



2009
UDFCD FLASH FLOOD PREDICTION
PROGRAM - ANNUAL REPORT

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TABLE OF CONTENTS

| <u>Section</u> | <u>Page</u> |
|---|-------------|
| 1.0: Introduction..... | 1 |
| 2.0: 2009 Operational Season | 1 |
| 3.0: 2009 Operational Products..... | 2-5 |
| 4.0: 2009 Message Statistics | 5 |
| 4.1: Message Verification..... | 5-7 |
| 4.2: County/City Message Statistics | 7-8 |
| 5.0: Notable Weather Events | 9-11 |
| 6.0: Recommendations..... | 12 |

LIST OF TABLES

| | |
|--|---|
| Table 1: 2009 F2P2 Products Description | 3 |
| Table 2: Message Definitions | 4 |
| Table 3: 2009 Product/Communication Summary..... | 5 |
| Table 4: Message Criteria | 6 |
| Table 5: Monthly Message 1 verification | 7 |
| Table 6: County/City Message 1 Verification..... | 8 |

LIST OF FIGURES

| | |
|-----------------|----|
| Figure 1: | 2 |
| Figure 2: | 9 |
| Figure 3: | 10 |
| Figure 4: | 10 |
| Figure 5: | 11 |

Appendix A: 2009 Cloud to Ground Lightning Table. Table 7.

1.0 Introduction

The Urban Drainage and Flood Control District (District or UDFCD) has used the forecasting and notification services of a private sector meteorologist for the Flash Flood Prediction Program (F2P2) since 1979. The services of a Private Meteorological Service (PMS) supplement the forecast and warning services of the National Weather Service (NWS) in Boulder, Colorado for the seven-county District area. This is the 31st year the UDFCD has funded the F2P2.

The UDFCD forecast area supported by the PMS is shown in Figure 1 and contains a population of approximately 2.8 million people. The forecast area of approximately 3,000 square miles includes the upper basin areas of watercourses that flow into the District. Terrain in the forecast area varies in elevation of around 5,000 feet above sea level to as high as 10,500 feet above sea level.

A team comprised of Genesis Weather Solutions, a Highlands Ranch, Colorado based company and Skyview Weather, a Castle Rock, Colorado based company was selected as the 2009 PMS.

