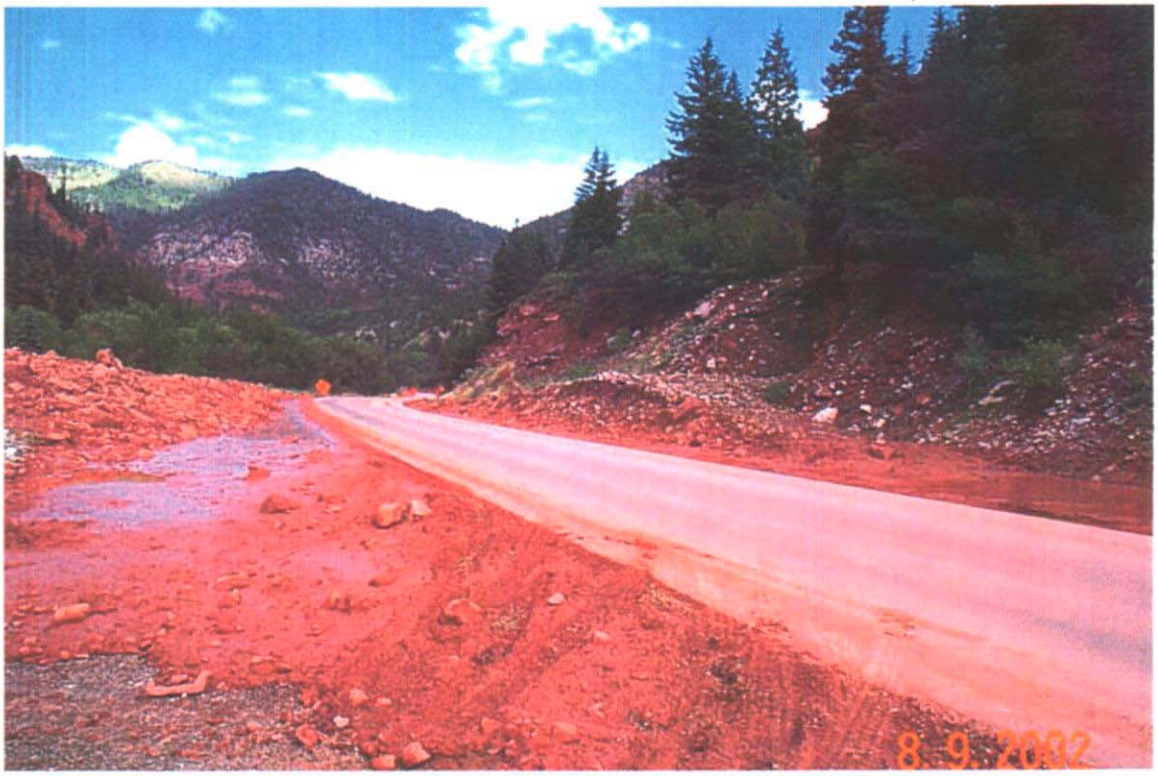
Drainage and the resulting overflow along State Route 145 - Telluride Vicinity

Drainage and the resulting overflow along State Route 145 – Telluride vicinity

Drainage and the resulting overflow along State Route 145 – Telluride vicinity



Drainage and the resulting overflow along State Route 145 – Telluride vicinity

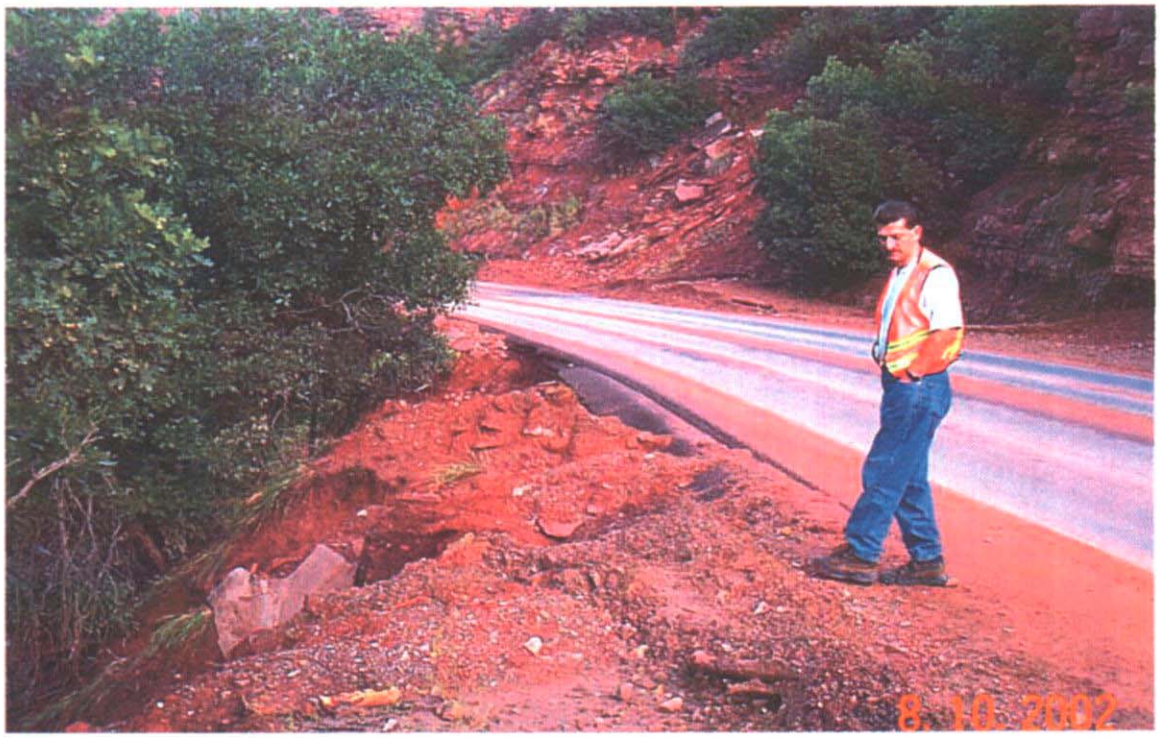


Drainage and the resulting overflow along State Route 145 – Telluride vicinity

Embankment deterioration along State Route 145 near Telluride

Examples of embankment drainage into the San Miguel River – Telluride vicinity

Drainage and embankment deterioration along State Route 145 near Telluride



Drainage and embankment deterioration along State Route 145 near Telluride

Drainage and embankment deterioration along State Route 145 near Telluride

Drainage and embankment deterioration along State Route 145 near Telluride

Examples of residential flooding near the City of Telluride

Examples of residential flooding near the City of Telluride

Examples of residential flooding near the City of Telluride

Appendix B
Newsletter/Newspaper Articles

Greeley

GREELEY, COLORADO
ARTICLE NO. 1

Crews work to save papers at City Hall

Story By Perry Swanson
Posted on Saturday, July 14 @ 04:21:24 EDT (217 reads)

Workers slogged through at least 6 inches of water in the basement of Greeley City Hall late Friday trying to save drenched historical documents.

The water was more than a foot deep in places. Only the records stored high off the floor were spared. It was unclear exactly how many and what type of records were damaged, City Clerk Betsy Holder said.

The city called in refrigerated trucks to fast-freeze some of the more sensitive documents, Holder said.

"It just gives us some time to thaw and dry them properly," she said.

The documents ranged from those recording property ownership to the city council's legislative history dating to the late 1800s.

Some of the documents were stored in a vault in the basement of City Hall at 1000 10th St. Others were in storage rooms, and some were slated for destruction anyway, Holder said.

It was unclear how the water entered the building, Fire Chief Bill Martin said. It could have been through drains in a utility shed near City Hall, he said. The streets surrounding the building and the City Hall parking lots were still flooded long after other parts of downtown Greeley were mostly drained.

"It overran the storm sewer system," he said. "We haven't had a problem here before, so this is a very centralized and unusual circumstance."

Fire and public works crews dammed part of the parking lot with dirt and used sand bags to block the water inside the building.

The last time water damaged city records was three or four years ago when a water pipe broke in the basement, Holder said. It took six months to recover from that incident, which was far less serious, she said.

But measures taken beforehand to protect the documents, such as putting the most valuable documents on high shelves, largely worked, Holder said, holding a flashlight and wading through the water.

"We're actually in good shape. It doesn't look like it, but we are," she said.

A building inspector will survey the building before Monday to determine whether it is safe for city workers to return to their jobs, Holder said.

• **Related story:** Deluge swamps streets,shops

GREELEY, COLORADO
ARTICLE NO. 2

Deluge swamps streets,shops

Story By Perry Swanson and Lisa Martinez
Posted on Saturday, July 14 @ 03:33:39 EDT (611 reads)

A downpour of rain pounded Weld County on Friday night, flooding basements and turning streets into swamps dotted with dozens of stranded motorists.

Those caught in the middle of the storm, which dumped as much as 5 inches of rain in less than two hours, couldn't do much but wait it out, as they were on a long list to get help from the city.

Businesses along 8th Avenue and other parts of town were flooded. Among businesses that received flood damage: India's Taj Mahal, 901 9th St., and Greeley-Evans School District 6 administration offices, 811 15th St. The water was more than 3 feet deep in places.

About 2,300 Xcel customers were without power for an hour in Greeley, according to spokesman Mark Stutz. A few other outages were reported later throughout the night, he said.

Flooding may have been the culprit of a collapsed roof and storefront at Larry's Barber Shop, 909½ 8th Ave. Larry and Kathy Parker, who have owned the store for 31 years, sadly picked a few mementos from the remains.

Larry pulled out his framed barber's license and carefully carried away the stained-glass sign reading "Larry's Barbershop," the few remains of the storefront.

"Our grandsons survived," Kathy said, displaying a folding frame holding photos of two young boys.

No one was in the store when it collapsed. Someone called the Parkers to alert them something was wrong at the store, and they drove through Greeley's deluge to get there.

"My heart was just pounding on the way down here," Kathy said.

The same day, Larry had signed up for Social Security benefits and was looking forward to a quiet retirement. Now the couple isn't sure what will happen.

Larry said he had hoped to sell the barbershop someday.

"I don't think I'll be able to do that now," he said.

Firefighters helped the couple retrieve other items and closed southbound traffic on 8th Avenue shortly after the collapse about 7:30 p.m. Inside, antiques were destroyed, including a 100-year old mirror, Kathy said.

The slow-moving storm brought heavy rains to Greeley, Evans and Kersey. Between 4 and 5 inches fell in a 1 1/2-hour period starting about 6:30 p.m. Friday, according to National Weather Service meteorologist Scott Entrekin.

The weather service issued a flash flood warning for the Greeley area until 9:15 p.m. Friday.

"The good rains up there a couple nights ago left things fairly saturated. The forecast calls for a gradual drying out," said Entrekin, who added that Sunday should remain free of thunderstorms.

But Sunday wasn't soon enough.

As happened with various basements across town, City Hall on 10th Street flooded.

About 36 city employees were busy packing sandbags to help residents fend off flooding to their homes. Many stopped by the street division offices at 1203 3rd St. to pick up sandbags.

"We've been doing the backstroke here," joked Jerry Pickett, Greeley superintendent of streets.

Joking aside, Pickett said the city designed the No. 3 Ditch to overflow into city streets when heavy rains hit. The ditch, which runs through the center of Greeley, was over its banks Friday night.

"They're designed for doing that. They flood the street instead of flooding homes," Pickett said.

Flood waters completely covered the front yard of Loretta Llamas' home in east Greeley. Three feet of water reached the porch of her one-story home before workers came to assess the problem.

"It sure came close," Llamas said. "I've lived here 14 years, and it's been like this each and every year. I always call the city and complain, but nothing is done about it. It gets so bad that sometimes I have to go out there and clean the drains myself. That's ridiculous."

Llamas said she called the city three times before crews arrived.

"There's only so much we can do at one time," said Clarence Sandoval with the city of Greeley's street maintenance division. "We've had calls left and right."

Sandoval dug out shrubs and limbs that were clogging the drain pipes at Llamas' home.

But that would be only a temporary fix, Llamas said.

Scores of cars stalled when motorists, including Carl England of Greeley, tried to drive through water that was too deep.

England attempted to cross the intersection of 16th Avenue and 13th Street when his car died. He had to call a tow truck.

"There were cars in front of me and to the side," England said. "I didn't even see it coming. I knew I should have stopped at the bar instead of coming straight home."

• **Related story:** Crews work to save papers at City Hall

GREELEY, COLORADO
ARTICLE NO. 3

Water all around

Story By Lisa Martinez
Posted on Sunday, July 15 @ 01:59:40 EDT (990 reads)

Greeley and Evans residents spent Saturday cleaning up after Friday's storm that caused thousands of dollars in damage to homes, businesses. More than 100 people had to be evacuated from the Travelodge motel Friday night in Evans when more than 7 feet of water flooded the parking lot and basement. About a dozen motorists had to abandon cars that couldn't get out of the deep waters while the power went out inside.

In Greeley, India's Taj Mahal Restaurant, 901 9th St., received heavy flood damage. Owner Ram Singh said 3 feet of water in his basement damaged about $6,000 worth of groceries stored there. "I lost my entire business," said Singh. "It was all Indian groceries; I can't just go out and buy more." Singh said he will continue with business as usual when he receives new supplies. Clogged drains at the Greeley-Evans School District 6 administration offices, 811 15th St., caused water to seep into the west side of the building and soak the carpets.

"We're lucky we found it before too much water got in there," said District 6 spokeswoman Dollie Zamora. "We just set up fans to air out the carpets. It was very minimal damage." City Hall also flooded Friday. Crews worked overnight to salvage important records. Only small portions of articles were damaged and the oldest city records of hand-written minutes from the 1870s were left unscathed. Others weren't as lucky. On Friday, Travelodge manager Chris Lee was installing a new air conditioner system for the entire building when the rain fell. "We didn't even use it one day and look what happened," Lee said. "I just lost $20,000 on the air conditioner, and that's not including carpets, new boilers and pumping this water out." About $4,000 in food had to be destroyed, according to Ray Villejo, who owns the restaurant in the motel. "It could have been a lot worse," Villejo said. "If it would have been a little later, there would have been more people out here and more cars stuck." Estimates for total damage sustained to the motel and restaurant were unknown Saturday. Lee and Villejo said it would be a few days before the businesses would be back to normal. Timmy Benally, who had been staying at Travelodge since Monday, came home from work Friday to find cars stuck in a pool of water. He parked his truck across U.S. 85 and rushed back to the motel to check on his girlfriend and daughter. "Everyone had to evacuate the building, so I couldn't find them anywhere," said Benally, who later found them safe and sound in the undamaged portion on the west side of the building. "I'm glad my car wasn't there. This is the first time I've ever seen anything like this," he added. The couple and his daughter came to Greeley from New Mexico for Benally's temporary job. The roaming electrician stayed home from work Saturday to make sure his family would have a place to stay. Flooding was a common problem in the area. Victor Tallon, owner of Cornerstone Plumbing Inc. in Greeley, said he received 20 service calls for flooded basements Saturday, which is more than double the amount he usually gets on a typical weekend day. "People were trying to figure out why their basements were flooding," Tallon said. "When I went to take a look at them, I'm thinking to myself, 'this could have been preventable.' " Tallon said most of the homes he assessed Saturday had no sump pumps in the basements and drainage pipes outside the home weren't connected properly. "People pick up the pipe while mowing their

lawns and forget to put it back," Tallon said. "Boy, all the water went right into their homes." A Greeley official said it would cost millions to safeguard the city against flooding, especially from the No. 3 Ditch, which runs through Greeley. The ditch was over its banks Friday.
Superintendent of streets Jerry Pickett said three new overflows — concrete slabs above the ditch — have been built to divert water into the streets when the ditch is overflowing. That way it's not as apt to come into residents' yards and flood homes, he added. "There's nothing in this town that's going to handle the amount of water that fell Friday," Pickett said. "We can only do what we're doing now.... cleaning out drains and working on irrigation ditches." Meanwhile, Red Cross officials are working with a dozen families needing assistance after Friday's storm. As of Saturday, no one was displaced. "Some of them needed to wash their clothes, others lost their shoes... We're just working with their individual needs during this time," said spokeswoman Linda Glendenning.

Holyoke

HOLYOKE, COLORADO
ARTICLE NO. 1

Recent heavy rains damage bean crop

Story By John Lindenberger
Holyoke Enterprise, Vol. 102, No. 29
Posted on Thursday, September 27, 2001

In 2000, drought-like conditions threatened the quality of the bean crop in Northeast Colorado.

This year, an unexpected wet month has significantly affected the 2001 bean harvest.

The recent wet weather has really slowed things down for farmers and is adversely affecting the quality of the year's crop, according to representatives from the local receiving stations.

Steve Brown at KBC Trading & Processing said Tuesday the quality has really gone downhill because of the recent rains. A total of 4.36 inches of precipitation has been recorded so far this month.

One recent rain storm mixed with hail damaged some fields by causing the unharvested pods to open and drop the beans, according to Darrel Krieg at Amherst Co-op.

Krieg said some fields were significantly affected by the rain, while other fields were only affected a little. He noted the quality of some fields is still pretty good despite the rain.

Average yields of 40-45 bushels per acre are still being seen at Amherst's state line facility. Brown said it is difficult to estimate an average right now until the damage has been more thoroughly assessed.

Earlier this month, both facilities reported seeing a good quality crop that was slightly above average. Yields as high as 58 bushels per acre were being reported in some areas.

Brown noted some fields probably won't be harvested this year because of the rain. He added the actual number of fields which have a total loss should be relatively low.

Insurance adjusters are reportedly in the area assessing the damage this week. Brown estimates the entire area was affected in some way by the wet weather.

Brown said they had received about 75 percent of this year's crop as of Tuesday, while Krieg estimated they were about 60 percent done. Krieg added the harvest will continue for about 10-14 more days.

Palisade

PALISADE, COLORADO
ARTICLE NO. 1

Daily Sentinel

Tuesday, September 18, 2001, Volume 111 No. 176

By Marija B. Vader and Mike Wiggins, The Daily Sentinel

Xcel Energy crews scrambled Thursday afternoon to restore power to 200 customers on Orchard Mesa after a quick and intense thunderstorm blew through the Grand Valley.

Lightning struck several places throughout the valley creating about 15 outages stretching from Fruita to Palisade, said Wade Haerle, Xcel spokesman.

The storm arrived about 2:30 p.m.

The largest outage affected homes on Orchard Mesa, between Lyndon Road and Unaweep Avenue and between the Gunnison River and 27 ¼ Road.

Power was restored 30 minutes later.

"We have small nuisance outages all over the place and our crews are out there restoring them as quickly as possible," Haer said Thursday afternoon.

