Dewberry

2018 UDFCD Heavy Rainfall Guidance Tool

FINAL REPORT

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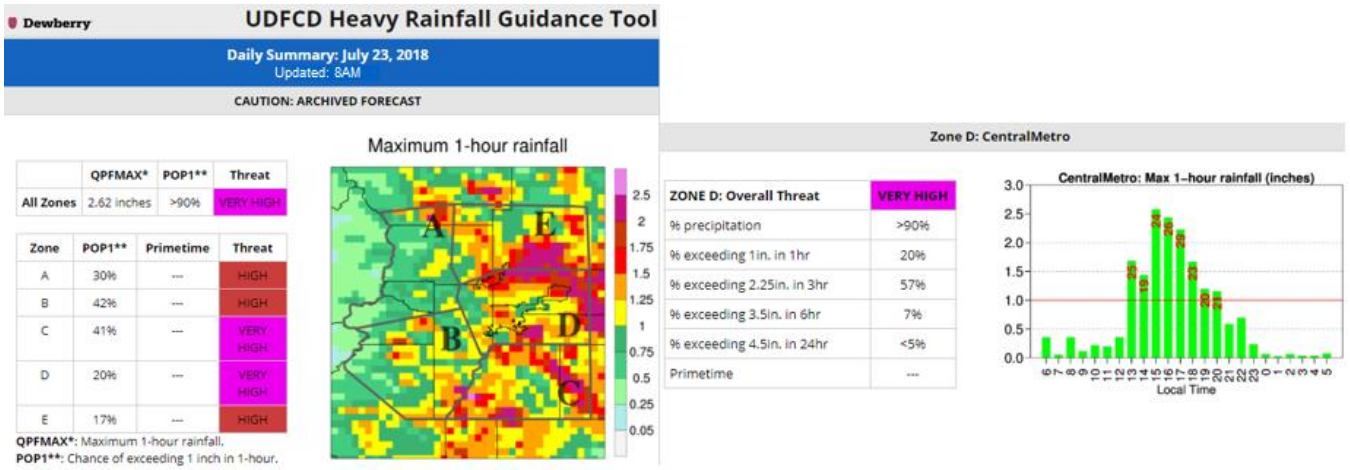
OVERVIEW

In early 2015, Dewberry designed and developed a Heavy Rainfall Guidance Tool (hereafter, Tool) for the Urban Drainage and Flood Control District (hereafter, UDFCD or District) to address four crucial questions regarding the summertime daily heavy rainfall threat across the UDFCD area: (i) timing, (ii) location, (iii) intensity and (iv) confidence. The Tool is based on an ensemble of high-resolution weather models that are able to directly simulate convective rainfall. The original 2015 operational version of the Tool was based on raw model data. In 2016, a Technical Memo documenting the 2015 Tool performance noted, among other things, a noticeable "overconfidence" bias where heavy rainfall was being predicted with higher frequency and higher probability than was being observed. Thus, a significant processing step was added for the 2016 operational season to reduce this bias. After the 2016 operational season, further research on bias correction was undertaken, and flow dependent biases were noted and corrections applied to the Tool for the 2017 and 2018 operational season. For the 2018 operational season, the Tool was reduced from six to five forecast zones with the existing zones trimmed from south to north and east to west. This reduced the rainfall influence of the climatological active regions of the eastern plains and southern half of the Palmer Ridge, whose rainfall had no effect on runoff over the District. At the beginning of 2018, the NCAR and NSSL ensembles used in the previous seasons were discontinued. To replace these 18 models, the 9 member High-Resolution Rapid Refresh Ensemble (hereafter, HRRRE) was added to the Tool. This Report provides an analysis of the Tool's performance during 2018 operational season.

Tool description

The Tool accesses hourly Quantitative Precipitation Forecast (QPF) data from up to 35 high resolution weather model simulations from the National Severe Storms Laboratory (NSSL), the National Centers for Environmental Prediction (NCEP) and the National Center for Atmospheric Research (NCAR). All models have horizontal resolution of 4 km (2.4 miles) or less allowing for a drastically more realistic representation of thunderstorm-based rainfall compared to weather models with coarser resolution. QPF data from the model "ensemble" is re-gridded to a common ~3.9 km grid across an area centered on the UDFCD, after which maximum hourly QPF (hereafter, QPF-Max) and Probability of Exceedance (POE); for example, chance of exceeding 1 inch per hour) are constructed for each of five forecast Zones (see Figure 1). Although UDFCD's area is about 1,600 sq. miles, the Tool's area covers about 5,700 sq. miles for two main reasons. First, to ensure that rainfall is captured within contributing watershed boundaries that extend outside of the official UDFCD boundary, and second, due to the imperfect (but improving) nature of heavy rainfall forecasts.