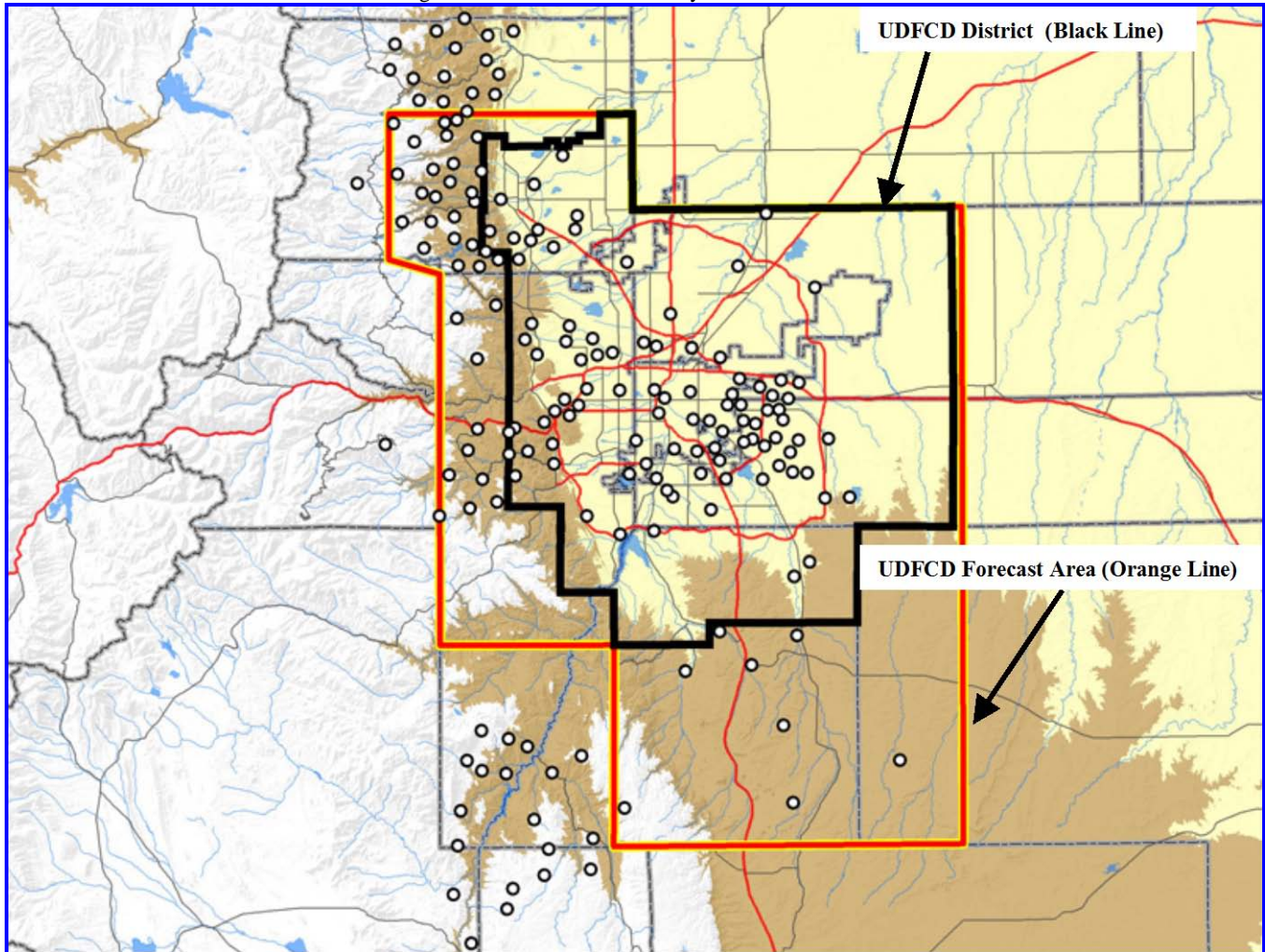
Weather prediction personnel Bryan Rappolt, Tim Tonge, Brad Simmons, and Chris Anderson provided the F2P2 prediction and notification services. Bryan Rappolt was as the Project Manager and Chief Operational Meteorologist.

Bryan Rappolt worked his 16th season on the F2P2 while Tim Tonge worked his 4th, Brad Simmons his 3rd, and Chris Anderson his 2nd season.

2.0 2009 Operational Season

The 2009 F2P2 season began on April 15, 2009 and concluded on September 15; 2009 for a total of 154 operational days. Normal operational hours were from 7:00 AM to 10:00 PM. A total of 1461 man-hours were expended by the PMS providing support of the F2P2 during normal operational hours. During the time period from 10:00 PM to 7:00 AM the PMS provided an additional 344 man-hours of operational support.

Figure 1: The UDFCD boundary and forecast area.



3.0 2009 Operational Products

The F2P2 is designed to provide rainfall prediction and notification services of urban flooding and flash flooding threats to the seven District counties and the cities and towns within those counties. Direct support is provided to the District basin-specific flood warning plans, which include the Westerly Creek, Boulder Creek, Toll Gate Creek, Lena Gulch, Ralston Creek, Goldsmith/Harvard Gulch, and the Bear Creek drainage basins.

Five specific F2P2 products were produced by the PMS. The products included the Heavy Precipitation Outlook (HPO), the Internal Message Status (IMS), the Quantitative Precipitation Forecast (QPF), Stormtrack (ST), and Messages. Table 1 provides a description of the first 4 products and Table 2 provides a description of Messages. Table 3 depicts the number of F2P2 products that were produced and the number of communication contacts made or received by the PMS in 2009.

Table 1. F2P2 product descriptions.

Heavy Precipitation Outlook (HPO)/Internal Message Statement (IMS). This HPO is available by 11:00 AM every day during our primary flood season as noted above. It provides a weather forecast for the District with emphasis on possible rainfall amounts and where storms are most likely to occur. When flood potentials threaten the District, the HPO will be revised and renamed "Internal Message Status" or IMS. This report will indicate the message status for each primary contact point within the District. The contact points include the counties of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas and Jefferson, and the City of Aurora.