In Palisade, heavy rains created a mudslide on to the westbound on ramp and off ramp of Interstate 70. Colorado Department of Transportation crews quickly scraped the mud away.

"When I got here, torrential rain was coming off the side of the mountain," said Andy Scott, code-enforcement officer for the Palisade Police Department.

Every year, a storm sends a mudflow down the road, said Palisade Fire Chief Richard Rupp.

At the Peach Bowl, Palisade High School varsity soccer players were covered in mud from their waists to their feet Thursday afternoon during a game against Glenwood Springs.

The storm left pools of water on low ground in Palisade and Clifton.

In Clifton Village South subdivision, rainwater stood 2 feet deep at the intersection of Bunting Avenue and Sara Lane east of 32 Road.

Neighborhood children rode bikes and scooters through the pool, laughing as they sprayed themselves with water. Adults were not as jovial, though, as the flooding washed leaves grass and mud into their yards and driveways.

Residents blamed a bad drainage system they say was replaced earlier this year.

Tammie Anderson, who lives at 3205 Bunting Ave., said Mesa County in February installed a concrete culvert above the ground to try to funnel water to a canal that runs south of her home.

Anderson said the county offered to by a portion of her property to install the culvert and a pipe. She turned the county down offering instead to help keep the culvert and drain clean so water can flow freely into the canal.

But while Anderson said she is constantly armed with a rake and shovel, she and the other neighbors claim the county hasn't kept up its end of the bargain.

We have not seen one truck come out to clean that," Anderson said reaching down at one point into the murky water near the drain and pulling out a handful of sticks and wet newspaper. "The way they did this is a joke."

Andrea Patrick said the problem grew so severe that she wrote a letter last year to state Rep. Gayle Berry, R-Grand Junction.

"No one wants to come out and fix the problem," said Patrick, who lives across the street from Anderson at 3204 Bunting Ave. "The county blames the state, the state blames the county and nothing gets done.

Workers from the Mesa County Road and Bridge Department came out to the subdivision Thursday to survey the flooding, but left before the water subsided to a couple of inches in depth.

The flooding was a result of a line of severe storms blown toward Grand Junction from central Utah on Thursday, said forecaster Jerry Smith with the National Weather Service.

"We haven't gotten any reports of large hail yet, but there could be some out there," Smith said.

Today and Saturday, temperatures are expected to reach into the 80s again, he added, with a slight chance Sunday and Monday of more thunderstorms.

Marija B. Vader can be reached via e-mail at mvader@gjds.com Mike Wiggins can be reached at mwiggins@gjds.com.

Telluride

TELLURIDE, COLORADO
ARTICLE NO. 1

San Miguel County Sheriff gives advice if trapped by mud slides

By Bob Beer

Several days of heavy rains that triggered numerous mud and rock slides have prompted the San Miguel County Sheriff to give out safety pointers in case vehicles are trapped in the slides.

Weather forecasters have predicted heavy rains, with flash floods and mud slides possible over the weekend. Although emergency teams are on call, people need to take responsibility for their own safety, too.

First and foremost, said Sheriff Bill Masters, "don't be afraid to spend the night in Telluride." For those who don't have friends who can put them up for the night or can not afford hotel accommodations, shelters will be provided at either the Telluride Middle/High School or the Telluride Firehouse. Masters urged employers to let their out-of-town workers go in the early afternoon so they can drive home before the afternoon thunderstorms usually start. On Thursday, government workers were let go early to avoid possibly being trapped in slides, as happened Wednesday afternoon and evening.

People are also encouraged to listen to KOTO Community Radio which has been giving up-to-the-minute reports on road and weather conditions.

Also, carrying a cell phone is recommended, Masters said. Drivers should let their family or friends know when they start their commute and what time they expect to arrive.

If a driver does encounter mud oozing over the roadway, "don't try to drive over it," said Masters.

If a lot of mud, rocks and other debris are flowing over the highway, Masters suggested driving to a wide spot - but not a drainage area or creek - and, if further threatened, abandon the vehicle and climb to higher ground.

Lessons learned from the infamous Thompson Creek flood in the 1970s, which killed many people, should be studied.

"All of the people who climbed to higher ground survived," said Masters.

Even a small amount of rain can trigger mud slides because the soil is saturated from recent heavy rains, Masters said.

On Wednesday, besides law enforcement, fire and rescue teams, private contractors supplied equipment to help clear Highway 145 from Keystone Hill to Placerville. Those private contractors providing heavy equipment include Williams Construction, Telluride Gravel and Alpine Rentals. Masters praised those companies for helping the San Miguel County Road and Bridge Department and the Colorado Department of Transportation.

Several vehicles were still embedded in mud Thursday morning along the highway.

Masters said two residences near Fall Creek were heavily damaged by mud and flood waters, with many houses receiving minor damage.

Hundreds of motorists were trapped between mud slides and several vehicles were swept off the road by the slides. An estimated five inches of rain fell in a short time Wednesday afternoon beginning at 3 p.m., which caused more than 100 rock and mud slides, some of which were six feet deep, Masters said.

Workers were able to open one lane of traffic at about 9:30 p.m. Wednesday, permitting most trapped vehicles to depart, he said. The highway was closed again for the night and re-opened to two-lane traffic at 3 a.m. Thursday.

The Telluride Elks Lodge reported serving food to about 35 people who were stranded in Telluride for the night.

Past Exalted Ruler Yvette Sylvia said three local Elks members helped cook hamburgers for the stranded people, which included tourists from Nebraska.

TELLURIDE, COLORADO
Newsletter NO. 1

The Watershed Connection, Fall 2001 Volume 13

A Publication of the San Miguel Watershed Coalition

Flash Flood Hits Upper River

On August 8th a flash flood in the upper San Miguel Canyon between Deep Creek and Leopard Creek was estimated by Grand Junction National Weather Service to have dropped over four inches of rain in forty minutes, more than any historically recorded event. Mud and debris piled up on Highway 145 stranded motorists for hours.

A storm of this magnitude, and the required cleanup can alter the river ecosystem and affect local citizens for years to come. Our typical summer weather pattern consists of beautiful warm days, and afternoon thunderstorms. Occasionally thunderheads build up over the desert, collide with the high peaks of the San Miguel Range west of Telluride, and cause torrential downpours. Rainfall rates can exceed two inches per hour, or even up to three times that rate. The river was flowing at about 250 cubic feet per second (cfs) prior to the storm and peaked well over 2000 cfs shortly thereafter, the highest recorded flow for the year, effecting the entire river system for seventy miles downstream.

Upper San Miguel side canyons are typically very steep and narrow, fed by both local rains and rainfall on expansive mesas 500 feet above. During rain events, large amounts of water and mud mixed with debris, rocks, boulders and trees cascade down the gullies. The debris flows affect the river ecosystem and local geology by depositing massive amounts of fine red silt in the river bed, sometimes altering its course.

Flash flood flows can change the aquatic biology, fishery and indigenous wildlife in the riparian zone. Changes to the river channel may effect recreational uses including fishing, rafting and kayaking. Newly transported boulders and modified gravel bars change flow patterns, altering fish habitat and changing rapids.

CDOW biologist Sherman Hebein claims silt flows can directly effect existing and future trout populations. Aquatic insects, their primary food source, can be smothered under stream bottom silt, damaging natural food chain processes. Young fingerling fish can be killed, and adult fish impaired by silt in their gills, abrasion against rocks or even burial in sediment.

However, fish often handle silt better than expected. Observations of "good-sized" trout in Leopard Creek the day after the 1999 flash flood event, when the San Miguel reached 2500 cfs, support this. Local fishing guides concur that fish in the impacted area this year were effected, but that fishing upstream improved shortly after the flood. The effects of debris flows in the canyon could continue for years.

Another impact to river corridor health is the cleanup by CDOT of the massive amount of debris deposited on the highway. Every drainage and culvert was cleared, and material transported to other locations. Some material was pushed over the edge toward the river disturbing natural vegetation. Other material was stockpiled, creating new level pullouts. The cleanup effort may cause increased siltation of the river in the future. Effects of enlarged and additional vehicular parking areas are unknown.

Additional impacts resulted from fiber optic cable installation directly after debris flows. The River road has been closed to vehicles for five years, and riparian vegetation was recovering remarkably. It will take quite a while for the vegetation to recover. Th health of the San Miguel River system will continue to be effected by man made and natural events. We continue to learn how they affect our complex, unique and incredibly beautiful watershed. All watershed citizens must work together to address the impacts and cleanup of major flash flood event.

By Ascenzo DiGiacomo, SMWC

Appendix C

Correspondence/Telephone Logs

Colorado Springs

DATE: 12/18/01 And 03/19/02 TIME:	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Bruce Thorson COMPANY Colo Springs Engineering PHONE NO. (719) 385-5054 RECORDED BY Swender, Zuber PROJECT Flood Documention Report 2001 Colorado Flood Events	ROUTING FILE

Jenn Swender talked to Bruce Thorson on 12/18/01. He indicated that there was no significant flooding in September. He gave the following precipitation values for 09/17/01: 0.85" at Nixon Power Plant, 0.31" at Pinello Ranch, and 0.08" at Colorado College.

Rob Zuber talked to Bruce on 03/19/02 about August 31, 2001 storm. He gave following precipitation values. At Colorado College, 5.4" – most in 8 hours from 11 AM to 7 PM. Total for Pinello Ranch: 0.41". Total for Nixon PP: 0.27". He indicated that a drop structure project in Monument Creek was damaged – about $30,000 cost.

DATE: 03/18/02 TIME:	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Phil Breesawitz
COMPANY CDOT Maintenance
PHONE NO. (719) 576-1868
RECORDED BY Rob Zuber
PROJECT Flood Documention Report 2001 Colorado Flood Events

ROUTING

FILE

Mr. Breesawitz provided the following information:

Lift station at Bijou/I25 interchange is always necessary (even in dry weather) because road is below water table. During 09/31 storm, lightning hit power pole, knocking out electricity to station and damaging 2 of 3 pumps. 2 to 3 feet of water inundated highway. I25 was closed for about 7 hours. Cleanup costs estimated at $1,500. Pump and other electrical repair estimated at $30,000.

Greeley

DATE: 12/12/01 TIME:	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Steve Bagley
COMPANY
PHONE NO. ?
RECORDED BY Rob Zuber
PROJECT Flood Documention Report 2001 Colorado Flood Events

ROUTING

FILE

Left message for Steve

Steve returned call and left message. He indicated that the local storm downtown did not effect any major streams. There was not much information that Mr. Bagley had so he suggested to contact Burt Leautaud with the City of Greeley.

DATE: 12/13/01 TIME: 12:00PM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Bert Leautaud
COMPANY City of Greeley
PHONE NO. 970.352.2801
RECORDED BY Jenn Swender
PROJECT Flood Documention Report 2001 Colorado Flood Events

ROUTING

FILE

12/13: 12:00p.m. – left message

12/13: 1:50p.m. – returned my call

Bert referred to a rainfall event recorded on July 4th. 8" of water was recorded in the City Hall basement. He indicated that the water entered the basement through the air circulation ducts.

Bert suggested that we contact Bill Sterling with the City of Greeley.

DATE: 12/13/01 – 1/28/02 TIME: 2:00 PM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Bill Sterling COMPANY City of Greeley PHONE NO. 970.350.9795 RECORDED BY Jenn Swender PROJECT Flood Documention Report 2001 Colorado Flood Events	ROUTING FILE

12/13: 2:00p.m. – left message

12/20: 12:10p.m. – left message

12/21: 10:20a.m. – returned my call

Bill indicated that no rainfall event was recorded for July 14th, but a rainfall event was recorded for July 13th and July 4th.

1/3: 5:00p.m. – left message

1/9: 3:30p.m. – left message

1/28: 2:30p.m. – left message

Holyoke

DATE: 12/13/01 – 1/9/02 TIME: 11:50AM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Randy Schaffer COMPANY Phillips County PHONE NO. 970.854.3778 RECORDED BY Jenn Swender PROJECT Flood Documention Report 2001 Colorado Flood Events	ROUTING FILE

12/13

Randy faxed a newspaper article (Holyoke Enterprise). He also gave me some names to contact for any possible road damages, crop damages, etc. Suggested I contact Ron K./Cindy Gilmore with the USDA/Phillips County FSA Office.

1/9/02

Just a follow up to see if he had any additional information. None found.

DATE: 12/17/01 TIME: 1:45PM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

	ROUTING
TO Harvey McCune COMPANY Phillips County Local Farmer PHONE NO. 970.854.4343 RECORDED BY Jenn Swender PROJECT Flood Documention Report 2001 Colorado Flood Events	FILE

Harvey is located approximately 13 miles northeast of Holyoke. He indicated that there was no single storm/rain event. There were several rains through the entire month, but no flooding or damage to his property.

Okay to contact him with any future questions.

DATE: 1/9/02 TIME: 3:45PM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Ron Koberstein
COMPANY USDA/Phillips County FSA Office
PHONE NO. 970.854.2812
RECORDED BY Jenn Swender
PROJECT Flood Documention Report 2001 Colorado Flood Events

ROUTING

FILE

Ron faxed a copy of the USDA Flash Situation Report for September 7, 2001. He does not have any pictures or dollar amounts on any damage done. If damage to crops is requested in dollar amounts, we need to contact insurance agents or local farmers.

DATE: 02/04/02 TIME:	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Paula Carper
COMPANY Community First Insurance
PHONE NO. 970.854.2290
RECORDED BY Rob Zuber
PROJECT Flood Documention Report 2001 Colorado Flood Events

ROUTING

FILE

She indicated that there were crop damages and claims in September. She did not feel comfortable giving dollar amount.

Rio Blanco County

DATE: 12/05/01 TIME: 9:10 AM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044488.00

TO Jeff Devere
COMPANY Rio Blanco County
PHONE NO. 970-878-5081
RECORDED BY Tom Joseph
PROJECT Flood Documention Report 2001 Colorado Flood Events

ROUTING

FILE

The flooding occurred as a result of a series of rain events starting in late July and continuing through August. Flash flooding occurred thought out the Piceance Creek Basin approximately 50 mile area.

The flash floods resulted in extensive road and agriculture damage from mud slides along a approximately 20 mile stretch of County Road 5. Riparian along the creek was also heavily damaged. Banks of the Piceance Creek where flowing full. No residential or commercial property was damaged.

Most expenditures was due to clean up efforts clearing roads of mud and debris. County Road 5 closed for several days near industry. People had to drive 50 miles out of their way to get work.

Damage cost estimates have not been determined however the Rio Blanco County maintenance department spent all of the winter maintenance budget on clean up efforts.

Jeff will e-mail me a report that he prepared for Tom Browning explaining in more detail the flood limits and damages incurred.

DATE: 12/12/01 TIME: 2:00 PM	**TELEPHONE MEMORANDUM**	PROJECT NO.

TO Paul McCollum COMPANY CDOT Craig, CO PHONE NO. 970-824-5104 RECORDED BY Tom Joseph PROJECT Flood Documentation Report 2001 Colorado Flood Events	ROUTING FILE

Paul is a foreman for CDOT. He said that State Route 64 was the only state road effected by the July flood events.

About 5-6 miles West of Highway 13 for approximately 3-4 mile stretch mud and other debris collected on the road. The road was not impassable by traffic for very long at all.

Clean up included cleaning culverts, reshaping ditches, and clearing roadway. The approximate cost of clean up efforts was $20,000

Only minor flooding in the Rangley area.

No traffic delays seen except when water was washing across road, but that was only for a short period of time.

New Castle

DATE: 12/04/01 TIME: 4:15 PM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO: Steve Rippy
COMPANY City of New Castle
PHONE NO. 970-984-2311
RECORDED BY Tom Joseph
PROJECT Flood Documentation Report 2001 Colorado Flood Events

ROUTING

FILE

Rainfall Amount – 1.5 in. in 17 min, City engineer projected it to be around a 250-300 yr. storm event

Water comes from high point north of town and travels south down local streets to Main St. where storm sewers backed up. Storm sewers convey water to Elk Creek. Local north/south streets act as primary water route to Main Street.

Flood damages on the order of $85,000 +/- $1000. Most of the damage was too residential homes on the north side of town water entered there basements through windows. Damage incurred was to dry wall, electric, flooring, and personal property in the basements. No significant commercial damage.

Elk Creek was not significantly effected most rain fell to the east of the creek.