Tool output is displayed on a web-based user interface, and is publicly available at: http://qpf.udfcd.org. Snapshots of the "Daily Summary" and 'Zone Forecasts" sections of the Tool's web interface are shown in Figure 1 from July 23rd, when rainfall exceeding 1 inch in 1 hour was observed within all five of the Tool's forecast zones. During 2017, a notable upgrade in the Tool's operations allowed for three updates per day compared to two daily updates during 2015 and 2016.



	QPFMAX*	POP1**	Threat
All Zones	2.62 inches	>90%	VERY HIGH

Zone	POP1**	Primetime	Threat
A	30%	---	HIGH
B	42%	---	HIGH
C	41%	---	VERY HIGH
D	20%	---	VERY HIGH
E	17%	---	HIGH

ZONE D: Overall Threat	VERY HIGH
% precipitation	>90%
% exceeding 1in. in 1hr	20%
% exceeding 2.25in. in 3hr	57%
% exceeding 3.5in. in 6hr	7%
% exceeding 4.5in. in 24hr	<5%
Primetime	---

Figure 1: Snapshot of the "Daily Summary" and "Zone-Specific Forecasts" of the Tool's website for the 8AM update of July 23, 2018. Heavy rainfall was observed in all five Forecast Zones during the afternoon and evening hours.

An archive of Tool output is available by clicking on the “Archives” link at the top right of the website. This Final Report represents an official validation of the Tool’s performance during the 2018 operational season spanning May 14 to September 30 with the HRRRE added to the Tool beginning on June 9th. In this report, we first discuss the methodology for the validation effort and present Tool validation statistics, as well as an example of a particular event. Finally, we provide conclusions and recommendations for future operation.

METHODOLOGY

Validating the performance of rainfall forecasts is notoriously difficult due to the large spectrum of possible metrics. This is especially relevant when data from multiple weather models are involved, as is the case with the Tool. For the purposes of this report, we must recall that the Tool was designed to predict the *maximum* rainfall potential on any given day. While it is possible and potentially useful to investigate other aspects of rainfall statistics (for example, distribution across the domain, relation to climatology, etc.), the primary focus of this report will be on analyzing maximum rainfall amounts in (i) each of the five Forecast Zones individually and (ii) across the five Zones collectively. Furthermore, since we are interested in relatively short-term rainfall capable of producing flash flooding, **the focus of the validation will be on the 1-hour time period for the morning run (produced at 8AM MDT) over the 140 day operational season**.

Rainfall Observations

We used UDFCD’s roughly 200 active ALERT rainfall gages as one of the primary inputs to the validation. Raw tipping bucket data was obtained from Novastar and processed maximum 30-minute and hourly accumulations with a sliding window. Note that this is a notable upgrade beginning in 2017, where ALERT data in 2015-2016 was binned into hourly increments before a maximum value was calculated. The 2015-2016 method was found to underestimate maximum rainfall by up to 40%. To supplement the ALERT data, we use two additional products: (i) gridded gauge-adjusted radar estimates provided by the National Oceanic and Atmospheric Administration’s Stage IV product at roughly 4 km resolution and (ii) volunteer-based observations from the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) network. The benefit of Stage IV is that it has full coverage in space and is especially useful due to UDFCD’s proximity to the Denver NEXRAD Doppler radar. However, Stage IV’s limitations are that (i) because it is first derived from radar reflectivity (and then gage corrected) it does not always accurately reflect the true rainfall, (ii) because the Stage IV product is on a 4-km grid, this may act to smooth out rainfall amounts, especially for spatially explicit storms, and (iii) the data is produced in hourly increments, which causes Stage

IV maximum hourly rainfall to be *lower* than corresponding ALERT data during most heavy rainfall events. CoCoRaHS observations were used mainly for quality control especially during cases where only one or two ALERT gages measured heavy rainfall or when Stage IV two hour rainfall totals were over 1 inch.