Quantitative Precipitation Forecast (QPF). This text product is only available on days when the rainfall potential exceeds 1.5 inches in one-hour or less. The QPF product contains more basin-specific information than the HPO or IMS, and requires some knowledge of the regional major drainage basins, streams and associated flood hazards that impact the District. Storm types, expected rainfall totals, storm duration, peak intensities and associated probabilities of occurrence are presented in this forecast product.

Storm Track (ST). This combination map/text product is a short lead-time forecast showing where a storm has formed or is forming, the approximate size of the storm(s), the direction (or track) of the storm(s), and the estimated arrival times along the forecast track(s). This is probably the most-anticipated hard copy product of the F2P2, but keep in mind that generally it is only available within an hour or less of storm impact. Also, the Storm Track is not prepared for storms that do not pose a flood threat. The map includes a captured radar image whenever possible.

All of the above products were produced and delivered to F2P2 participants using the UDFCD F2P2 Internet based Product Generator Interface (PGI). All F2P2 products were made available on the PGI in both html and pdf format.

Voice communication is the principal method of disseminating information within the F2P2. Six hundred and forty-four (644) telephone contacts were made to F2P2 communication points by the PMS.

Denver Office of Emergency Management and Denver Wastewater received notification of the issuance of Messages and Red Flood Alerts through pager text messages. There were a total of 125 text pages disseminated to these two organizations.

Table 2: Message definitions.



URBAN DRAINAGE AND FLOOD CONTROL DISTRICT FLASH FLOOD PREDICTION PROGRAM (F2P2) MESSAGE DEFINITIONS

MESSAGE 1 (*Nuisance Flood Advisory*)

This advisory message is to inform key people that weather conditions are such that nuisance flooding of streets, low-lying areas, and small streams could develop later in the day. It will be issued by PMS after consultations with NWS. If PMS considers the threat imminent, the message will be identified as a **RED FLOOD ALERT**.

MESSAGE 2 (*Flash Flood Watch*)

This advisory message is to inform key people that either a Flash Flood Watch has been issued by NWS or PMS believes that weather conditions are such that a life-threatening flash flood may occur later in the day. Significant stream flooding and property damage is possible. PMS will add any additional information that is available.

MESSAGE 3 (*Flash Flood Warning*)

This warning message will be issued to inform key people that a Flash Flood Warning has been issued by NWS or PMS feels that a life-threatening flash flood is imminent. Significant stream flooding and property damage is expected. PMS will add any additional information that is available. This warning message should be disseminated as quickly as possible.

MESSAGE UPDATE

This message will be used by PMS to update any of the previous messages. For example, this message can be used to narrow a watch or warning area as more information becomes available, or to provide more site-specific data and direction during an event. If PMS considers the threat imminent, the message will be identified as a **RED FLOOD ALERT**.

MESSAGE 4 (*All Clear*)

This message cancels the flood potential status. It is issued by PMS after consultation with NWS and other entities involved with direct PMS communications.

CONCERNING RED FLOOD ALERT

The term **RED FLOOD ALERT** is used when PMS believes that a flooding rainstorm is imminent. When a MESSAGE 2 is in effect, **RED FLOOD ALERT** may be used with a MESSAGE UPDATE to indicate imminent nuisance flooding that does not warrant a MESSAGE 3. When a MESSAGE 3 is in effect, **RED FLOOD ALERT** may be used with a MESSAGE UPDATE to indicate that an approaching storm is expected to cause nuisance flooding outside the warning area. In summary, **RED FLOOD ALERTS** are short lead notifications of imminent flood threats (low to moderate risk to life and property) that should be disseminated as quickly as possible.

ABBREVIATIONS:

NWS National Weather Service
PMS Private Meteorological Service

NOTE: For Boulder County only, MESSAGE Numbers 1, 2, 3 and 4 will be issued as A, B, C and D respectively to avoid confusion with their MACS operational "MODE" Numbers 1-4.