Steve
FYI

Lisa Cain Town of New Castle

From: Soule, Jim [Jim.Soule@state.co.us]
Sent: Thursday, August 23, 2001 1:02 PM
To: 'tnc@glenwood.net'
Subject: FW: Mud/Water Flooding in New Castle and Rockfall Hazards on C.R. 115 (aka Red Canyon Road)

> -----Original Message-----
> From: Soule, Jim
> Sent: Wednesday, August 22, 2001 3:28 PM
> To: 'gmeyer@garfield-county.com'
> Cc: Wait, TC; Greenman, Celia; Noe, Dave; Cowart, Vicki
> Subject: Mud/Water Flooding in New Castle and Rockfall Hazards on
> C.R. 115 (aka Red Canyon Road)
>
> Dear Mr. Meyer:
>
> On August 20 and 21, TC Wait and I investigated the August 15 flood
> event in New Castle and the recent rockfall(s) on Red Canyon Road,
> respectively. Upon arrival in Glenwood Springs about noon Monday, we
> stopped by your emergency-management office. You were not there. Staff
> there recommended that we should contact Mr. Steve Rippey, New Castle Town
> Manager, which we did later that afternoon.
> New Castle-- We informally studied the entire affected area in the
> older parts of New Castle as well as nearby places (e.g. Castle Valley) to
> evaluate the causal mechanisms and potential future hazards related to
> this kind of flooding. We observed that the most seriously affected areas
> were almost entirely confined to the coalescing alluvial-fans (alluvial
> apron) below the bedrock hogback hill which bounds the north side of the
> older part of the Town. The dip (inclination) of the flaggy (thin, platy)
> sandstone and shale bedrock is about 45 degrees approximately to the
> south; this condition apparently contributed greatly to the mobilization
> within the bedrock during this event. This is the area that reportedly
> received approximately 1.5 in. of rainfall in about 15 minutes. Our
> interpretation is that the intense, short duration rainfall was sufficient
> to dislodge and mobilize loose bedrock and its derived rubble only at
> shallow depths, but over a relatively widespread extent across nearly all
> of the south side of the indicated hill and the slopes immediately below
> it. The resulting (debris) flows moved down streets and into the yards of
> houses. The most seriously affected areas were near the source areas of
> the debris. Farther down slope adjacent to U.S. Hwy. 6 (Main Street), most
> of the flood materials consisted of muddy water.
> Our most significant observations about this event related to a future
> nuisance and property losses are that steep bedrock and rubble slopes on
> and adjacent to the hogback present the most serious threat to structures
> immediately adjacent to them. Some older existing houses had deflection
> and/or retaining walls behind them and these worked reasonably well during
> this event. There are newer houses or ones under construction in this area
> which do not have such walls: we recommend that they be installed The
> steep north-south-oriented streets appeared to do a reasonably good job of
> conveying muddy water down to Main Street which is at a gentle grade.
> Remedial work on the source areas would be costly and probably futile
> considering the amount of rubble and the composition of and fracturing in
> the bedrock.
> We met with Mr. Rippey at the Town Hall for about an hour late Monday
> afternoon and conveyed our findings to him.
>
> C.R. 115-- Rockfalls along a nearly 600 ft reach of this road in the
> nearly lowest part of Red Canyon have occurred frequently during the
> nearly 25 years that I have been familiar with the situation. They present
> an ongoing road-maintenance problem as well as a serious safety hazard for

1

> motorists. The most recent events occurred a few weeks ago when our office
> was contacted by the County. Unfortunately, our response has been delayed
> until now because of a temporary, seasonal (summer) personnel shortage.
>
> The Maroon Formation bedrock in this area consists of heavily
> fractured red sandstone interbedded with red shale. This fracturing
> extends tens, if not more, of feet into the subsurface and is caused by
> the nearly continuous shale and evaporite diapirism tectonics which is
> prevalent in much of the Roaring Fork Valley and nearby places.
>
> I spoke this afternoon with Mr. Tom Russell of Garfield County Road
> and Bridge about the possibility of solving this rockfall problem.
> Unfortunately, I can only be very pessimistic as it will be practically
> impossible to remediate the fractures in the bedrock and the slope
> profile(s) of the steep canyon walls (which largely result from a rapid
> rate of slope disintigration caused by nearly continuous rock movements.
>
> I recommended to Mr. Russell that the situation here is potentially
> so bad that the County should consider closing this road altogether. He
> indicated that this has been considered before and is politically
> untenable. Because of this, I suggested that the county consider
> installing a series of "Jersey Barrier" structures out into the roadway
> and that this segment be made into an alternating one-way road with an
> automated signaling system. The one-way system would presumably slow
> traffic down and possibly lessen hazard by lowering the relative velocity
> of rocks hitting vehicles. Appropriate signage warning motorists about the
> danger should also be installed. This should include a "NO STOPPING OR
> STANDING" zone and possibly informative signs at either end of the road
> which explain the danger.
>
> I indicated to Mr. Russell that CGS is willing to continue to help
> Garfield County with this matter. I suggested that this might include a
> field meeting, on site, in the near future.
>
> Sincerely,
> JAMES M. SOULE
> Senior Engineering Geologist Emeritus
> Colorado Geological Survey
>
> Tel. (303) 894-2056
> Cell. (303) 8090431
> (FAX) (303) 866-2461

2

Palisade

DATE: 12/06/01 TIME: 11:00 AM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044888.00

TO Ed Hill
COMPANY CDOT Maintenance
PHONE NO. 970.248.7362
RECORDED BY Tom Joseph
PROJECT Flood Documentation Report 2001
Colorado Flood Events

ROUTING

FILE

Ed Hill is with the CDOT Maintenance crew in Grand Junction. Ed said that the only damaged incurred by the August flood event was mud and debris on the Palisade interchange off Interstate 70, driving lanes were not effected.

The clean up and repair consisted of a maintenance crew cleaning off the interchange, regarding ditch slopes and cleaning out storm sewers. The estimated cost to this maintenance was approximately $30,000

There was approximately 48 in of debris on the interchange.

Telluride

DATE: 12/05/01 TIME: 2:00 PM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044488.00

TO Karen Guglielmoe
COMPANY City of Telluride
PHONE NO. 970-728-3071
RECORDED BY Tom Joseph
PROJECT Flood Documentation Report 2001 Colorado Flood Events

ROUTING

FILE

There was a storm on August 9 2001 rather than September 17 as stated in the Scope.

Heavy rain did occur in Telluride but no negative effects were reported.

Most damage occurred a few miles down steam between the west side of Telluride and Saw Pit. Mud slides from the north resulted in the closure of highway 145. There was also damage to both commercial and residential properties in Saw Pit.

DATE: 12/18/01 TIME: 10:00 AM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044488.00

TO Jay Carlson COMPANY CDOT PHONE NO. _____ RECORDED BY Tom Joseph PROJECT Flood Documentation Report 2001 Colorado Flood Events	ROUTING FILE

Jay told me that some residents reported 4in in the rain gages , but unreliable cost. He will send me pictures and all information he has via e-mail.

DATE: 12/18/01 TIME: 10:00 AM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044488.00

TO Blair Renfro, Project Engineer COMPANY CDOT PHONE NO. _____ RECORDED BY Rob Zuber PROJECT Flood Documentation Report 2001 Colorado Flood Events	ROUTING _____ _____ _____ _____ FILE

Mr. Renfro stated that the $2.8 Million in costs to CDOT for the Telluride/Placerville storm from Jay Carlson is accurate. This includes past costs and estimated future costs. He categorized the estimated CDOT costs:

- $300,000 for debris removal
- $150,000 for pipe cleaning
- $920,000 for rebuilding of retaining walls
- remainder for slope stability, traffic control, and project management

DATE: 01/07/01 TIME: 4:00 AM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044488.00

TO Mike Horner COMPANY San Miguel County PHONE NO. 970-327-4835 RECORDED BY Tom Joseph PROJECT Flood Documentation Report 2001 Colorado Flood Events	ROUTING FILE

Mike relayed to me that the rain occurred on August 8 rather than September 13, 2001.

Mike told me there was damage to several county roads including:

60M - $5604

57P - $6736

58P - $1617

63L - $147

62L - $85

St. Route 145 - $5840

Town of Placerville Local Roads - $1325

Town of Sawpit Local Roads - $400

Most of the damage was a result of debris deposits on roads and in culverts, several culverts were filled and required to be cleaned.

Bear Creek was flowing very high and was eroding parts of county road 60M

DATE: 03/20/02 TIME: 8:00 AM	**TELEPHONE MEMORANDUM**	PROJECT NO. 68-00044488.00

TO Telluride Daily Planet Editor COMPANY Telluride Daily Planet PHONE NO. 970-728-9788 RECORDED BY Tom Joseph PROJECT Flood Documentation Report 2001 Colorado Flood Events	ROUTING FILE

URS Spoke with the Daily Planet Editor to ensure that we (URS) could use a picture that the had posted on there web site. He said that was fine as long as we said stated courtesy of the Telluride Daily Planet below the picture.

Appendix C
Correspondence/Telephone Logs

Date Contacted	Contacted by	Name	Company	Phone Number
12/12/01	Rob Zuber	Steve Bagley	City of Greeley	970.350.9792
03/19/02	Rob Zuber	Phil Breesawitz	CDOT Maintenance, Colo. Springs	719.576.1868
		Mark Brown	Holyoke	970.854.2266
		Tom Browning	CWCB	303.866.3441
12/18/01	Tom Joseph	Jay Carlson	CDOT	970.385.1400
02/04/02	Rob Zuber	Paula Carper	Community First Insurance	970.854.2290
12/5/01	Tom Joseph	Jeff Devere	Rio Blanco County	970.878.5081
		Nolan Doesken	Colorado Climate Center	970.491.8545
		Bill Frownfelter	Telluride	970.728.3071
		Marylin Galley	Colorado OEM	303.273.1622
		Stuart Gardner	CDOT, Grand Junction	970.248.7222
		Cindy Gilmore	CSU Agricultural Extension	970.854.2812
12/5/01	Tom Joseph	Karen Guglielmoe	City of Telluride	970.728.3071
		Gary Haynes	Colorado Springs	719.636.1212
12/6/01	Tom Joseph	Ed Hill	CDOT Maintenance	970.248.7362
1/7/02	Tom Joseph	Mike Horner	San Miguel County	970.327.4835
		Brian Hyde	CWCB	303.866.3441, x318
		Bob Jarrett	USGS	303.236.6447
01/09/02	Jenn Swender	Ron Koberstein	USDA	970.854.2812
		Larry Lang	CWCB	303.866.3441, x320
12/13/01	Jenn Swender	Bert Leautaud	City of Greeley	970.352.2801
		Mark Matulik	CWCB	303.866.3441, x301
12/12/01	Tom Joseph	Paul McCollum	CDOT, Craig	970.824.5104
12/17/01	Jenn Swender	Harvey McCune	Holyoke Local Farmer	970.854.4343
03/20/02	Rob Zuber	Blair Renfro	CDOT Engineer	970-385-3625
		Randy Rindquist	Phillips County Road Department	970.474.3576
12/4/01	Tom Joseph	Steve Rippy	New Castle	970.984.2311
		Mike Rozyski	San Miguel County	970.728.3083
		Ken Sampley	Colorado Springs	719.385.5417
12/13/01, 1/9/02	Jenn Swender	Randy Schaffer	Phillips County	970.854.3778
12/13/01, 1/28/02	Jenn Swender	Bill Sterling	City of Greeley	970.350.9795
12/18/01, 03/19/02	Swender, Zuber	Bruce Thorson	City of Colorado Springs	719.385.5054

Appendix D
Data

Table D-1
Summary of Collected Data

Location/Date	Precipitation Data	Discharge Data	Damage Data
Colorado Springs / September 16	-Bruce Thorson, City of C.S.: 5/100 inch at Nixon PP, 0 inch at Pinello Ranch, 2/100 inch at Colo College -Western Regional Climate Center: not available -Event Record for 8/31/01: approx. 5 inches in 5 hours	U.S.G.S.: Fountain (07103700) and Monument Creeks (07103780)	No data
Greeley / July 13	-NCDC website (NOAA): 3"-5" in 2 hours -Greeley Tribune: 3.48" -NOAA Event Record: 3"-5" in less than 2 hours -Western Regional Climate Center: not available	U.S.G.S.: none available	-Misc. data from Greeley Tribune -NOAA Event Report: $600k in property damage
Holyoke / September 9	-Western Regional Climate Center: not available	U.S.G.S.: none available	-Crop losses from FSA
Meeker/Rio Blanco County / mid July-late August	-Several storms but no specific information -Western Regional Climate Center: not available	U.S.G.S.: Piceance Creek (09306200)Two sites on White River (09304800 and 09306290) Yellow Creek (09306255)	-Jeff Devere, Rio Blanco County -Paul McCollum, CDOT
New Castle / August 14	-Event Record and County officials: 1"-1.5" in 20 minutes -Western Regional Climate Center: not available	U.S.G.S.: none available	-Steve Rippy, City of New Castle
Palisade/Grand Valley / September 13	-Newspaper 9/14/01: 0.07 inch in 20 minutes -Western Regional Climate Center: not available -Event Record for 8/21/01: 1.5 inch in 1 hour	U.S.G.S.: none available	-Ed Hill, CDOT
Telluride to Placerville / August 8	-Event Record and County officials: 5" in 2 hours -Western Regional Climate Center: not available	U.S.G.S.: San Miguel River (09172500)	-Mike Horner, San Miguel County -Jay Carlson, CDOT Region 5 -NOAA Event Record:

Table D-2
Precipitation from NOAA Atlas (values in inches)

Colorado Springs		2-year	5-year	10-year	25-year	100-year	500-year
	5-min	0.3	0.4	0.5	0.6	0.8	0.9
	10-min	0.5	0.7	0.8	0.9	1.2	1.4
	15-min	0.6	0.9	1.0	1.2	1.5	1.8
	30-min	0.9	1.2	1.4	1.7	2.1	2.5
	1-hour	1.1	1.5	1.8	2.1	2.6	3.2
	6-hour	1.6	2.0	2.4	2.8	3.4	
	24-hour	2.1	2.6	3.0	3.6	4.4	

Greely		2-year	5-year	10-year	25-year	100-year	500-year
	5-min	0.3	0.4	0.5	0.6	0.8	1.0
	10-min	0.5	0.7	0.8	1.0	1.3	1.6
	15-min	0.6	0.9	1.0	1.3	1.7	2.1
	30-min	0.8	1.2	1.4	1.7	2.3	2.8
	1-hour	1.0	1.5	1.8	2.2	2.9	3.6
	6-hour	1.4	2.0	2.2	2.6	4.2	
	24-hour	1.7	2.2	2.6	3.4	5.0	

Holyoke		2-year	5-year	10-year	25-year	100-year	500-year
	5-min	0.4	0.6	0.7	0.8	0.9	1.1
	10-min	0.7	0.9	1.0	1.2	1.4	1.7
	15-min	0.9	1.1	1.3	1.5	1.8	2.1
	30-min	1.2	1.5	1.8	2.1	2.4	2.9
	1-hour	1.5	2.0	2.3	2.6	3.1	3.7
	6-hour	2.0	2.6	3.0	3.6	4.2	
	24-hour	2.2	3.0	3.4	4.2	5.0	

Meeker/Rio Blanco County		2-year	5-year	10-year	25-year	100-year	500-year
	5-min	0.2	0.2	0.2	0.3	0.4	0.5
	10-min	0.2	0.3	0.4	0.5	0.6	0.7
	15-min	0.3	0.4	0.5	0.6	0.7	0.9
	30-min	0.4	0.6	0.7	0.8	1.0	1.3
	1-hour	0.5	0.7	0.8	1.0	1.3	1.6
	6-hour	0.8	1.1	1.2	1.5	1.8	
	24-hour	1.0	1.5	1.6	1.8	2.4	

New Castle		2-year	5-year	10-year	25-year	100-year	200-year	300-year	500-year
	5-min	0.2	0.2	0.3	0.3	0.5	0.5	0.6	0.6
	10-min	0.2	0.3	0.4	0.5	0.7	0.8	0.9	1.0
	15-min	0.3	0.4	0.5	0.7	0.9	1.1	1.1	1.2
	30-min	0.4	0.6	0.8	0.9	1.3	1.5	1.6	1.7
	1-hour	0.5	0.8	1.0	1.2	1.6	1.9	2.0	2.2
	6-hour	0.7	1.0	1.2	1.5	1.8			
	24-hour	1.0	1.4	1.6	2.0	1.8			

Palisade/ Grand Valley		2-year	5-year	10-year	25-year	100-year	500-year
	5-min	0.2	0.3	0.3	0.4	0.5	0.6
	10-min	0.3	0.5	0.5	0.6	0.7	0.9
	15-min	0.4	0.6	0.6	0.7	0.9	1.2
	30-min	0.5	0.8	0.9	1.0	1.3	1.7
	1-hour	0.6	1.1	1.1	1.3	1.6	2.1
	6-hour	0.7	1.2	1.2	1.4	1.8	
	24-hour	0.8	1.4	1.4	1.8	1.8	

Telluride to Placerville		2-year	5-year	10-year	25-year	100-year	150-year	500-year
	5-min	0.1	0.2	0.3	0.3	0.4	0.4	0.5
	10-min	0.2	0.3	0.4	0.5	0.6	0.7	0.8
	15-min	0.3	0.4	0.5	0.6	0.8	0.9	1.0
	30-min	0.4	0.6	0.7	0.9	1.1	1.2	1.4
	1-hour	0.5	0.7	0.9	1.1	1.4	1.5	1.8
	6-hour	1.0	1.2	1.5	1.9	2.0		
	24-hour	1.2	1.8	2.0	2.4	2.8		

NOAA Event Records

BEGBEG*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

Event Record Details

Event: **Hail**

State: **Colorado**
Map of Counties

Begin Date: **31 Aug 2001, 03:51:00 PM MST**

County: **El Paso**

Begin Location: **2 Miles South of Colorado Spgs**

Begin LAT/LON: **38°48'N / 104°49'W**

End Date: **31 Aug 2001, 03:56:00 PM MST**

End Location: **2 Miles South West of Colorado Spgs**

End LAT/LON: **38°48'N / 104°49'W**

Magnitude: **0.75 inches**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 0.0**

Crop Damage: **$ 0.0**

Description:
None Reported

ENDEND*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

This page dynamically generated 19 Mar 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

BEGBEG*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

Event Record Details

Event:	**Flash Flood**	State:	**Colorado** Map of Counties
Begin Date:	**31 Aug 2001, 10:15:00 AM MST**	County:	**El Paso**
Begin Location:	**Colorado Spgs**		
End Date:	**31 Aug 2001, 03:00:00 PM MST**		
End Location:	**(cos)peterson Field**		
Magnitude:	**0**		
Fatalities:	**0**		
Injuries:	**0**		
Property Damage:	**$ 0.0**		
Crop Damage:	**$ 0.0**		

Description:
Intense rainfall...at times exceeding 2 inches per hour and over 5 inches in approximately 5 hours... caused serious urban and creek flooding concentrated near downtown Colorado Springs. Interstate 25 at the Bijou Street bridge flooded...when the water pump failed due to a lightning strike. The Interstate was closed for about 10 hours...and traffic was rerouted through downtown Colorado Springs.

ENDEND*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

BEGBEG*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

Event Record Details

Event: **Hail**

State: **Colorado**
Map of Counties

Begin Date: **31 Aug 2001, 11:42:00 AM MST**

County: **El Paso**

Begin Location: **3 Miles West of Colorado Spgs**

Begin LAT/LON: **38°50'N / 104°52'W**

End Date: **31 Aug 2001, 11:47:00 AM MST**

End Location: **3 Miles West North West of Colorado Spgs**

End LAT/LON: **38°50'N / 104°52'W**

Magnitude: **1.25 inches**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 0.0**

Crop Damage: **$ 0.0**

Description:
None Reported

ENDEND*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

This page dynamically generated 19 Mar 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

BEGBEG*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

Event Record Details

Event: **Hail**

State: **Colorado**
Map of Counties

Begin Date: **31 Aug 2001, 12:24:00 PM MST**

County: **El Paso**

Begin Location: **Colorado Spgs**

Begin LAT/LON: **38°50'N / 104°49'W**

End Date: **31 Aug 2001, 12:29:00 PM MST**

End Location: **Colorado Spgs**

End LAT/LON: **38°50'N / 104°49'W**

Magnitude: **1.00 inches**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 0.0**

Crop Damage: **$ 0.0**

Description:
None Reported

ENDEND*NCDC* / *Climate Resources* / *Climate Data* / *Events* / *Storm Events* / *Results* / *Search* / *Help*

This page dynamically generated 19 Mar 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

NCDC / Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

Event Record Details

Event: **Flash Flood**

State: **Colorado**
Map of Counties

Begin Date: **13 Jul 2001, 06:39:00 PM MST**

County: **Weld**

Begin Location: **Greeley**

End Date: **13 Jul 2001, 08:15:00 PM MST**

End Location: **Greeley**

Magnitude: **0**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 600.0K**

Crop Damage: **$ 0.0**

Description:
Anywhere from 3 to 5 inches of rainfall reportedly fell in the Greeley area in less the 2 hours. As a result, several roads were inundated with up to 2 feet of water and many basements of homes and businesses were flooded. In the basement of Greeley City Hall, several boxes of documents dating back to the 1800's were drenched in the floodwaters. The roof of a local business collapsed during the deluge. Approximately 2300 homes and businesses in town suffered electrical outages.

