



THE DENVER FLASH FLOOD PREDICTION PROGRAM
OF THE
URBAN DRAINAGE & FLOOD CONTROL DISTRICT OF DENVER
CONDUCTED BY
HENZ KELLY & ASSOCIATES
DENVER COLORADO

Final Report for the 1988 Operational Season
15 April to 15 September 1988

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INTRODUCTION

Since 1979 the Urban Drainage & Flood Control District (referred to hereafter as District) has sponsored a flash flood prediction program (F2P2) for the six county Denver metropolitan area. The six counties served directly are: Denver, Boulder, Jefferson, Adams, Arapahoe and Douglas. Additionally site-specific predictions are given to Lowry Air Force Base, Aurora, Lakewood, Wheatridge and Consolidated Mutual Water. This report presents a verification of the 1988 operational season and identifies potential improvement areas to be addressed for the 1989 season.

VERIFICATION OF THE 1988 F2P2 OPERATIONAL SEASON

A continued high level of support was achieved in the 1988 F2P2 program despite two unfavorable factors which inhibited the program. These inhibiting factors were:

- a. The change in location of Henz Kelly & Associates from 1776 S. Jackson St. to 2480 West 26th Avenue during June 1988. The move reduced operational data availability and confused work patterns.
- b. The National Weather Service 10cm radar operated at Limon, Colorado was unavailable for frequent on-line updates for periods of 10-50 minutes during most storm periods.

A summary of verification statistics achieved by the program for the 1988 operational season as compared to the previous five year average is presented in Table 1. Of special note is the general improvement noted in the county Message verification statistics.

Table 1 1988 Operational Verification Results for the
UDFCD Flash Flood Prediction Program
Conducted by Henz Kelly & Associates

	1988	Average 1983-87
Number of Message Days	28	33
Percent correct District Message Day forecasts	85%	85%
District Message Day False Alarm Rate	15%	15%
Percent correct Yes/No Daily Forecasts	96%	96%

Percent correct County Message Day forecasts	70%	56%
County Message False Alarm Rate On Message Days	30%	44%
Percent of heavy rain events forecast in Messages	100%	99%

(all days)

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The statistics in Table 1 present 1988 F2P2 operational results on both a District-wide and a county basis. The expanded statistics suggest that while District support continued at a high level county level support improved.

Within the F2P2 the District-wide Message day forecast continues to be 85% correct with a District-wide false alarm rate of 15%. This statistic means that on 85% of the days HKA issued a Message for all or part of the District a heavy rain or flash flooding event was observed within the portion of the District receiving the Message. It does not imply that all the counties receiving the Message experienced a heavy rain or flash flooding event.

No heavy rain events occurred within the District in 1988 that went unforecast. Messages were issued on four days for which no heavy rain events were noted. On two of these days severe weather events did occur as heavy thunderstorms crossed the District. It is possible a heavy rain event went unrecorded

and verification efforts are still in progress.

The verification of Messages on a county basis continues to suffer from the lack of a sufficient data base to assess occurrence of heavy rain events. Our best attempts to produce a county level Message verification suggest that 70% of the time a county was issued a Message in 1988 a heavy rain event producing street or stream flooding occurred. This performance represents a 10% improvement over the 1987 season and a 16% improvement over the 5 year average. The county level false alarm rate dropped to 30% with the most significant improvement noted Denver County where the false alarm rate dropped from 45% to 20%.

The primary reason for the improvement may be linked to a change in Message issuance for lower intensity storms. Last year's report noted that most false alarms were related to the over-prediction of storms's producing less than 1.5 inches of rainfall. A new policy on issuing Messages for storms producing 0.75 - 1.00"/30-60 minutes reduced the leadtime requirement and the number of counties alerted. Meetings held with county representatives agreed that these storms were of lesser importance. Instead of Messages HKA agreed to issue Thunderstorm Advisories to alert users of the storms' strength but allow them more latitude in resource allocation than a Message issuance might. The results are encouraging and the new policy will be implemented again in 1989.

It should be noted that the county Message day verification is based on a data base that may be full of holes, especially from years past. Many heavy rain events go un-noticed or ^{un}reported each year. However we feel that it is of value to try to evaluate the service being given to each county. Thus atleast 70% of the individual county Messages verified during the 1988 season. On about 35% of the Message days severe weather events in the form of tornadoes, high winds, hail or funnel clouds were noted over the counties in the District. Forecasts and information on these associated weather events was provided upon request to the counties. The perceived value of the county Messages was enhanced, we believe, by these weather events and the support received by the counties even if a heavy rain event was not observed.

We believe that an acceptable county Message false alarm rate is 20%. Boulder, Adams and Denver County false alarm rates were this low. Jefferson, Arapahoe and Douglas County false alarm rates were closer to 40% while Lakewood, Wheatridge, Aurora and Lowry AFB were about 50%. The reason for the high false alarm rate in Jefferson and Douglas Counties may be the lack of ground truth reports of flooding events that actually occurred. In Denver, Arapahoe and Douglas Counties the mesonet surface weather station

coverage continues to be much sparser than in the northern suburbs.

Finally information is presented in Table 2 below on the monthly issuance of Messages and thunderstorm advisories (TA). The occurrence of 28 Message days in the 1988 operational season was the lowest total since 1980. Thunderstorm advisories were issued for another 47 days when near-Message level rainfall was expected or intense storms were likely to occur. All thunderstorm advisories verified. The number of Thunderstorm Advisory days increased by almost 40% over the average in part due to the new issuance policy earlier discussed.

Table 2 Monthly Message Day Verification for 1988

Month	# Message Days	# Hits	# Misses	# Thunderstorm Advisory Days
April	0	0	0	6
May	3	3	0	3
June	10	9	1	12
July	5	3	2	12
August	7	6	1	10
Sept	3	3	0	4
Total	28	24	4	47

Additional advances were made in the issuance of basin specific forecasts of storm mass rainfall. A report was issued which discusses these forecasts and their utility. The UDFCD bulletin board received extensive use as a dissemination tool of F2P2 products. New forms of cooperation with the National Weather Service were tested and may be extended into the next operational year.