Table 3: 2009 product/communication summary.

| Product/Communication | Number |
|--|---------------|
| Heavy Precipitation Outlook (HPO) | 177 |
| Messages and Red Flood Alerts | 647 |
| Internal Message Status (IMS) | 121 |
| Basin-Specific Quantitative Precipitation Forecasts (QPF) | 52 |
| Storm Tracks (ST) | 156 |
| Weather Information E-mail Text Pages (Denver County Specific) | 125 |
| PMS Initiated Telephone Contacts | 576 |
| F2P2 Participant Initiated Telephone Contacts | 62 |
| Total | 1,916 |

One hundred seventy-seven (177) emails identifying daily Message potential were disseminated to F2P2 participants. The SMS email included a convenient link to the HPO for those wanting more information.

4.0 2009 Message Statistics

The primary service provided to F2P2 participants is early prediction and notification of the potential for flash flooding, urban and small stream flooding, and locally heavy rainfall events that can initiate nuisance flooding. The PMS indicated the potential for these events in a series of products issued to F2P2 participants by phone, facsimile, email and Internet.

4.1 Message Verification

A Message day is defined as any day in which a Message 1, Message 2 or Message 3 is issued based on the criteria depicted in Table 4. Messages were issued on 52 days during the 2009 F2P2 between April 15, 2009 and September 15, 2009. All of the 52 Message days were Message 1 days as there were no Message 2's issued. Of the 52 Message 1 days 45 of these days had at least one Message verify, based on the criteria listed in Table 4. The result was an 87% verification rate of Message 1 days on a District-wide basis. Table 5 depicts the number of Message 1 days and the number of Message 1's issued and verified for each month of the 2009 F2P2.

Table 4: Message Criteria.

| Message 1 “Nuisance Flood Advisory” Criteria (Boulder County Message A) |
|---|
| <ul style="list-style-type: none">• Message-1 (Nuisance street or gutter flooding): 0.50"/10 minutes or 1.00"/60 minutes• Message-1 (Significant urban street and stream flooding): 1.00 to <3.00"/ 60 minutes• Red Flood Alert: Rainfall intensity: 0.50"/10 minutes or 1.00"/60 min AND occurrence is imminent |
| Message 2 Flash Flood Watch Criteria (Boulder County Message B) |
| <ul style="list-style-type: none">• Option A: National Weather Service issues a Flash Flood Watch affecting the District• Option B: PMS predicts rainfall that will equal/exceed 3.00"/hour (No NWS Flash Flood Watch exists) |
| Message 3 Flash Flood Warning Criteria (Boulder County Message C) |
| <ul style="list-style-type: none">• Option A: National Weather Service issues a Flash Flood Warning affecting the District• Option B: PMS issues a Flash Flood Warning for a specific District river/stream/drainageway (No NWS Flash Flood Warning exists) |
| Message 4 (Boulder County Message D) |
| <ul style="list-style-type: none">• Message 4 (“All Clear”) is issued whenever Messages are rescinded before their expiration time. |

There were 7 “nearby hit” days where a Message 1 was issued for a portion of the District and Message level rainfall was not observed within the District; however Message level rainfall was observed within the “nearby hit” zone outside of the District. Including “near hit” days in the Message 1 day statistics results in a 100% verification rate of Message 1 level rainfall being observed within or near the District on the 52 Message 1 days.

Of the 52 Message 1 days, all of these days had Message level rainfall observed within either the forecast area or near by the forecast area.

There were 3 days (June 11, July, 20 and September, 5) where Message 1 level rainfall was observed within a portion of the District and a Message 1 was issued with short lead-time (< 30 minutes) or zero lead-time.

There were no days where Message 1 level rainfall was observed within a portion of the District and no Message 1 was issued by the PMS for that location.

There was 1 day (June, 11) where a Message 1 was issued for a portion of the District, the Message 1 was rescinded and then re-issued due a renewed threat of Message 1 level rainfall.