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404256 - END
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404256 - END*NCDC /*
Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

This page dynamically generated 29 Jan 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

Event Record Details

Event: **Urban/sml Stream Fld**

State: **Colorado**
Map of Counties

Begin Date: **13 Sep 2001, 01:30:00 PM MST**

County: **Mesa**

Begin Location: **Palisade**

End Date: **13 Sep 2001, 02:00:00 PM MST**

End Location: **Palisade**

Magnitude: **0**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 0.0**

Crop Damage: **$ 0.0**

Description:
Heavy rain from a slow moving thunderstorm triggered a mudslide near a highway on ramp next to Interstate 70 in Palisade. Water backed up over the roadway resulting in the flooding of an intersection. The water quickly ran off shortly after the heavy rain ended.

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404435 - END
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404435 - END*NCDC* /
Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

This page dynamically generated 29 Jan 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

NCDC / Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

Event Record Details

Event: **Urban/sml Stream Fld**

State: **Colorado**
Map of Counties

Begin Date: **21 Aug 2001, 07:05:00 PM MST**

County: **Mesa**

Begin Location: **4 Miles North of Grand Jct**

End Date: **21 Aug 2001, 08:05:00 PM MST**

End Location: **4 Miles North of Grand Jct**

Magnitude: **0**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 0.0**

Crop Damage: **$ 0.0**

Description:
A slow moving thunderstorm dropped up to 1.5 inches of rain in less than one hour. This resulted in minor flooding of small creeks in the area and left standing water in several fields.

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404410 - END
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404410 - END*NCDC* /
Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

This page dynamically generated 29 Jan 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

NCDC / Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

Event Record Details

Event: **Flash Flood**

State: **Colorado**
Map of Counties

Begin Date: **21 Aug 2001, 02:55:00 PM MST**

County: **Rio Blanco**

Begin Location: **12 Miles West of Rio Blanco**

End Date: **21 Aug 2001, 03:15:00 PM MST**

End Location: **12 Miles West North West of Rio Blanco**

Magnitude: **0**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 0.0**

Crop Damage: **$ 0.0**

Description:
A series of slow moving thunderstorms dropped very heavy rainfall resulting in numerous mud and rock slides. Portions of Colorado Road 5 in central Rio Blanco County were washed away due to the excessive runoff.

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404407 - END
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404407 - END*NCDC* /
Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

NCDC / Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

Event Record Details

Event: **Flash Flood**

State: **Colorado**
Map of Counties

Begin Date: **14 Aug 2001, 08:00:00 PM MST**

County: **Garfield**

Begin Location: **New Castle**

End Date: **14 Aug 2001, 08:45:00 PM MST**

End Location: **New Castle**

Magnitude: **0**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 100.0K**

Crop Damage: **$ 0.0**

Description:
A strong thunderstorm over the town of New Castle produced very heavy rain and small hail. This storm was part of a line of storms that were moving slowly south through west-central Colorado. Up to one inch of rain fell in less than 20 minutes. The heavy rain triggered a massive mudslide which flooded several homes and businesses in New Castle and closed U.S. Highway 6 and several other streets within the town. Up to 2 feet of mud and rocks were left behind after the flooding and it took several days to clear all of the debris.

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404390 - END
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404390 - END*NCDC* /
Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

This page dynamically generated 29 Jan 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

Event Record Details

Event: **Flash Flood**

State: **Colorado**
Map of Counties

Begin Date: **08 Aug 2001, 02:00:00 PM MST**

County: **San Miguel**

Begin Location: **Telluride**

End Date: **08 Aug 2001, 04:00:00 PM MST**

End Location: **Placerville**

Magnitude: **0**

Fatalities: **0**

Injuries: **0**

Property Damage: **$ 400.0K**

Crop Damage: **$ 0.0**

Description:
Slow moving thunderstorms over eastern San Miguel County dropped up to 5 inches of rain in a 2 hour period between Telluride and Placerville. The heavy rains triggered numerous mud and rock slides throughout the eastern portion of the county. Several vehicles were swept from highway 145/62 as up to 6 feet of mud and rock slid over the road. Most of the vehicles were damaged and one vehicle was pushed down to the river bed, where 9 people had to be rescued. Two homes sustained major damage from the floods with several others receiving minor damage. No injuries were reported, although rescue workers had to use off-road motorcycles and medical evacuation buggies to rescue and evacuate a woman in labor across seven mud slides to a waiting ambulance.

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404374 - END
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~404374 - END*NCDC /*
Climate Resources / Climate Data / Events / Storm Events / Results / Search / Help

This page dynamically generated 29 Jan 2002 from:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Please send questions or comments about this system to rray@ncdc.noaa.gov
Please see the NCDC Contact Page if you have questions or comments.

Attachment 1

Technical Evaluations & Backup Information

Colorado Springs

Fountain Creek

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

--- PROCESSING DATE/TIME ---

2002 JAN 17 10:45:31

--- PROCESSING OPTIONS ---

Plot option	= Graphics & Printer
Basin char output	= WATSTORE
Print option	= Yes
Debug print	= No
Input peaks listing	= Long
Input peaks format	= WATSTORE peak file

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

Station - 07103700 FOUNTAIN CREEK NEAR COLORADO SPRINGS, CO.
2002 JAN 17 10:45:31

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	43
Peaks not used in analysis	=	0
Systematic peaks in analysis	=	43
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.115
Standard error of generalized skew	=	0.550
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

```
    WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.                    0.0
    WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.              37.8
    WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE.       4252.2
1
```

Station - 07103700 FOUNTAIN CREEK NEAR COLORADO SPRINGS, CO.
2002 JAN 17 10:45:31

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	2.6031	0.3784	0.170
BULL.17B ESTIMATE	0.0	1.0000	2.6031	0.3784	0.084

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	'EXPECTED SYSTEMATIC RECORD	PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	45.5	48.8	40.2	26.7	67.1
0.9900	55.7	58.9	50.5	34.0	80.1
0.9500	97.7	99.9	93.1	66.1	131.4
0.9000	132.3	133.5	128.4	94.2	172.6
0.8000	191.9	191.4	189.0	144.3	243.1
0.5000	396.1	391.2	396.1	317.0	494.5
0.2000	831.6	828.0	845.3	656.9	1105.0
0.1000	1234.0	1243.0	1275.0	944.5	1738.0
0.0400	1890.0	1937.0	2006.0	1383.0	2862.0
0.0200	2496.0	2596.0	2715.0	1768.0	3979.0
0.0100	3211.0	3391.0	3595.0	2205.0	5373.0
0.0050	4052.0	4346.0	4683.0	2699.0	7094.0
0.0020	5381.0	5895.0	6521.0	3452.0	9972.0
0.6667	272.9	(1.50-year flood)			
0.4292	462.4	(2.33-year flood)			

1

Station - 07103700 FOUNTAIN CREEK NEAR COLORADO SPRINGS, CO.
2002 JAN 17 10:45:31

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1958	752.0		1980	338.0	
1959	584.0		1981	650.0	
1960	89.0		1982	305.0	
1961	955.0		1983	286.0	
1962	366.0		1984	305.0	
1963	428.0		1985	229.0	
1964	2630.0		1986	72.0	
1965	359.0		1987	202.0	
1966	317.0		1988	163.0	
1967	544.0		1989	170.0	
1968	301.0		1990	318.0	
1969	295.0		1991	2340.0	
1970	616.0		1992	299.0	
1971	96.0		1993	78.0	
1972	223.0		1994	736.0	
1973	283.0		1995	1760.0	
1974	500.0		1996	657.0	
1975	492.0		1997	1610.0	
1976	408.0		1998	1290.0	
1977	560.0		1999	1750.0	
1978	342.0		2000	117.0	
1979	416.0				

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

1

Station - 07103700 FOUNTAIN CREEK NEAR COLORADO SPRINGS, CO.
2002 JAN 17 10:45:31

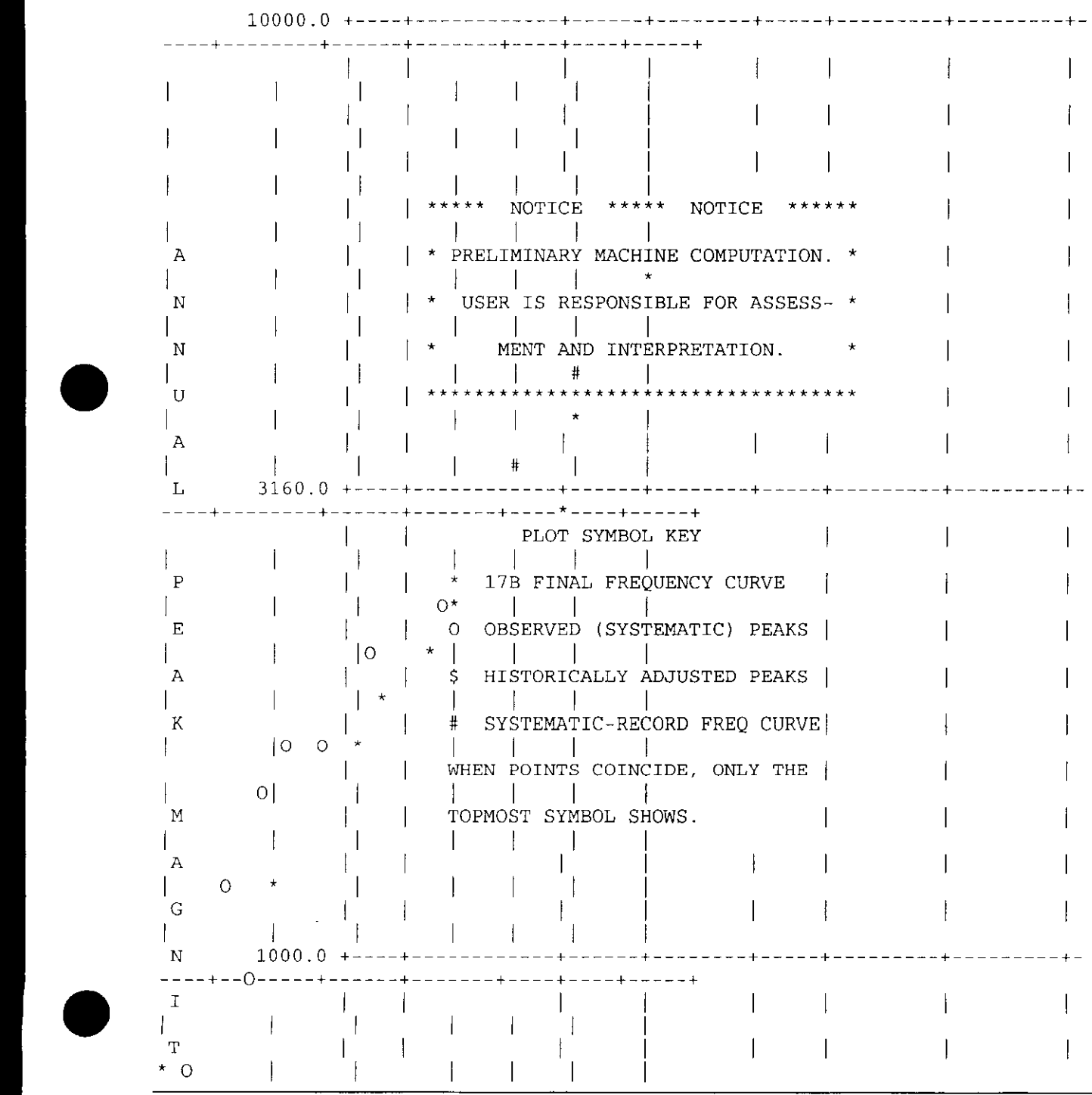
EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

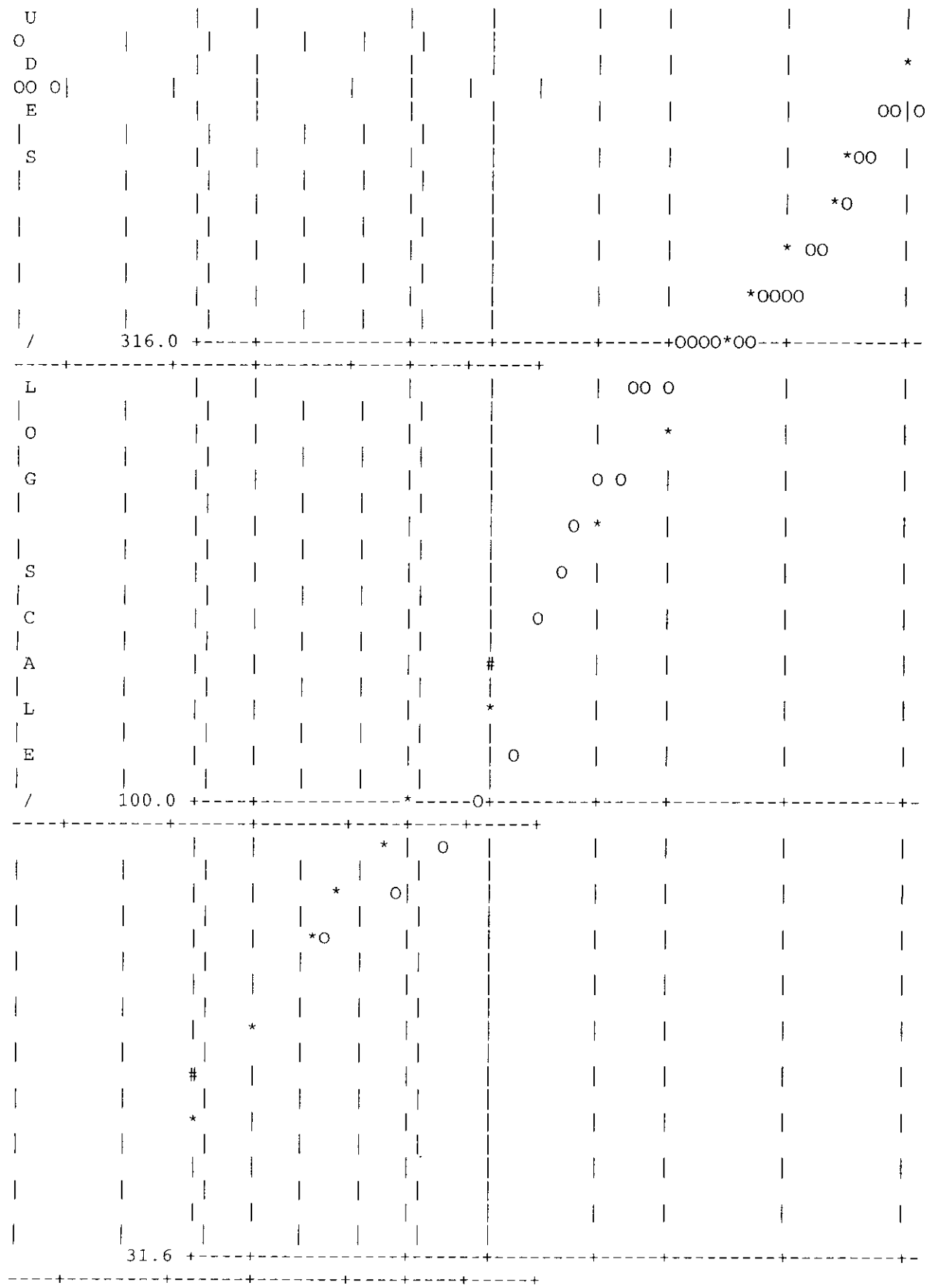
WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1964	2630.0	0.0227	0.0227
1991	2340.0	0.0455	0.0455
1995	1760.0	0.0682	0.0682
1999	1750.0	0.0909	0.0909
1997	1610.0	0.1136	0.1136
1998	1290.0	0.1364	0.1364
1961	955.0	0.1591	0.1591
1958	752.0	0.1818	0.1818
1994	736.0	0.2045	0.2045
1996	657.0	0.2273	0.2273
1981	650.0	0.2500	0.2500
1970	616.0	0.2727	0.2727
1959	584.0	0.2955	0.2955
1977	560.0	0.3182	0.3182
1967	544.0	0.3409	0.3409
1974	500.0	0.3636	0.3636
1975	492.0	0.3864	0.3864
1963	428.0	0.4091	0.4091
1979	416.0	0.4318	0.4318
1976	408.0	0.4545	0.4545
1962	366.0	0.4773	0.4773
1965	359.0	0.5000	0.5000
1978	342.0	0.5227	0.5227
1980	338.0	0.5455	0.5455
1990	318.0	0.5682	0.5682
1966	317.0	0.5909	0.5909
1982	305.0	0.6136	0.6136
1984	305.0	0.6364	0.6364
1968	301.0	0.6591	0.6591
1992	299.0	0.6818	0.6818
1969	295.0	0.7045	0.7045
1983	286.0	0.7273	0.7273
1973	283.0	0.7500	0.7500
1985	229.0	0.7727	0.7727
1972	223.0	0.7955	0.7955
1987	202.0	0.8182	0.8182
1989	170.0	0.8409	0.8409
1988	163.0	0.8636	0.8636
2000	117.0	0.8864	0.8864
1971	96.0	0.9091	0.9091
1960	89.0	0.9318	0.9318
1993	78.0	0.9545	0.9545
1986	72.0	0.9773	0.9773

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)
2002 JAN 17 10:45:31

Station - 07103700 FOUNTAIN CREEK NEAR COLORADO SPRINGS, CO.