For our validation, ***we use the maximum hourly rainfall from either processed ALERT data or Stage IV***. This represents the best readily available estimate of maximum rainfall, which is what the Tool is designed to forecast. Daily summaries of zone-aggregated and zone-specific precipitation amounts are shown in Appendices A and B, respectively.

Table 1 describes the characteristics of the five forecast zones. All five zones are between 1,000 and 1,100 square miles, while Zone B (Southern Foothills) is the exception at about 1,300 square miles due to its extension to the Continental Divide. The roughly equal area size of the 2018 zones (as opposed to the prior zones) makes post-processing of the QPF data more consistent and validation between the zones more comparable. Table 1 also shows that each Zone had a widely varying number of gages within it (note that not all gages may be active at all times), ranging from 16 in Zone E (North Metro) to 100 in Zone D (Central Metro). The right two columns of Table 1 show rainfall statistics for the 2018 season. The number of days where maximum hourly rainfall exceeded 0.5 inch ranged from 18 in Zone A/B to 36 in Zone C. There were 49 days during the 140 day operational season when at least one Zone measured 0.5 inches in 1 hour, which was down from 64 days during the 2017 season. It is likely that the zone cutbacks helped decrease the number of 0.5 inches in 1 hour days. Regarding the more important threshold of 1 inch over 1 hour, there were 22 such days, which was up 3 from the 2017 season. Unlike last season, all A-E Zones had at least 1 day of 1 inch over 1 hour. To be brief, **2018 can be described as relatively active across the adjacent plains (C, D) but more quiet across the mountain zones (A, B)**. Finally, note that in the two right columns of Table 1, the sum of the values across each Zone do not equal the total: this occurs because there are often instances when multiple zones record rainfall accumulations exceeding these thresholds *simultaneously*.

Table 1: Summary of Forecast Zones and 2018 statistics. Note that there are 140 days in the 2018 operational season.

Forecast Zone	Area (sq. mi.)	# of ALERT gages	# of days with rainfall >= 0.5 in/hr	# of days with rainfall >= 1.0 in/hr
(A) Northern Foothills	1,034	68 gages	18 days	6 days
(B) Southern Foothills	1,317	27	18	5
(C) Palmer Divide	1,131	47	36	12
(D) Central Metro	1,151	100	20	13
(E) Northern Metro	1,130	16	21	9
All Zones	**5,763**	**258**	**49 (2017 - 64)**	**22 (2017 - 19)**

Threat Classification System

Although the Tool outputs forecasted rainfall amounts, its broader purpose is to act as a decision support tool. Accordingly, a translation between rainfall intensity and probability into a threat level(s) is required. As in 2015 through 2017, five threat levels were used: No Threat, Low, Moderate, High and Very High. The Threat Level is based on two considerations: rainfall intensity and probability of exceedance. The following four rainfall duration thresholds are used to identify a possible threat: **1 inch per 1 hour**, **2.25 inches per 3 hours**, **3.5 inches per 6 hours** and **4.5 inches per 24 hours**. Using multiple durations captures the wide array of rainfall events, ranging from very intense, short-duration events (e.g. 1 hour) to low-to-moderate intensity, long-duration events (e.g. 6+ hours). In addition to the threshold itself, the probabilistic capabilities of the Tool were leveraged to quantify the confidence of a threshold being exceeded. Intuitively, assuming atmospheric model QPF

has some skill, a higher POE warrants a higher threat level (as was shown to be true during 2015 through 2017). The classifications are determined using the protocol in Table 2. Note that in addition to the Zone-Specific thresholds, an "All Zones" threshold was also used to assign a single threat across the entire Tool domain. As can be expected, the thresholds for the All Zones threat levels were significantly higher than Zone-Specific ones, due to the increased skill that exists as a larger area is considered. For 2018 season, the All Zones High threat threshold was increased from 65% to 84%, which based on 2016-2017 historical data would allow for a 75% hit rate.

Table 2: Threat classification system.