Table 5: Monthly Message 1 verification.

| Month | Number of Message 1 Days | Verified Message 1 Days | Percent of Verifying Message 1 Days | Message 1's Issued | Verified Message 1's | Percent of Verified Message 1's |
|--------------|--------------------------|-------------------------|-------------------------------------|--------------------|----------------------|---------------------------------|
| April | 0 | 0 | N/A | 0 | 0 | N/A |
| May | 6 | 6 | 100% | 46 | 40 | 87% |
| June | 16 | 14 | 88% | 133 | 91 | 68% |
| July | 17 | 16 | 94% | 135 | 90 | 67% |
| August | 9 | 7 | 78% | 62 | 38 | 61% |
| September | 4 | 2 | 50% | 17 | 8 | 47% |
| Total | 52 | 45 | 87% | 393 | 267 | 68% |

A Red Flood Alert was issued when the PMS felt that there is a 90% or greater probability that Message 1 level rainfall would be observed within a portion of the District. There were a total of 38 Red Flood Alert days, of which 38 of these Red Flood Alert days verified somewhere within the District; resulting in a verification rate of 100 %.

The 52 Message 1 days is the tied for the highest number of Message days in the 31-year history of the F2P2. The other year that had 52 Message days was 1996.

There was zero NWS issued Flash Flood Watches and subsequently there were zero of Message 2 days. The average annual number of Message 2 days in the 31-year history of the F2P2 is 4.

The NWS in Boulder issued 3 Flash Flood Warnings for portions of the District. The Flash Flood Warnings were issued on June 23rd, June 25th, and September 5th. Although significant urban and street flooding was observed on both June 23rd and June 25th flash flooding of watercourses was not experienced. The rainfall observed on September 5th only affected a small area and no flooding was reported. Message 2's were not issued on any of these three days due to the fact that the NWS and the PMS did not feel that a Flash Flood Watch or Message 2's were warranted. Message 1's and RFA's were issued on all three of these days for the area that experienced flooding.

4.2 County/City Message Statistics

Each Message issued within the F2P2 is disseminated to a primary contact point in which flooding potential has been predicted. The counties and cities that receive Messages are listed in Table 6.

A Message is verified as a "hit" when a rainfall event meeting the Message criteria depicted in Table 4 is observed in the District-portion of that City/County or in the drainage area of a watercourse that flows into the jurisdiction. Table 6 contains the results of the Message 1 verification on a City/County basis.

Verification of Message 1's issued for the City of Aurora and Denver International Airport (DIA) are included in the County statistics because Aurora is a primary contact point and Denver County is segmented into two sections which includes the City and County of Denver and northeast Denver County (DIA). The cities of Arvada, Lakewood and Wheat Ridge receive Message 1 notifications from Jefferson County dispatch, but also receive Red Flood Alerts, Message 2's and Message 3's directly from the PMS.

Table 6: County/City Message 1 Verification.

| Primary Message Contact Points | Message 1's Issued | Message 1 Hits | % Message 1 Hits | Red Flood Alerts Issued | Red Flood Alert Hits | % Message Red Flood Alert Hits | Events Missed | Event < 30 min Lead Time |
|--------------------------------|--------------------|----------------|------------------|-------------------------|----------------------|--------------------------------|---------------|--------------------------|
| Adams | 48 | 38 | 79% | 37 | 35 | 95% | 0 | 1 |
| Arapahoe | 47 | 35 | 74% | 35 | 33 | 94% | 0 | 1 |
| Aurora | 47 | 31 | 66% | 33 | 22 | 67% | 0 | 1 |
| Boulder | 40 | 19 | 48% | 8 | 5 | 63% | 0 | 1 |
| Broomfield | 42 | 16 | 38% | 9 | 8 | 89% | 0 | 0 |
| Denver | 40 | 30 | 75% | 21 | 16 | 76% | 0 | 1 |
| DIA | 41 | 25 | 61% | 20 | 14 | 67% | 0 | 0 |
| Douglas | 46 | 41 | 89% | 24 | 24 | 100% | 0 | 0 |
| Jefferson | 42 | 32 | 76% | 27 | 25 | 93% | | 0 |
| TOTAL | 393 | 267 | 68% | 214 | 182 | 85% | 0 | 5 |
| Red Flood Alert Contact Points | Message 1's Issued | Message 1 Hits | % Message 1 Hits | Red Flood Alerts Issued | Red Flood Alert Hits | % Message Red Flood Alert Hits | Events Missed | Event < 30 min Lead Time |
| Arvada | N/A | N/A | N/A | 8 | 7 | | 0 | 0 |
| Lakewood | N/A | N/A | N/A | 11 | 11 | | 0 | 0 |
| Wheat Ridge | N/A | N/A | N/A | 9 | 7 | | 0 | 0 |
| TOTAL | N/A | N/A | N/A | | | | | |
| GRAND TOTAL | 393 | | | 242 | 207 | 86% | 0 | 5 |