U
O
D
E
S
316.0
L
O
G
S
C
A
L
E
100.0
31.6

```
              99.5 99.0          95.0   90.0     80.0  70.0       50.0       30.0
20.0      10.0     5.0      2.0  1.0  0.5   0.2
                  ANNUAL EXCEEDANCE PROBABILITY, PERCENT   (NORMAL SCALE)
1

                          U. S. GEOLOGICAL SURVEY
                       ANNUAL PEAK FLOW FREQUENCY ANALYSIS
                       Following Bulletin 17-B Guidelines
                                Program peakfq
                            (Version 4.0, December, 2000)


 End PEAKFQ analysis.
   Stations processed :        1
   Number of errors   :        0
   Stations skipped   :        0
   Station years      :       43
```

Monument Creek

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

--- PROCESSING DATE/TIME ---

2002 JAN 17 13:50:59

--- PROCESSING OPTIONS ---

Plot option	= Graphics & Printer
Basin char output	= WATSTORE
Print option	= Yes
Debug print	= No
Input peaks listing	= Long
Input peaks format	= WATSTORE peak file

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

Station - 07103780 MONUMENT C AB N.GATE BLVD AT USAF ACADEMY, CO.
2002 JAN 17 13:50:59

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	17
Peaks not used in analysis	=	0
Systematic peaks in analysis	=	17
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.117
Standard error of generalized skew	=	0.550
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.		0.0
WCF162I-SYSTEMATIC PEAKS EXCEEDED HIGH-OUTLIER CRITERION.	1	1258.1
WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.		15.4

1

Station - 07103780 MONUMENT C AB N.GATE BLVD AT USAF ACADEMY, CO.
2002 JAN 17 13:50:59

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	2.1435	0.4141	0.894
BULL.17B ESTIMATE	0.0	1.0000	2.1435	0.4141	0.332

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	'EXPECTED SYSTEMATIC RECORD	PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	16.1	26.1	12.0	6.0	29.1
0.9900	19.1	28.5	15.2	7.6	33.6
0.9500	31.9	38.2	28.3	15.1	51.4
0.9000	42.6	46.6	39.5	22.1	66.1
0.8000	61.7	61.6	59.2	35.6	91.9
0.5000	132.0	121.0	132.0	88.3	195.6
0.2000	304.6	289.9	320.5	204.8	523.5
0.1000	486.1	498.8	539.7	311.0	957.4
0.0400	819.5	952.3	1001.0	484.4	1924.0
0.0200	1163.0	1503.0	1561.0	646.9	3098.0
0.0100	1609.0	2326.0	2421.0	842.2	4831.0
0.0050	2181.0	3546.0	3751.0	1076.0	7347.0
0.0020	3183.0	6085.0	6772.0	1457.0	12400.0
0.6667	88.7	(1.50-year flood)			
0.4292	156.1	(2.33-year flood)			

1

Station - 07103780 MONUMENT C AB N.GATE BLVD AT USAF ACADEMY, CO.
2002 JAN 17 13:50:59

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1985	372.0		1994	93.0	
1986	72.0		1995	235.0	
1987	261.0		1996	194.0	
1988	72.0		1997	169.0	
1989	24.0		1998	134.0	
1990	64.0		1999	1790.0	
1991	166.0		2000	67.0	
1992	110.0		2000	67.0	
1993	253.0				

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

1

Station - 07103780 MONUMENT C AB N.GATE BLVD AT USAF ACADEMY, CO.
2002 JAN 17 13:50:59

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1999	1790.0	0.0556	0.0556
1985	372.0	0.1111	0.1111
1987	261.0	0.1667	0.1667
1993	253.0	0.2222	0.2222
1995	235.0	0.2778	0.2778
1996	194.0	0.3333	0.3333
1997	169.0	0.3889	0.3889
1991	166.0	0.4444	0.4444
1998	134.0	0.5000	0.5000
1992	110.0	0.5556	0.5556
1994	93.0	0.6111	0.6111
1986	72.0	0.6667	0.6667
1988	72.0	0.7222	0.7222
2000	67.0	0.7778	0.7778

```
       2000            67.0          0.8333          0.8333
       1990            64.0          0.8889          0.8889
       1989            24.0          0.9444          0.9444
1
```

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)
2002 JAN 17 13:50:59

Station - 07103780 MONUMENT C AB N.GATE BLVD AT USAF ACADEMY, CO.

```
      100000.0 +----+------------+------+--------+-----+---------+----------+-
----+--------+------+-------+----+----+-----+
                |    |            |      |        |     |         |          |
|        |      |       |    |    |     |
                |    |            |      |        |     |         |          |
|        |      |       |    |    |     |
                |    |            |      |        |     |         |          |
|        |      |       |    |    |     |
                |    | *****  NOTICE  *****  NOTICE  ******        |          |
|        |      |       |    |    |     |
 A              |    | * PRELIMINARY MACHINE COMPUTATION. *        |          |
|        |      |       |    |    |     |
 N              |    | *  USER IS RESPONSIBLE FOR ASSESS- *        |          |
|        |      |       |    |    |     |
 N              |    | *     MENT AND INTERPRETATION.     *        |          |
|        |      |       |    |    |     |
 U              |    | ************************************        |          |
|        |      |       |    |    |     |
 A              |    |            |      |        |     |         |          |
|        |      |       |    |    |     |
 L     10000.0 +----+------------+------+--------+-----+---------+----------+-
----+--------+------+-------+----+----+-----+
                |    |          PLOT SYMBOL KEY          |         |          |
|        |      |       |    |    |     |
 P              |    |   *  17B FINAL FREQUENCY CURVE    |         |          |
|        |      |       |    |    |     #
 E              |    |   O  OBSERVED (SYSTEMATIC) PEAKS  |         |          |
|        |      |       |    |    |     |
 A              |    |   $  HISTORICALLY ADJUSTED PEAKS  |         |          |
|        |      |       |    |    |     |
 K              |    |   #  SYSTEMATIC-RECORD FREQ CURVE |         |          |
|        |      |       |    |    #     *
                |    |   WHEN POINTS COINCIDE, ONLY THE  |         |          |
|        |      |       |    #    |     |
 M              |    |   TOPMOST SYMBOL SHOWS.           |         |          |
|        |     O|       |    |    *     |
 A              |    |            |      |        |     |         |          |
|        |      |       #    *    |     |
 G              |    |            |      |        |     |         |          |
|        |      |     # *    |     |
 N     1000.0 +----+------------+------+--------+-----+---------+----------+-
----+--------+------+-#---*-+----+----+-----+
```

```
I                  |     |            |       |         |     |         |         |
|        |      * *    |     |    |    |      |
T                  |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
U                  |     |            |       |         |     |         |         |
|        *       |     |     |    |    |      |
D                  |     |            |       |         |     |         |         |
|      O|        |     |     |    |    |      |
E                  |     |            |       |         |     |         |         |
*        |       |     |     |    |    |      |
S                  |     |            |       |         |     |         |         |
O   O|   O      |      |       |    |     |     |
                   |     |            |       |         |     |         |     O *
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |   O**O  |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     *         |
|        |       |     |     |    |    |      |
/       100.0 +----+------------+-------+---------+-----+-----*-*--+---------+-
----+--------+------+-------+----+----+-----+
L                  |     |            |       |         |  O* O  |         |
|        |       |     |     |    |    |      |
O                  |     |            |O    O   *O     |         |         |
|        |       |     |     |    |    |      |
G                  |     |            |       #         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |          # #       *         |     |         |         |
|        |       |     |     |    |    |      |
S                  |     #     # #    * *     |         |     |         |         |
|        |       |     |     |    |    |      |
C                  #     |     * *      |O    |         |     |         |         |
|        |       |     |     |    |    |      |
A                  |     *            |       |         |     |         |         |
|        |       |     |     |    |    |      |
L                  *     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
E                  |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
/        10.0 +----+------------+-------+---------+-----+---------+---------+-
----+--------+------+-------+----+----+-----+
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
                   |     |            |       |         |     |         |         |
|        |       |     |     |    |    |      |
```

```
                                 |          |                    |          |            |         |               |              |
 |             |          |            |      |      |        |
                1.0 +----+-----------+------+--------+-----+---------+---------+-
----+--------+------+-------+----+----+-----+

                   99.5 99.0         95.0   90.0     80.0  70.0       50.0      30.0
20.0      10.0     5.0      2.0  1.0  0.5   0.2
                                                    ANNUAL EXCEEDANCE PROBABILITY, PERCENT
(NORMAL SCALE)
1
```

```
                              U. S. GEOLOGICAL SURVEY
                         ANNUAL PEAK FLOW FREQUENCY ANALYSIS
                         Following Bulletin 17-B Guidelines
                                  Program peakfq
                            (Version 4.0, December, 2000)


 End PEAKFQ analysis.
   Stations processed :        1
   Number of errors   :        0
   Stations skipped   :        0
   Station years      :       17
```

Rio Blanco County

Piceance Creek

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

--- PROCESSING DATE/TIME ---

2001 DEC 26 12:35:58

--- PROCESSING OPTIONS ---

Plot option	= Graphics & Printer
Basin char output	= WATSTORE
Print option	= Yes
Debug print	= No
Input peaks listing	= Long
Input peaks format	= WATSTORE peak file

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

Station - 09306200 PICEANCE CREEK BL RYAN GULCH, NR RIO BLANCO, CO.
2001 DEC 26 12:35:58

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	35
Peaks not used in analysis	=	0
Systematic peaks in analysis	=	35
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.299
Standard error of generalized skew	=	0.550
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

```
    WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.                  0.0
    WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.            24.2
    WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE.      929.1
1
```

Station - 09306200 PICEANCE CREEK BL RYAN GULCH, NR RIO BLANCO, CO.
2001 DEC 26 12:35:58

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	2.1761	0.3013	0.082
BULL.17B ESTIMATE	0.0	1.0000	2.1761	0.3013	-0.044

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	24.4	26.5	21.2	14.8	34.6
0.9900	29.2	31.1	26.2	18.4	40.4
0.9500	47.5	48.7	45.2	33.2	61.7
0.9000	61.5	62.0	59.6	45.2	77.6
0.8000	83.8	83.4	82.5	64.9	103.1
0.5000	150.8	148.6	150.8	123.9	183.6
0.2000	269.4	268.2	273.5	219.0	347.9
0.1000	363.8	367.2	374.9	288.2	494.2
0.0400	500.1	515.4	528.0	382.4	722.8
0.0200	613.5	643.0	661.9	457.1	925.5
0.0100	736.8	785.9	814.7	535.6	1157.0
0.0050	870.6	945.4	989.4	618.3	1418.0
0.0020	1065.0	1185.0	1260.0	734.7	1816.0
0.6667	111.8	(1.50-year flood)			
0.4292	170.6	(2.33-year flood)			

```
1
```

Station - 09306200 PICEANCE CREEK BL RYAN GULCH, NR RIO BLANCO, CO.
2001 DEC 26 12:35:58

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1965	190.0		1983	480.0	
1966	400.0		1984	525.0	
1967	75.0		1985	550.0	
1968	184.0		1986	283.0	
1969	141.0		1987	134.0	
1970	104.0		1988	114.0	
1971	211.0		1989	212.0	
1972	105.0		1990	119.0	
1973	100.0		1991	105.0	
1974	69.0		1992	159.0	
1975	60.0		1993	323.0	
1976	107.0		1994	145.0	
1977	136.0		1995	239.0	
1978	85.0		1996	134.0	
1979	130.0		1997	268.0	
1980	169.0		1998	437.0	
1981	42.0		2000	34.1	
1982	60.0				

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

1

Station - 09306200 PICEANCE CREEK BL RYAN GULCH, NR RIO BLANCO, CO.
2001 DEC 26 12:35:58

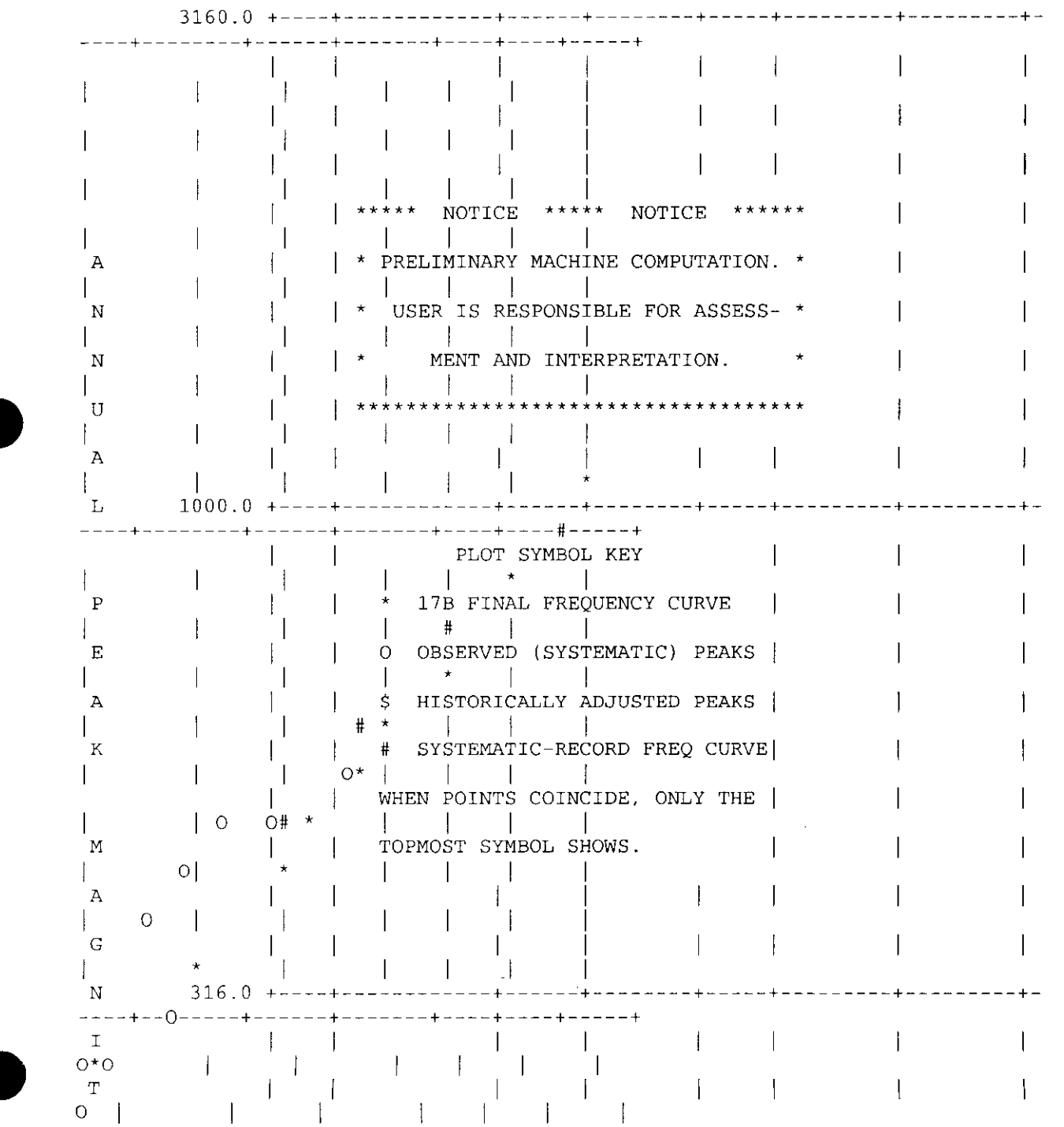
EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

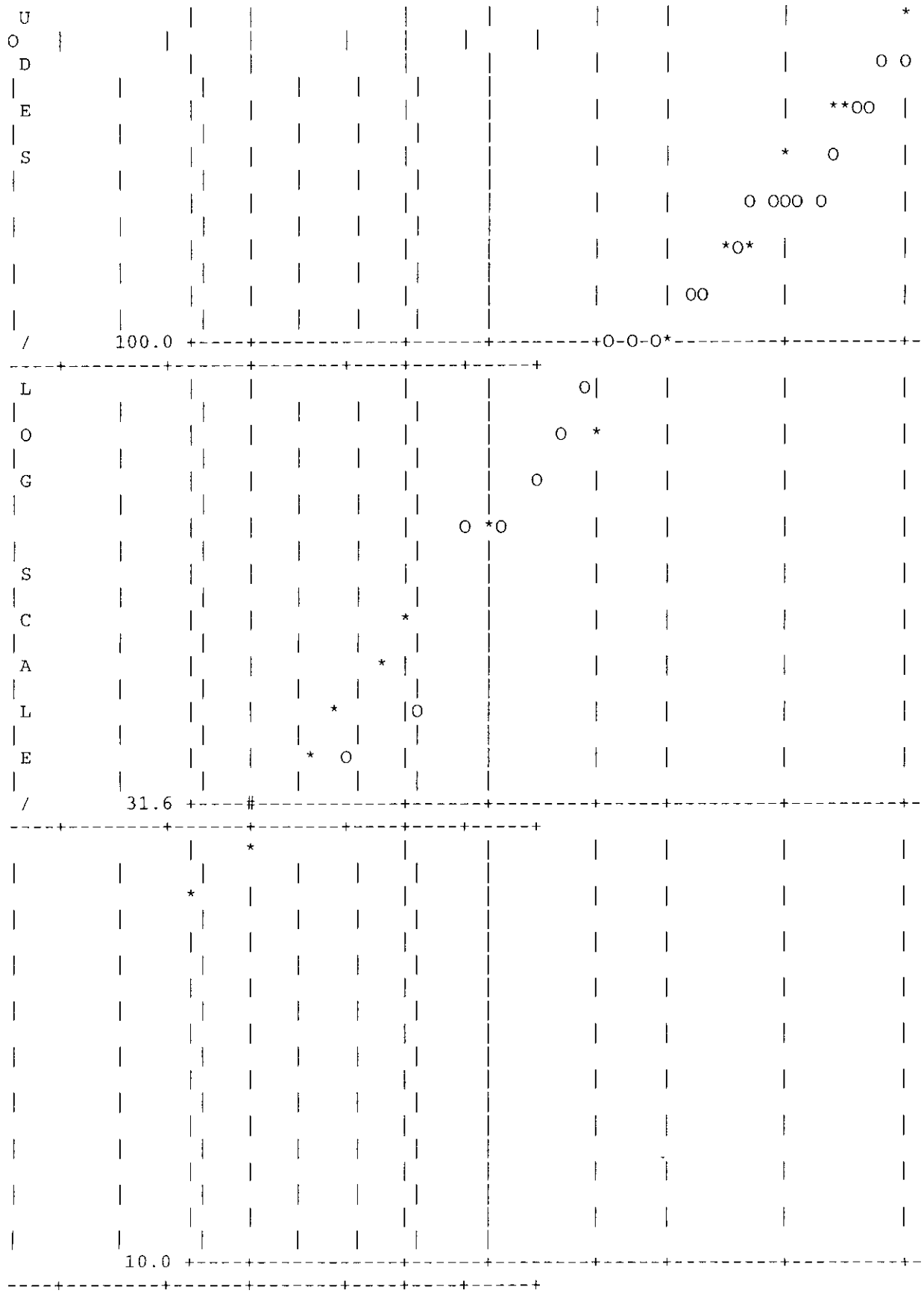
WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1985	550.0	0.0278	0.0278
1984	525.0	0.0556	0.0556
1983	480.0	0.0833	0.0833
1998	437.0	0.1111	0.1111
1966	400.0	0.1389	0.1389
1993	323.0	0.1667	0.1667
1986	283.0	0.1944	0.1944
1997	268.0	0.2222	0.2222
1995	239.0	0.2500	0.2500
1989	212.0	0.2778	0.2778
1971	211.0	0.3056	0.3056
1965	190.0	0.3333	0.3333
1968	184.0	0.3611	0.3611
1980	169.0	0.3889	0.3889
1992	159.0	0.4167	0.4167
1994	145.0	0.4444	0.4444
1969	141.0	0.4722	0.4722
1977	136.0	0.5000	0.5000
1987	134.0	0.5278	0.5278
1996	134.0	0.5556	0.5556
1979	130.0	0.5833	0.5833
1990	119.0	0.6111	0.6111
1988	114.0	0.6389	0.6389
1976	107.0	0.6667	0.6667
1972	105.0	0.6944	0.6944
1991	105.0	0.7222	0.7222
1970	104.0	0.7500	0.7500
1973	100.0	0.7778	0.7778
1978	85.0	0.8056	0.8056
1967	75.0	0.8333	0.8333
1974	69.0	0.8611	0.8611
1975	60.0	0.8889	0.8889
1982	60.0	0.9167	0.9167
1981	42.0	0.9444	0.9444
2000	34.1	0.9722	0.9722

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)
2001 DEC 26 12:35:58

Station - 09306200 PICEANCE CREEK BL RYAN GULCH, NR RIO BLANCO, CO.




UNDESIRABLE
100.0
LOGSCALE
31.6
10.0

```
            99.5 99.0          95.0   90.0     80.0  70.0       50.0       30.0
20.0     10.0    5.0     2.0  1.0  0.5   0.2
                                   ANNUAL EXCEEDANCE PROBABILITY, PERCENT
(NORMAL SCALE)
1
```

Yellow Creek

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

Station - 09306255 YELLOW CREEK NEAR WHITE RIVER, CO.
2001 DEC 26 12:35:58

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	23
Peaks not used in analysis	=	1
Systematic peaks in analysis	=	22
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.300
Standard error of generalized skew	=	0.550
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

**WCF109W-PEAKS WITH MINUS-FLAGGED DISCHARGES WERE BYPASSED. 1
**WCF113W-NUMBER OF SYSTEMATIC PEAKS HAS BEEN REDUCED TO NSYS = 22
WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE. 0.0
WCF162I-SYSTEMATIC PEAKS EXCEEDED HIGH-OUTLIER CRITERION. 1 4993.8
WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION. 3.2
WCF002J-CALCS COMPLETED. RETURN CODE = 2
1

Station - 09306255 YELLOW CREEK NEAR WHITE RIVER, CO.
2001 DEC 26 12:35:58

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	2.1033	0.6567	0.793
BULL.17B ESTIMATE	0.0	1.0000	2.1033	0.6567	0.245

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	3.7	7.8	2.5	0.9	8.7
0.9900	5.0	9.2	3.7	1.4	11.2
0.9500	11.8	15.5	10.1	4.3	23.3
0.9000	19.1	21.7	17.4	7.9	35.5
0.8000	35.0	34.8	33.3	16.7	61.4
0.5000	119.3	104.1	119.3	68.6	205.6
0.2000	443.4	413.0	470.7	253.6	921.0
0.1000	912.6	956.7	1031.0	485.8	2250.0
0.0400	2026.0	2576.0	2546.0	966.7	6216.0
0.0200	3442.0	5152.0	4798.0	1512.0	12350.0
0.0100	5602.0	9968.0	8815.0	2269.0	23310.0
0.0050	8826.0	18810.0	16010.0	3303.0	42310.0
0.0020	15480.0	42240.0	34930.0	5239.0	88640.0
0.6667	63.1	(1.50-year flood)			
0.4292	155.7	(2.33-year flood)			

1

Station - 09306255 YELLOW CREEK NEAR WHITE RIVER, CO.
2001 DEC 26 12:35:58

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1965	-1050.0	H	1989	120.0	
1973	468.0		1991	38.0	
1974	123.0		1992	100.0	
1975	38.0		1993	96.0	
1976	37.0		1994	240.0	
1977	756.0		1995	45.0	
1978	6800.0		1996	8.3	

1979	144.0	1997	1450.0
1980	494.0	1998	49.0
1981	36.0	1999	133.0
1982	165.0	2000	20.0
1988	144.0		

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

1

Station - 09306255 YELLOW CREEK NEAR WHITE RIVER, CO.
2001 DEC 26 12:35:58

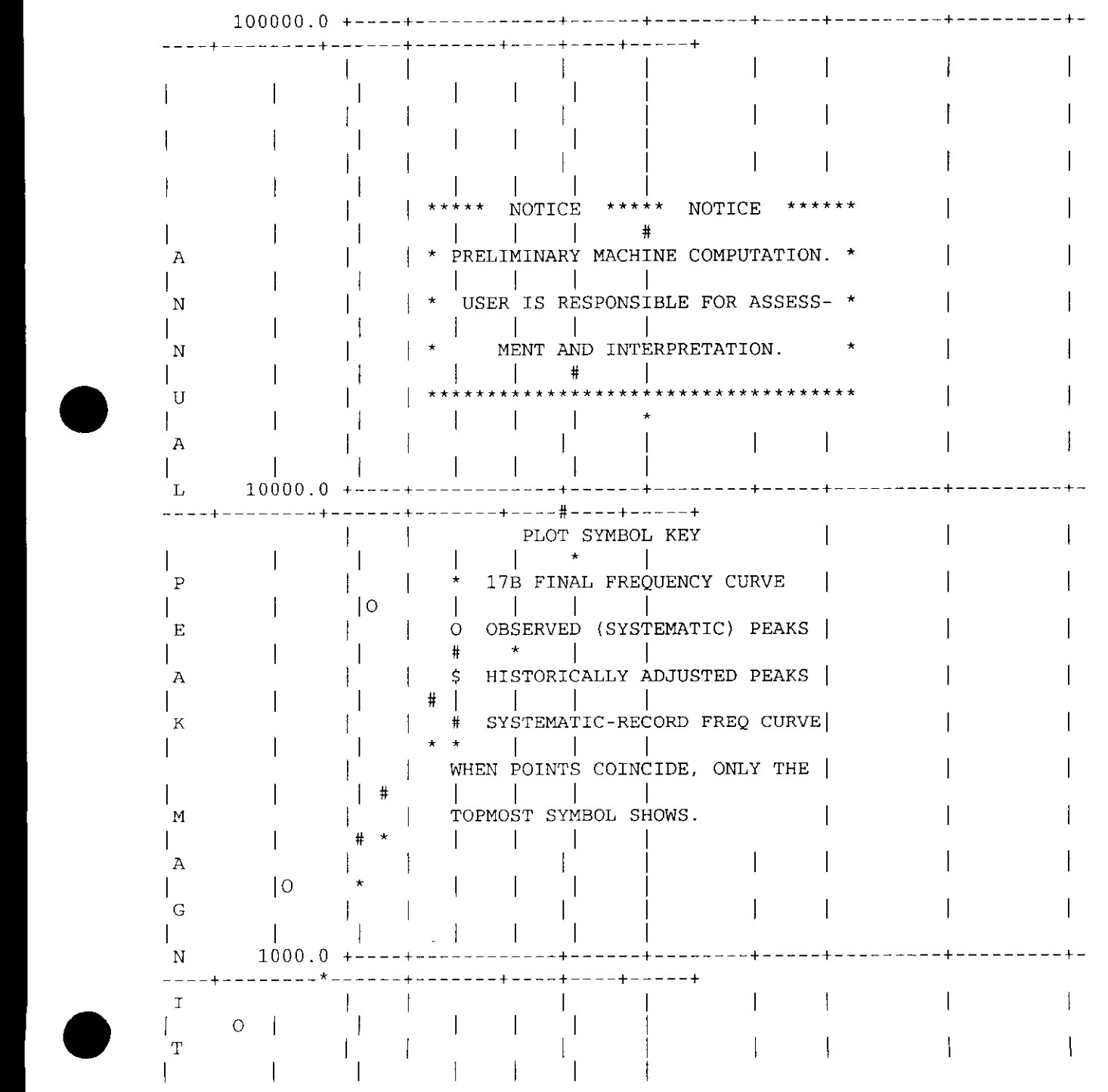
EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

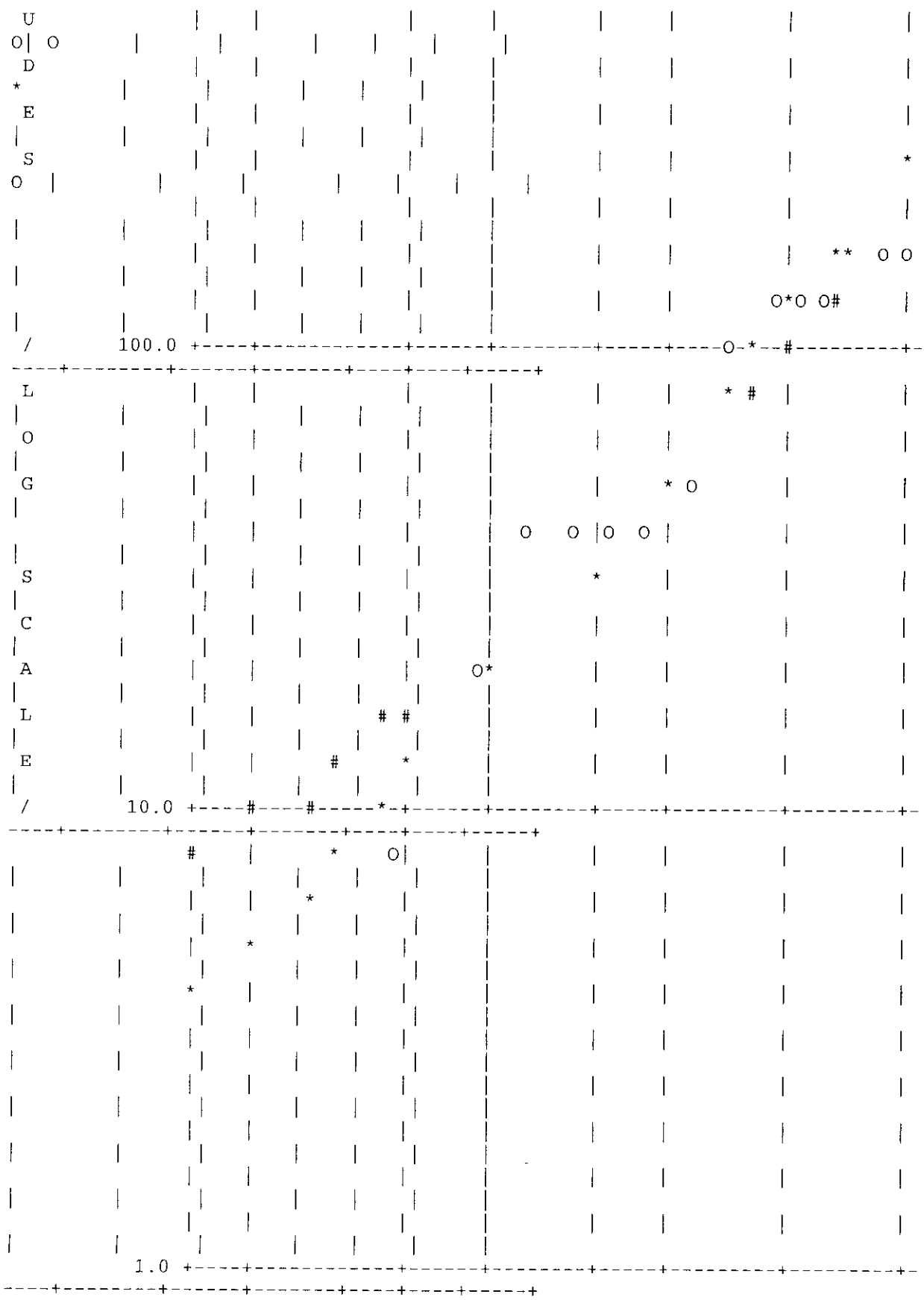
WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1978	6800.0	0.0435	0.0435
1997	1450.0	0.0870	0.0870
1977	756.0	0.1304	0.1304
1980	494.0	0.1739	0.1739
1973	468.0	0.2174	0.2174
1994	240.0	0.2609	0.2609
1982	165.0	0.3043	0.3043
1979	144.0	0.3478	0.3478
1988	144.0	0.3913	0.3913
1999	133.0	0.4348	0.4348
1974	123.0	0.4783	0.4783
1989	120.0	0.5217	0.5217
1992	100.0	0.5652	0.5652
1993	96.0	0.6087	0.6087
1998	49.0	0.6522	0.6522
1995	45.0	0.6957	0.6957
1975	38.0	0.7391	0.7391
1991	38.0	0.7826	0.7826
1976	37.0	0.8261	0.8261
1981	36.0	0.8696	0.8696
2000	20.0	0.9130	0.9130
1996	8.3	0.9565	0.9565
1965	-1050.0	--	--

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)
2001 DEC 26 12:35:58

Station - 09306255 YELLOW CREEK NEAR WHITE RIVER, CO.




UNDESIRABLE
100.0
LOGSCALE
10.0
1.0

```
              99.5 99.0          95.0   90.0     80.0  70.0       50.0       30.0
20.0      10.0     5.0      2.0  1.0  0.5   0.2
                                    ANNUAL EXCEEDANCE PROBABILITY, PERCENT

(NORMAL SCALE)
1
```

White River Below Meeker, CO

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

Station - 09304800 WHITE RIVER BELOW MEEKER, CO
2001 DEC 26 12:35:58

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	38
Peaks not used in analysis	=	0
Systematic peaks in analysis	=	38
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.300
Standard error of generalized skew	=	0.550
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE. 0.0
WCF198I-LOW OUTLIERS BELOW FLOOD BASE WERE DROPPED. 1 1083.6
WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE. 8043.9
1

Station - 09304800 WHITE RIVER BELOW MEEKER, CO
2001 DEC 26 12:35:58

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	3.4936	0.1724	-0.751
BULL.17B ESTIMATE	1083.6	0.9737	3.5023	0.1526	-0.228

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	--	851.5	--	--	--
0.9900	--	1002.0	--	--	--
0.9500	1745.0	1508.0	1701.0	1464.0	1987.0
0.9000	2011.0	1834.0	1979.0	1732.0	2255.0
0.8000	2376.0	2282.0	2358.0	2102.0	2628.0
0.5000	3222.0	3273.0	3222.0	2930.0	3547.0
0.2000	4287.0	4378.0	4316.0	3875.0	4852.0
0.1000	4941.0	4967.0	5004.0	4414.0	5719.0
0.0400	5717.0	5580.0	5846.0	5028.0	6796.0
0.0200	6263.0	5961.0	6457.0	5449.0	7580.0
0.0100	6785.0	6288.0	7060.0	5843.0	8346.0
0.0050	7290.0	6573.0	7659.0	6219.0	9101.0
0.0020	7936.0	6896.0	8457.0	6692.0	10090.0
0.6667	2763.5	(1.50-year flood)			
0.4292	3430.9	(2.33-year flood)			

1

Station - 09304800 WHITE RIVER BELOW MEEKER, CO
2001 DEC 26 12:35:58

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1962	3580.0		1982	2680.0	
1963	2180.0		1983	6590.0	
1964	3110.0		1984	6320.0	
1965	4010.0		1985	4800.0	
1966	1790.0		1986	4410.0	
1967	2920.0		1987	2370.0	
1968	3700.0		1988	2910.0	
1969	2590.0		1989	1740.0	
1970	3990.0		1990	2340.0	
1971	3000.0		1991	2760.0	
1972	3390.0		1992	2060.0	
1973	3660.0		1993	4170.0	
1974	3540.0		1994	1500.0	
1975	4370.0		1995	4780.0	
1976	2260.0		1996	3170.0	
1977	918.0		1997	4140.0	
1978	4750.0		1998	3590.0	
1979	4150.0		1999	3200.0	
1981	2080.0		2000	3520.0	

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

1

Station - 09304800 WHITE RIVER BELOW MEEKER, CO
2001 DEC 26 12:35:58

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

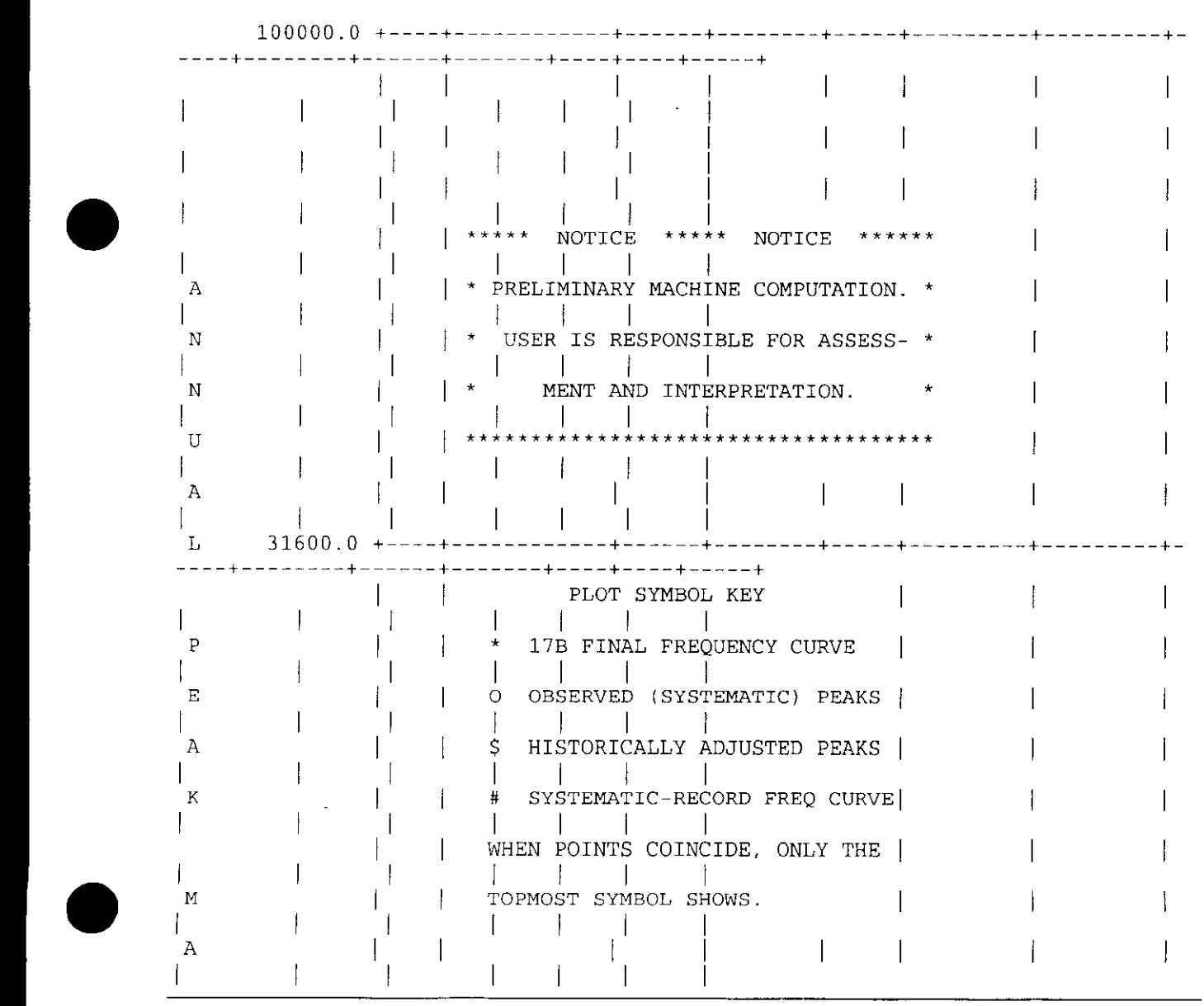
WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1983	6590.0	0.0256	0.0256
1984	6320.0	0.0513	0.0513
1985	4800.0	0.0769	0.0769
1995	4780.0	0.1026	0.1026
1978	4750.0	0.1282	0.1282
1986	4410.0	0.1538	0.1538
1975	4370.0	0.1795	0.1795
1993	4170.0	0.2051	0.2051
1979	4150.0	0.2308	0.2308
1997	4140.0	0.2564	0.2564
1965	4010.0	0.2821	0.2821
1970	3990.0	0.3077	0.3077
1968	3700.0	0.3333	0.3333
1973	3660.0	0.3590	0.3590
1998	3590.0	0.3846	0.3846
1962	3580.0	0.4103	0.4103
1974	3540.0	0.4359	0.4359
2000	3520.0	0.4615	0.4615
1972	3390.0	0.4872	0.4872
1999	3200.0	0.5128	0.5128
1996	3170.0	0.5385	0.5385
1964	3110.0	0.5641	0.5641
1971	3000.0	0.5897	0.5897
1967	2920.0	0.6154	0.6154
1988	2910.0	0.6410	0.6410
1991	2760.0	0.6667	0.6667
1982	2680.0	0.6923	0.6923
1969	2590.0	0.7179	0.7179
1987	2370.0	0.7436	0.7436
1990	2340.0	0.7692	0.7692