A total of 393 Message 1's were issued to the 8 primary contact points within the District. Of the 393 Message 1's that were issued, 267 verified, resulting in a verification rate of 68%. Douglas County had the highest verification rate, 89%, while Broomfield County had the lowest verification rate, 38%.

A total of 242 Red Flood Alerts were issued. Of the 242 Red Flood Alerts issued, 207 of them verified, resulting in a verification rate of 86%. Douglas County had the highest Red Flood Alert verification rate, 100%, while Boulder had the lowest Red Flood Alert verification rate, 63%.

The PMS prepared a cloud-to-ground lightning table that covered the forecast period of April 15, 2009 through September 15, 2009. Archived cloud-to-ground lightning data was reviewed for each of the 154 operational days of the F2P2. The table shows that of the 154 days, 109 of the days (71% of the total days) cloud-to-ground lightning was observed within or near the District. Of the 109 "thunderstorm days" within the District 48 % of the days had Messages issued for them. The cloud-to-ground lightning table can be found in Appendix A.

5.0 Notable Weather Events

The 2009 F2P2 season was more active than normal with respect to the number of thunderstorms, precipitation and severe weather that was observed within the District. Some of the notable weather events observed during the 2009 F2P2 are listed below:

June 1st: A slow moving thunderstorm produced heavy rainfall of 2.50” to 3.00” in 90 minutes across east central Douglas County. Runoff associated with the rainfall caused high flows on Cherry Creek in east central Douglas County. A USGS stream gage located on Cherry Creek in Franktown, CO, downstream of the heavy rainfall, measured a peak stage of 9.40 feet and measured a peak flow of 4370 cfs. Flash flooding was experienced in Castlewood Canyon State Park. According to Dr. Robert Jarrett of the USGS the flows observed within Castlewood Canyon State Park was the third highest since 1940. Figure 2 shows the results of the flash flooding experienced in Castlewood Canyon State Park.



Figure 2: A pedestrian bridge damaged by high flows on Cherry Creek in Castlewood Canyon State Park on the night of June 1, 2009 (Courtesy of Tim Tonge).

June 23rd: A severe thunderstorm produced heavy rainfall and large hail across northeast Douglas County and the City of Parker. Heaviest rainfall 1.50” to 2.25”/30-60 minutes was observed in the City of Parker. A Flash Flood Warning was issued for this location due to the heavy rainfall that was observed. Large hail, up to 1.50” in diameter, and strong straight-line winds accompanied the heavy rainfall. Figure 4 shows the flooding and hail observed in the City of Parker.



Figure 3: Flooding and hail in Parker, Colorado observed on June 23, 2009.

June 25th: A line of moderate to strong thunderstorms developed over the higher terrain of Jefferson County and moved to the east. An outflow boundary from these storms initiated additional strong thunderstorms over Denver County and western Aurora. The thunderstorms moved slowly to east and produced heavy rainfall of 1.50” to 2.40”/20-45 minutes across east Denver County, northwest and central Aurora/Arapahoe County. A Flash Flood Warning was issued for these locations due to the heavy rainfall that was observed. Although Flash Flooding was not experienced, significant street and urban flooding was observed. Figure 5 shows the flooding in east Denver County.



Figure 4: Flooding at Leetsdale and Oneida in east Denver on June 25, 2009.

July 20, 2009: A supercell thunderstorm developed late at night across southeast Boulder County and moved quickly to the south producing heavy rainfall, large hail and strong straight line winds across northern and central Jefferson County, including the cities of Arvada, Lakewood, and Wheat Ridge. Significant damage was experienced to residential and commercial structures due to the large hail and strong winds. The supercell continued to move south and finally weakened in southern Colorado Springs, Colorado. Figure 6 shows the damage experienced in Wheat Ridge, Colorado. Nuisance flooding was observed in southern Boulder and Jefferson Counties.