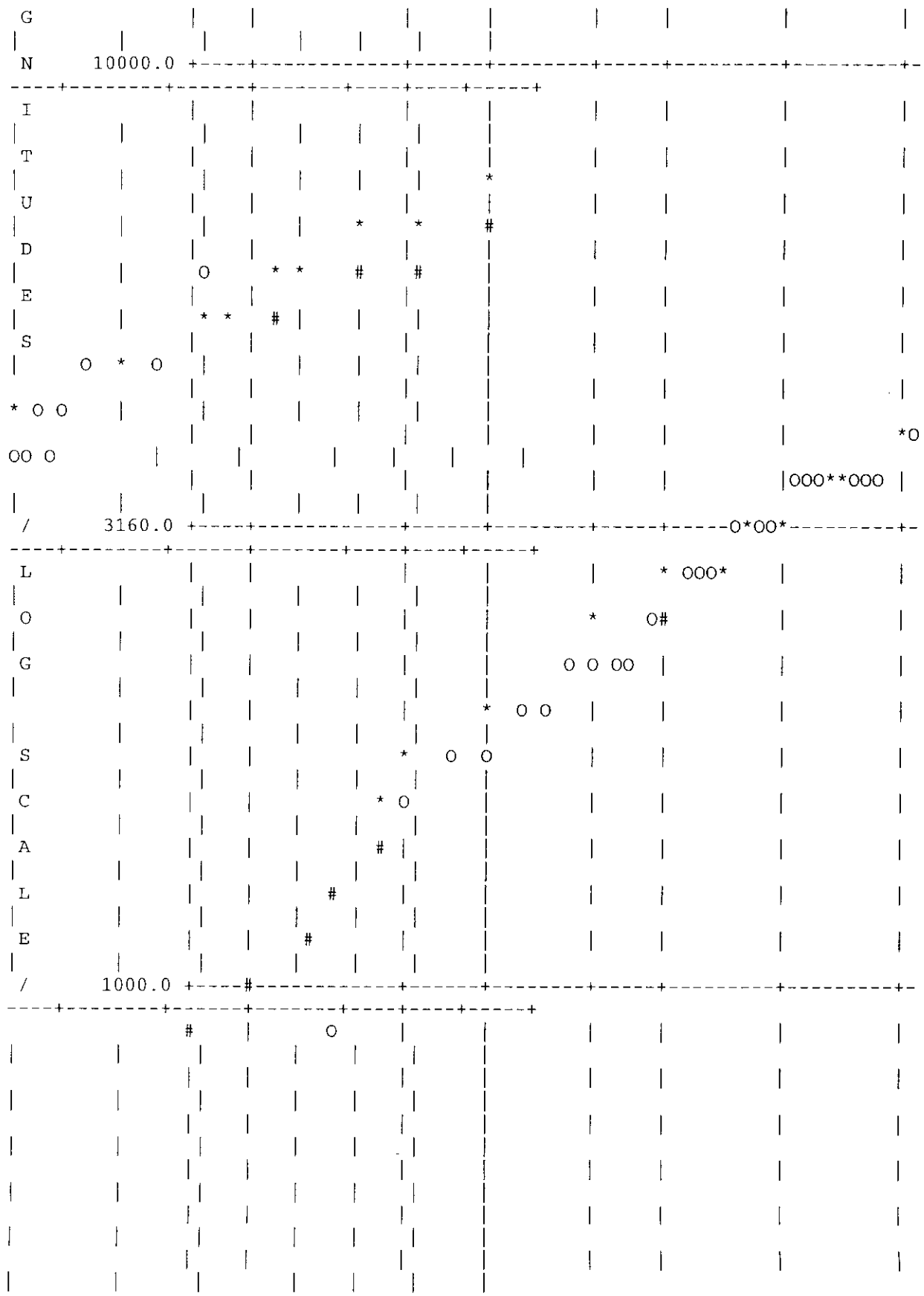
1976	2260.0	0.7949	0.7949
1963	2180.0	0.8205	0.8205
1981	2080.0	0.8462	0.8462
1992	2060.0	0.8718	0.8718
1966	1790.0	0.8974	0.8974
1989	1740.0	0.9231	0.9231
1994	1500.0	0.9487	0.9487
1977	918.0	0.9744	0.9744

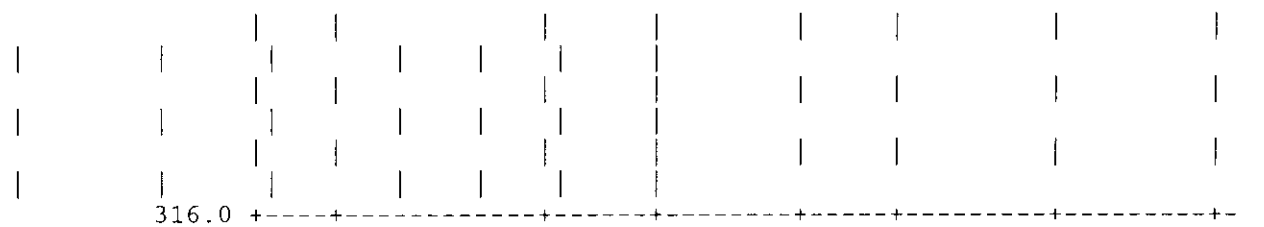
1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)
2001 DEC 26 12:35:58

Station - 09304800 WHITE RIVER BELOW MEEKER, CO




G
N
10000.0
I
T
U
D
E
S
/
3160.0
L
O
G
S
C
A
L
E
/
1000.0


316.0
99.5 99.0 95.0 90.0 80.0 70.0 50.0 30.0
20.0 10.0 5.0 2.0 1.0 0.5 0.2
ANNUAL EXCEEDANCE PROBABILITY, PERCENT
(NORMAL SCALE)

1

White River
Below Boise Creek

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

Station - 09306290 WHITE RIVER BELOW BOISE CREEK, NEAR RANGELY, CO.
2001 DEC 26 12:35:58

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	18
Peaks not used in analysis	=	0
Systematic peaks in analysis	=	18
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.300
Standard error of generalized skew	=	0.550
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE. 0.0
WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION. 1196.0
WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE. 8844.7
1

Station - 09306290 WHITE RIVER BELOW BOISE CREEK, NEAR RANGELY, CO.
2001 DEC 26 12:35:58

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	3.5122	0.1861	-0.378
BULL.17B ESTIMATE	0.0	1.0000	3.5122	0.1861	-0.339

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	941.9	927.3	749.2	557.4	1285.0
0.9900	1081.0	1068.0	909.3	672.0	1436.0
0.9500	1546.0	1540.0	1437.0	1089.0	1931.0
0.9000	1854.0	1851.0	1773.0	1383.0	2254.0
0.8000	2288.0	2291.0	2239.0	1810.0	2722.0
0.5000	3332.0	3341.0	3332.0	2808.0	3971.0
0.2000	4689.0	4691.0	4769.0	3937.0	5949.0
0.1000	5532.0	5519.0	5711.0	4567.0	7347.0
0.0400	6535.0	6494.0	6908.0	5272.0	9142.0
0.0200	7240.0	7172.0	7808.0	5747.0	10480.0
0.0100	7912.0	7813.0	8720.0	6187.0	11800.0
0.0050	8557.0	8424.0	9655.0	6600.0	13120.0
0.0020	9377.0	9192.0	10930.0	7113.0	14850.0
0.6667	2760.2	(1.50-year flood)			
0.4292	3597.4	(2.33-year flood)			

1

Station - 09306290 WHITE RIVER BELOW BOISE CREEK, NEAR RANGELY, CO.
2001 DEC 26 12:35:58

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1983	6060.0		1992	1760.0	
1984	6440.0		1993	4160.0	
1985	4300.0		1994	1520.0	
1986	4080.0		1995	4750.0	
1987	2520.0		1996	3520.0	
1988	2840.0		1997	4180.0	
1989	1580.0		1998	3730.0	
1990	2240.0		1999	3290.0	
1991	2420.0		2000	4140.0	

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

1

Station - 09306290 WHITE RIVER BELOW BOISE CREEK, NEAR RANGELY, CO.
2001 DEC 26 12:35:58

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

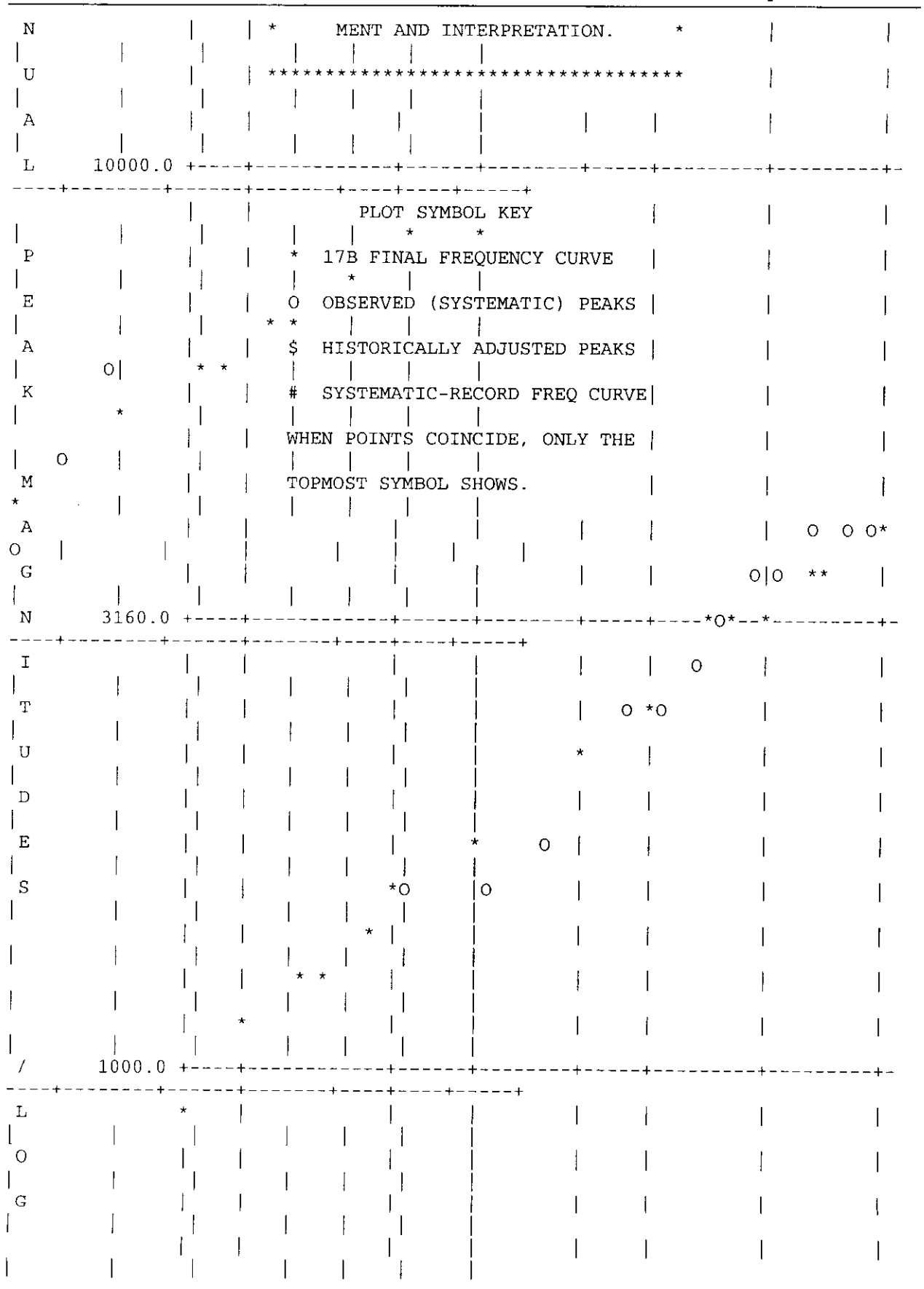
WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1984	6440.0	0.0526	0.0526
1983	6060.0	0.1053	0.1053
1995	4750.0	0.1579	0.1579
1985	4300.0	0.2105	0.2105
1997	4180.0	0.2632	0.2632
1993	4160.0	0.3158	0.3158
2000	4140.0	0.3684	0.3684
1986	4080.0	0.4211	0.4211
1998	3730.0	0.4737	0.4737
1996	3520.0	0.5263	0.5263
1999	3290.0	0.5789	0.5789
1988	2840.0	0.6316	0.6316
1987	2520.0	0.6842	0.6842
1991	2420.0	0.7368	0.7368
1990	2240.0	0.7895	0.7895
1992	1760.0	0.8421	0.8421
1989	1580.0	0.8947	0.8947
1994	1520.0	0.9474	0.9474

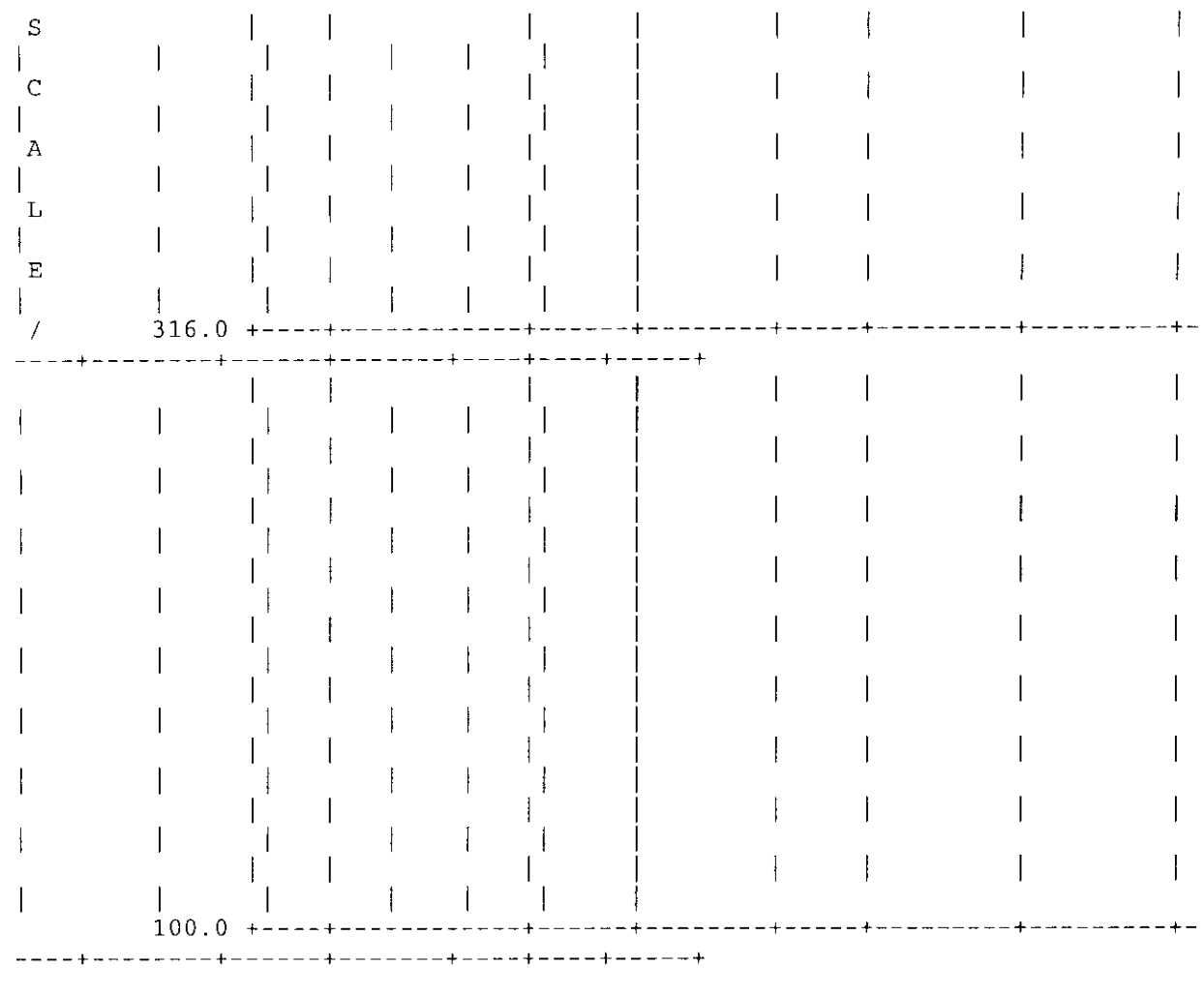
1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)
2001 DEC 26 12:35:58

Station - 09306290 WHITE RIVER BELOW BOISE CREEK, NEAR RANGELY, CO.

```
      31600.0 +----+----------+------+--------+------+---------+---------+-
----+--------+------+-------+----+----+------+
                |    |          |      |        |      |         |         |
|       |       |      |       |    |    |      |
                |    |          |      |        |      |         |         |
|       |       |      |       |    |    |      |
                |    |          |      |        |      |         |         |
|       |       |      |       |    |    |      |
                |    | *****  NOTICE  *****  NOTICE  ******       |         |
|       |       |      |       |    |    |      |
 A              |    | * PRELIMINARY MACHINE COMPUTATION. *       |         |
|       |       |      |       |    |    |      |
 N              |    | *  USER IS RESPONSIBLE FOR ASSESS- *       |         |
|       |       |      |       |    |    |      |
```


MENT AND INTERPRETATION.
10000.0
PLOT SYMBOL KEY
17B FINAL FREQUENCY CURVE
OBSERVED (SYSTEMATIC) PEAKS
HISTORICALLY ADJUSTED PEAKS
SYSTEMATIC-RECORD FREQ CURVE
WHEN POINTS COINCIDE, ONLY THE
TOPMOST SYMBOL SHOWS.
3160.0
1000.0



1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

End PEAKFQ analysis.