Figure 5: Damage caused by straight-line winds on July 20, 2009 in Wheat Ridge, Colorado

6.0 Recommendations

The PMS has made the following recommendations for future improvements to the F2P2:

Storm Track

It is recommended that the GIS-based stormtrack application used to produce stormtrack products within the program be upgraded. Currently it is rather cumbersome to add text, shapes and lines, which are all used to create the product. It is felt that the current application could be improved in how text, shapes and lines are added to the product, allowing the user to produce and disseminate the stormtrack product in a more efficient and timelier manor.

Flood Prediction Equipment

It is recommended that the one “older” computer in the northeast corner of the FPC be replaced with a new computer that can provide video to multiple (two or more) LCD monitors simultaneously. The new computer should be used to produce Storm Tracks with ArcGIS and view Doppler radar using GRLevel simultaneously.

Denver OEM and Denver Wastewater Pages

It is recommended that the text pages that are sent to Denver OEM and Denver Wastewater that indicate the heavy rainfall potential and status of Messages be automated similar to how the SMS's are created and disseminated using the F2P2 product generator.

APPENDIX A

Table 7: 2009 F2P2 Thunderstorm (TRW) Days

| Comments | Adams | Arapahoe | Boulder | Broomfield | Denver | Douglas | Jeffco | Metro Dnvr | Total |
|--|-------|----------|---------|------------|--------|---------|--------|------------|-------|
| 2009 UDFCD Thunderstorm Days | | | | | | | | | |
| Isolated Lightning Far East Adams County | 1 | | | | | | | | |
| Scattered Lightning South/East Denver Metro Area | 1 | 1 | | | | 1 | 1 | | 1 |
| Isolated Lightning Denver Metro Area | 1 | 1 | | | | 1 | 1 | | 1 |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Isolated Lightning Boulder County | | | 1 | | | | | | |
| Isolated Lightning South Denver Metro | | | | | | 1 | | | 1 |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Isolated Lightning Jefferson County | | | | | | | 1 | | |
| Isolated Lightning | | 1 | 1 | | | | 1 | | 1 |
| No Lightning | | | | | | | | | |
| Isolated Lightning | | | | | | 1 | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Isolated Lightning Colorado Springs | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Isolated Lightning Colorado Springs | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Scattered Lightning South Douglas | | | | | | 1 | | | 1 |
| Scattered Lightning | 1 | 1 | | | | 1 | 1 | | 1 |
| Isolated Lightning | 1 | | | | | 1 | | | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No Lightning | | | | | | | | |
| Scattered Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| No Lightning | | | | | | | | |
| Isolated Lightning | | | 1 | | | | 1 | |
| Isolated Lightning Estes Park, Boulder County | | | 1 | | | | | |
| Scattered Lightning | | | 1 | | | 1 | 1 | |
| Widespread Lightning | 1 | 1 | | | | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| No Lightning | | | | | | | | |
| Scattered Lightning | | 1 | 1 | | | 1 | 1 | 1 |
| Isolated Lightning | | | | | | 1 | 1 | |
| Scattered Lightning | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| No Lightning | | | | | | | | |
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Isolated Lightning | | 1 | 1 | | | 1 | 1 | 1 |
| Isolated Lightning W and NW Denver Metro | 1 | | 1 | 1 | 1 | | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | 1 | | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Isolated Lightning | 1 | 1 | 1 | 1 | 1 | | 1 | 1 |
| Isolated Lightning | 1 | | 1 | | | | | 1 |
| Scattered Lightning | 1 | | 1 | 1 | | 1 | 1 | 1 |
| Isolated Lightning | 1 | | 1 | | | | | 1 |
| Scattered Lightning Mountains | | | | | | | 1 | |
| Scattered Lightning | 1 | 1 | 1 | | | 1 | 1 | 1 |
| Scattered Lightning Mountains | | | | | | | 1 | |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| Isolated Lightning South Douglas | | | | | | 1 | 1 | |
| Scattered Lightning South Douglas, COS | | | | | | 1 | 1 | |
| Scattered Lightning | | | | | | 1 | 1 | |
| Isolated Lightning South Douglas | | | | | | 1 | 1 | |