Stations processed	:	4
Number of errors	:	0
Stations skipped	:	0
Station years	:	114

San Miguel County

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

--- PROCESSING DATE/TIME ---

2002 JAN 29 08:30:17

--- PROCESSING OPTIONS ---

Plot option	= Graphics & Printer
Basin char output	= WATSTORE
Print option	= Yes
Debug print	= No
Input peaks listing	= Long
Input peaks format	= WATSTORE peak file

1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

Station - 09172500 SAN MIGUEL RIVER NEAR PLACERVILLE, CO.
2002 JAN 29 08:30:17

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	66
Peaks not used in analysis	=	2
Systematic peaks in analysis	=	64
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.144
Standard error of generalized skew	=	0.550
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
User supplied low outlier criterion	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

**WCF109W-PEAKS WITH MINUS-FLAGGED DISCHARGES WERE BYPASSED. 2
**WCF113W-NUMBER OF SYSTEMATIC PEAKS HAS BEEN REDUCED TO NSYS = 64

```
    WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.                    0.0
    WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.             421.6
    WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE.       4550.5
    WCF002J-CALCS COMPLETED.  RETURN CODE =  2
1
```

Station - 09172500 SAN MIGUEL RIVER NEAR PLACERVILLE, CO.
2002 JAN 29 08:30:17

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	3.1415	0.1806	-0.012
BULL.17B ESTIMATE	0.0	1.0000	3.1415	0.1806	-0.040

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	'EXPECTED SYSTEMATIC RECORD	PROBABILITY' FOR BULL. 17B ESTIMATE	95-PCT CONFIDENCE LIMITS LOWER	UPPER
0.9950	467.1	472.3	447.1	379.3	548.4
0.9900	520.0	524.5	502.4	429.2	603.4
0.9500	695.6	697.9	684.3	598.8	783.8
0.9000	811.4	812.4	803.2	712.8	902.3
0.8000	976.8	976.3	971.9	876.2	1073.0
0.5000	1389.0	1386.0	1389.0	1274.0	1515.0
0.2000	1967.0	1966.0	1977.0	1792.0	2193.0
0.1000	2356.0	2359.0	2379.0	2119.0	2681.0
0.0400	2852.0	2864.0	2903.0	2523.0	3328.0
0.0200	3225.0	3246.0	3305.0	2819.0	3830.0
0.0100	3600.0	3632.0	3718.0	3111.0	4346.0
0.0050	3981.0	4025.0	4146.0	3402.0	4878.0
0.0020	4493.0	4558.0	4740.0	3789.0	5611.0
0.6667	1160.7	(1.50-year flood)			
0.4292	1495.8	(2.33-year flood)			

1

Station - 09172500 SAN MIGUEL RIVER NEAR PLACERVILLE, CO.
2002 JAN 29 08:30:17

I N P U T D A T A L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1909	-10000.0	D H	1968	1820.0	
1912	-2380.0	H	1969	1060.0	
1930	1710.0		1970	2300.0	
1931	715.0		1971	1370.0	
1932	1270.0		1972	873.0	
1933	1470.0		1973	2660.0	
1934	656.0		1974	1100.0	
1942	1460.0		1975	2010.0	
1943	900.0		1976	1090.0	
1944	3060.0		1977	516.0	
1945	1430.0		1978	1770.0	
1946	1220.0		1979	2190.0	
1947	1330.0		1980	1930.0	
1948	1610.0		1981	1150.0	
1949	2370.0		1982	1770.0	
1950	864.0		1983	3830.0	
1951	734.0		1984	2780.0	
1952	1710.0		1985	1950.0	
1953	1760.0		1986	1540.0	
1954	600.0		1987	1790.0	
1955	1140.0		1988	1110.0	
1956	980.0		1989	789.0	
1957	2350.0		1990	1150.0	
1958	2180.0		1991	1030.0	
1959	1120.0		1992	956.0	
1960	1720.0		1993	1620.0	
1961	1350.0		1994	1300.0	
1962	1030.0		1995	2110.0	
1963	916.0		1996	1200.0	
1964	1400.0		1997	1790.0	
1965	2400.0		1998	1180.0	
1966	860.0		1999	2190.0	
1967	963.0		2000	1270.0	

Explanation of peak discharge qualification codes

PEAKFQ CODE	WATSTORE CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

1

Station - 09172500 SAN MIGUEL RIVER NEAR PLACERVILLE, CO.
2002 JAN 29 08:30:17

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

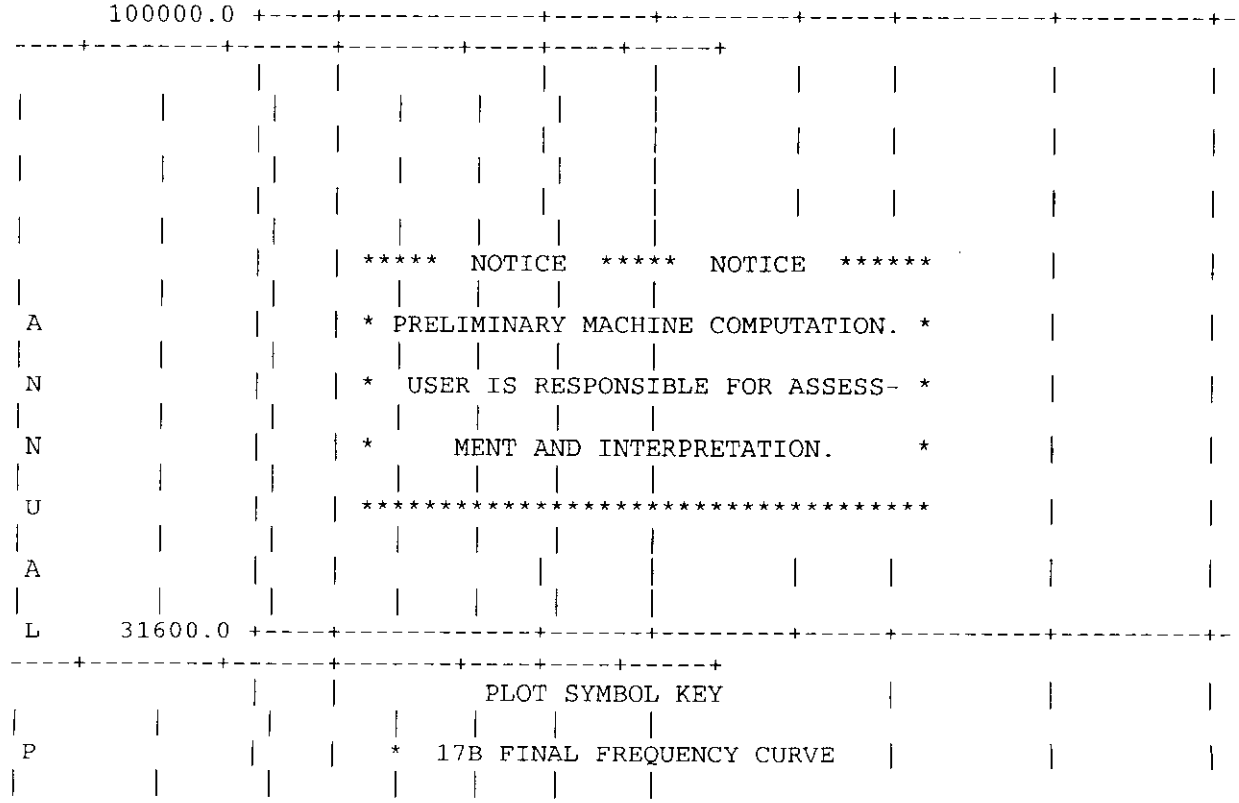
WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1983	3830.0	0.0154	0.0154
1944	3060.0	0.0308	0.0308
1984	2780.0	0.0462	0.0462
1973	2660.0	0.0615	0.0615
1965	2400.0	0.0769	0.0769
1949	2370.0	0.0923	0.0923
1957	2350.0	0.1077	0.1077
1970	2300.0	0.1231	0.1231
1979	2190.0	0.1385	0.1385
1999	2190.0	0.1538	0.1538
1958	2180.0	0.1692	0.1692
1995	2110.0	0.1846	0.1846
1975	2010.0	0.2000	0.2000
1985	1950.0	0.2154	0.2154
1980	1930.0	0.2308	0.2308
1968	1820.0	0.2462	0.2462
1987	1790.0	0.2615	0.2615
1997	1790.0	0.2769	0.2769
1978	1770.0	0.2923	0.2923
1982	1770.0	0.3077	0.3077
1953	1760.0	0.3231	0.3231
1960	1720.0	0.3385	0.3385
1930	1710.0	0.3538	0.3538
1952	1710.0	0.3692	0.3692
1993	1620.0	0.3846	0.3846
1948	1610.0	0.4000	0.4000
1986	1540.0	0.4154	0.4154
1933	1470.0	0.4308	0.4308
1942	1460.0	0.4462	0.4462
1945	1430.0	0.4615	0.4615
1964	1400.0	0.4769	0.4769
1971	1370.0	0.4923	0.4923
1961	1350.0	0.5077	0.5077
1947	1330.0	0.5231	0.5231
1994	1300.0	0.5385	0.5385
1932	1270.0	0.5538	0.5538
2000	1270.0	0.5692	0.5692
1946	1220.0	0.5846	0.5846
1996	1200.0	0.6000	0.6000
1998	1180.0	0.6154	0.6154
1981	1150.0	0.6308	0.6308
1990	1150.0	0.6462	0.6462
1955	1140.0	0.6615	0.6615
1959	1120.0	0.6769	0.6769
1988	1110.0	0.6923	0.6923
1974	1100.0	0.7077	0.7077
1976	1090.0	0.7231	0.7231

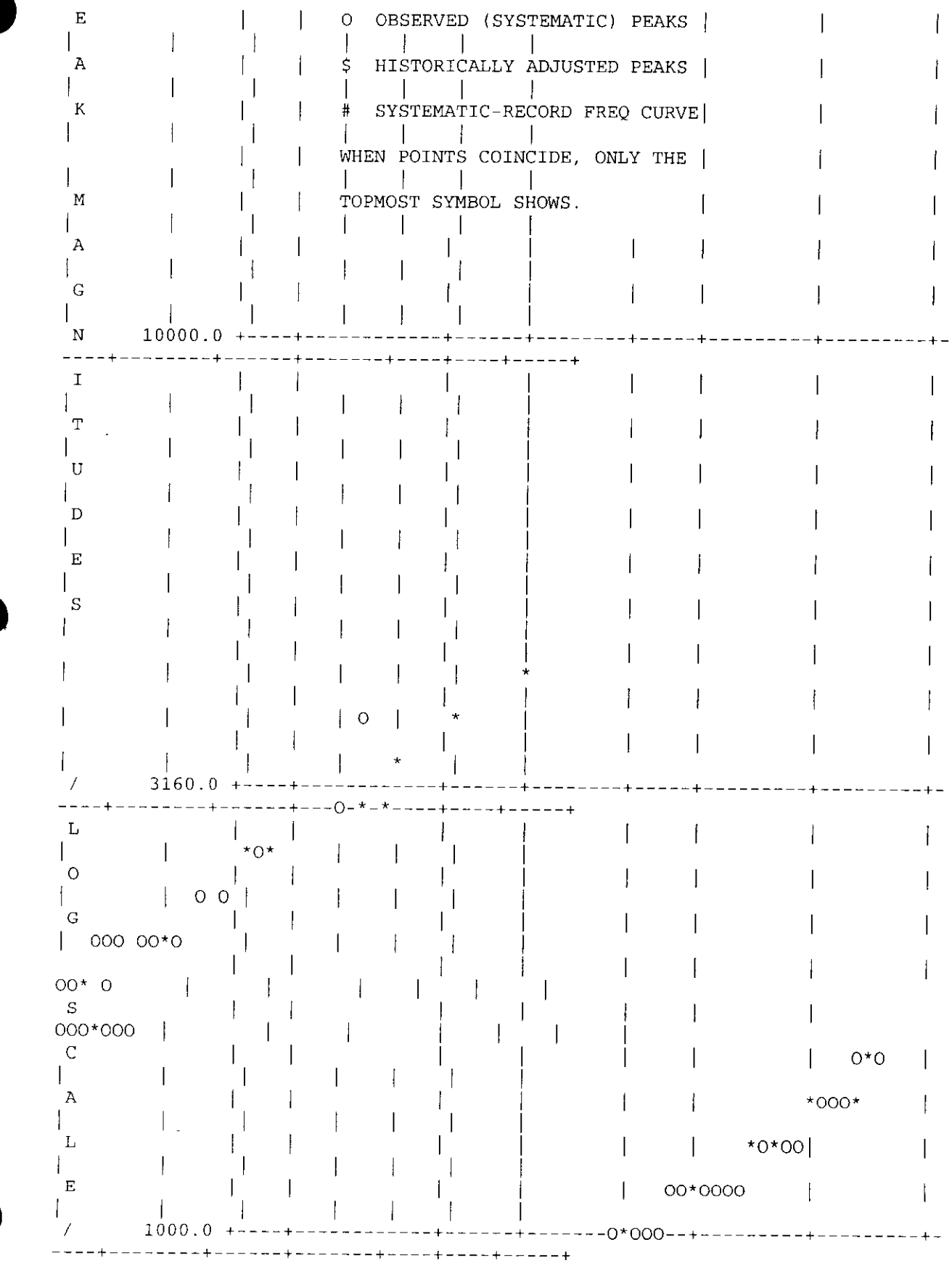
1969	1060.0	0.7385	0.7385
1962	1030.0	0.7538	0.7538
1991	1030.0	0.7692	0.7692
1956	980.0	0.7846	0.7846
1967	963.0	0.8000	0.8000
1992	956.0	0.8154	0.8154
1963	916.0	0.8308	0.8308
1943	900.0	0.8462	0.8462
1972	873.0	0.8615	0.8615
1950	864.0	0.8769	0.8769
1966	860.0	0.8923	0.8923
1989	789.0	0.9077	0.9077
1951	734.0	0.9231	0.9231
1931	715.0	0.9385	0.9385
1934	656.0	0.9538	0.9538
1954	600.0	0.9692	0.9692
1977	516.0	0.9846	0.9846
1912	-2380.0	--	--
1909	-10000.0	--	--

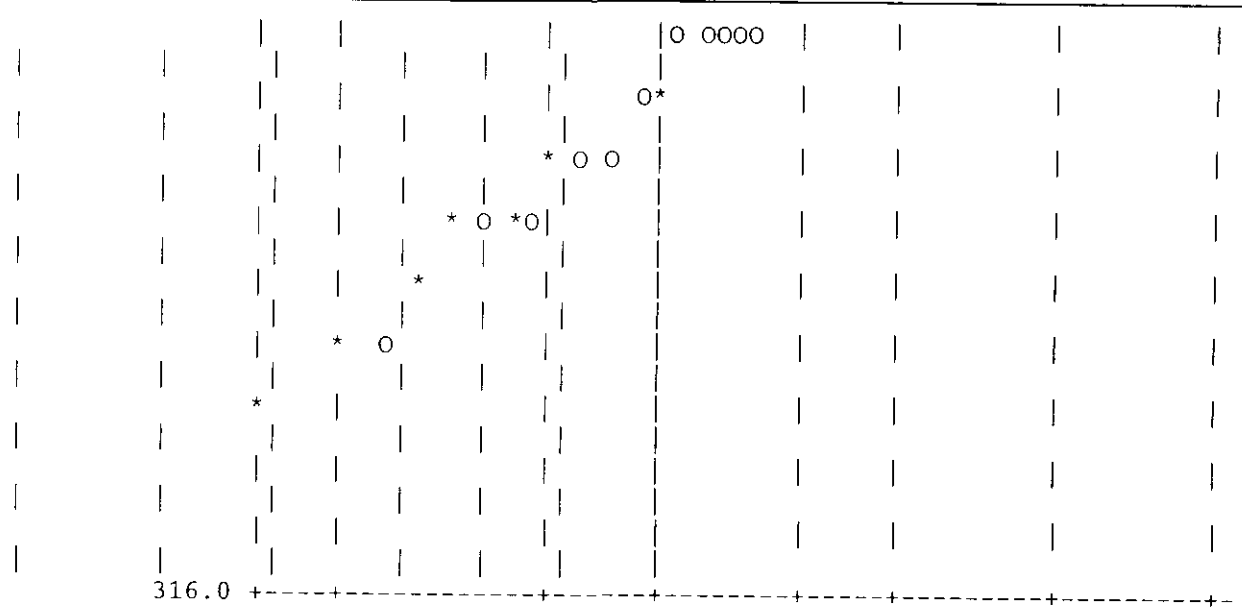
1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)
2002 JAN 29 08:30:17

Station - 09172500 SAN MIGUEL RIVER NEAR PLACERVILLE, CO.




O OBSERVED (SYSTEMATIC) PEAKS
$ HISTORICALLY ADJUSTED PEAKS
# SYSTEMATIC-RECORD FREQ CURVE
WHEN POINTS COINCIDE, ONLY THE TOPMOST SYMBOL SHOWS.
ANNUAL
10000.0
INSTANTANEOUS
3160.0
LOG
1000.0



1

U. S. GEOLOGICAL SURVEY
ANNUAL PEAK FLOW FREQUENCY ANALYSIS
Following Bulletin 17-B Guidelines
Program peakfq
(Version 4.0, December, 2000)

End PEAKFQ analysis.

Stations processed	:	1
Number of errors	:	0
Stations skipped	:	0
Station years	:	66