| | | | | | | | | |
|--------------------------------------|---|---|---|---|---|---|---|---|
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Isolated Lightning | | | | | | | 1 | |
| Isolated Lightning | | | | | | 1 | | |
| Minor Lightning late | 1 | 1 | | | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Heavy Lightning South Denver, COS | | | 1 | | | 1 | 1 | 1 |
| Widespread Lightning | 1 | | 1 | 1 | | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Minor Lightning late | 1 | 1 | | | 1 | | 1 | 1 |
| Isolated Lightning Colorado Springs | | | | | | | | |
| No Lightning | | | | | | | | |
| No Lightning | | | | | | | | |
| No Lightning | | | | | | | | |
| Scattered Lightning | 1 | 1 | 1 | | | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Scattered Lightning Colorado Springs | | | | | | 1 | 1 | |
| Scattered Lightning Colorado Springs | | | | | 1 | | | |
| No Lightning | | | | | | | | |
| Scattered Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | | | | | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Widespread Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Scattered Lightning West Slope, COS | | | | | | 1 | 1 | |
| Scattered Lightning | 1 | | 1 | | 1 | 1 | 1 | 1 |
| No Lightning | | | | | | | | |
| Isolated Colorado Springs | | | | | | | | |
| Scattered Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Isolated Lightning West Denver, COS | | | | | | 1 | 1 | 1 |
| Scattered Lightning | 1 | | 1 | 1 | 1 | 1 | 1 | |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Isolated Lightning Boulder County | | | 1 | | | | | |
| Isolated Lightning Boulder County | | | 1 | | | | | |
| Moderate Lightning Denver Metro | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| Scattered Lightning | 1 | 1 | | | | 1 | 1 | 1 |

| | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|-----|
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Scattered Lightning | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | |
| Isolated Lightning Douglas County | | | | | | 1 | | | |
| Scattered Lightning | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | |
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Scattered Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Widespread Lightning | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Isolated Lightning Douglas County | | | | | | 1 | | | |
| Isolated Lightning Northwest Denver | 1 | | 1 | | | | 1 | | |
| Isolated Lightning Boulder County | | | 1 | | | | | | |
| Widespread Lightning | 1 | 1 | | | 1 | 1 | 1 | 1 | |
| Scattered Lightning | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | |
| No Lightning | | | | | | | | | |
| No Lightning | | | | | | | | | |
| Scattered Lightning Colorado Springs | | | | | | 1 | 1 | | |
| Scattered Lightning | 1 | 1 | 1 | | | 1 | 1 | 1 | |
| Isolated Lightning | | 1 | | | | 1 | | | |
| No Lightning | | | | | | | | | |
| Isolated Lightning Denver Metro Area | 1 | 1 | 1 | | | 1 | 1 | 1 | |
| Isolated Lightning Denver | | | | | 1 | | | | 1 |
| Isolated Lightning Colorado Springs | | | | | | | | | |
| Scattered Lightning | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Scattered Lightning | | | 1 | | | 1 | 1 | 1 | |
| Scattered Lightning South Denver Area | 1 | 1 | | | | 1 | 1 | 1 | |
| Scattered Lightning | 1 | | 1 | | | 1 | 1 | 1 | |
| Isolated Lightning Denver | | 1 | 1 | | 1 | 1 | 1 | 1 | |
| Isolated Lightning Douglas County | | 1 | | | | 1 | | | |
| No Lightning | | | | | | | | | |
| Isolated Lightning Colorado Springs | | | | | | | 1 | | |
| Scattered Lightning, W. and S. Denver Metro | 1 | | 1 | | | 1 | 1 | 1 | |
| Isolated Lightning, Douglas, Jeffco | | | | | | 1 | 1 | 1 | |
| Scattered Lightning, Colorado Springs | | | 1 | | | 1 | 1 | 1 | |
| Apr 15 to Sep 15 | 68 | 58 | 70 | 33 | 51 | 87 | 89 | 78 | 109 |