Threat	Zone-Specific Threshold	All Zones Threshold
LOW	POE >= 8%	POE >= 25%
MODERATE	POE >= 19%	POE >= 39%
HIGH	POE >= 29%	POE >= 84%
VERY HIGH	POE >= 45%	POE >= 90%

Table 3 is the culmination of three years' worth of operational experience, although it is important to realize that as the science continues to evolve, updates to Table 3 can be expected. Table 3 shows the number of threats identified for each Zone, categorized by threat level. Of the 140 days in the 2018 operational season, there were 25 days where at least a Low threat was present for All Zones. Table 4 shows the 2018 All Zones threat summary next to the 2017 All Zone summary for reference though the area size, number of days in the operational season and High threat threshold was different. Though not an apples to apples comparison, the number of All Zone threat days decreased more than 50% from the 2017 to 2018 season. There are also zero High threat days during 2018 season with little to no change in Low threats. Even if the High threat threshold was not increased in 2018, there would only be 2 All Zones High threats for the season. To measure the effects of the updated equations on the Tool, a row has been included where the 2018 data use the "2017 equations" in a hindcast. The number of threats issued increased by 11 with the largest increase in the Moderate threat category. Also included in Table 4 is the F2P2 Heavy Precipitation Outlook (HPO) provided each morning by Skyview Weather. The HPO issued 28 days more threats days than the Tool with 11 more high-end threat days (~18% increase).

Table 3: 2018 Threat Level Summary, by Zone

Zone	None	Low	Mod	High	Very	Threats Issued
(A) Northern Foothills	123	11	1	4	1	14
(B) Southern Foothills	120	13	2	2	3	20
(C) Palmer Ridge	122	9	1	4	4	18
(D) Central Metro	121	9	6	3	1	19
(E) Northern Metro	126	8	3	1	2	14
All Zones	115	15	9	0	1	25

Table 4: All Zones Threat Comparison between 2018, 2017 and 2018 HPOs for reference. Also included is a 2017 equation hindcast to better quantify the effects of updating the post-processing equations.

All Zones	None	Low	Mod	High	Very	Threats Issued
2018	115	15	9	0	1	25
2017	87	13	28	24	1	66
2017 equations	104	8	23	2	3	36
2018 HPO	87	18	23	12	--	53

VALIDATION

Worst-case scenario analysis

A key output of the Tool is the daily 1-hour QPF-Max, which is analogous to the *realistic* worst-case scenario estimate. It is important to appreciate the significance of the term "realistic". From a simple theoretical standpoint, one can assign a maximum potential rainfall intensity (i.e. worst-case scenario) based on historical rainfall climatology such as NOAA Atlas 14. For example, the 1-in-100 year hourly point rainfall in the Denver area is 2.34 inches, while the 1-in-1000 year amount is 3.67 inches. Unfortunately, these values will drastically overestimate observed maximum rainfall the vast majority of the time, decreasing their utility in operations. To add realism, consideration of factors such as Precipitable Water content, atmospheric flow, and seasonality, will allow for a better estimate of the daily worst-case scenario. The Tool accomplishes this by considering the simulations from many weather models, in order to capture the variety of outcomes that are possible given an initial atmospheric state.

In a perfect system, the worst-case scenario intensity will be higher than observed maximum rainfall, though occasionally the worst-case scenario will be realized. Figure 2 shows this worst-case scenario assessment during the 2018 season. Note that the vast majority of the time, the QPF-Max is indeed higher than, or equal to the observed maximum (hereafter, QPE-Max) rainfall. Of the 49 days when hourly rainfall intensity exceeded 0.5 inches, QPF-Max was higher 61% of the time (63% of the time if a 10% margin is added). Focusing only on days when hourly intensity exceeds 1 inch, QPF-Max is higher or equal to observed intensity 47% of the time (53% of the time if allowing for a 10% margin). Furthermore, the correlation between QPF-Max and QPE-Max is a moderately strong (0.70), implying that as the worst-case scenario increases, so does the observed intensity. The presence of a correlation reiterates the "realistic" aspect of the QPF-Max, making it more useful for operations.

Before the 2018 season, the max 1-hour QPF bias correction was increased from 2.45 inches to 2.8 inches to ensure the worst-case scenario was captured for the higher end threats (see vertical lines in Figure 2). This value was determined by averaging the top two QPE values from the ALERT gages starting in 2015. During the 2018 season, the max ALERT value observed was 2.76 inches in 1 hour on July 23rd near Buckley Air Force Base. This was the second highest QPE-Max from an ALERT gage since data collection began in 2015. The QPE-Max record is from August 30, 2016 where 2.96 inches was observed. Although 2.8 inches in 1 hour was not realized or forecast in 2018, the 2.8 inch max 1-hour QPF bias correction remains reasonable to use for future operational seasons. The worst-case scenario was realized seven times during the 2018 season when QPE was greater than 1 inch in 1 hour; however, two of these events fell within the 10% margin of error.

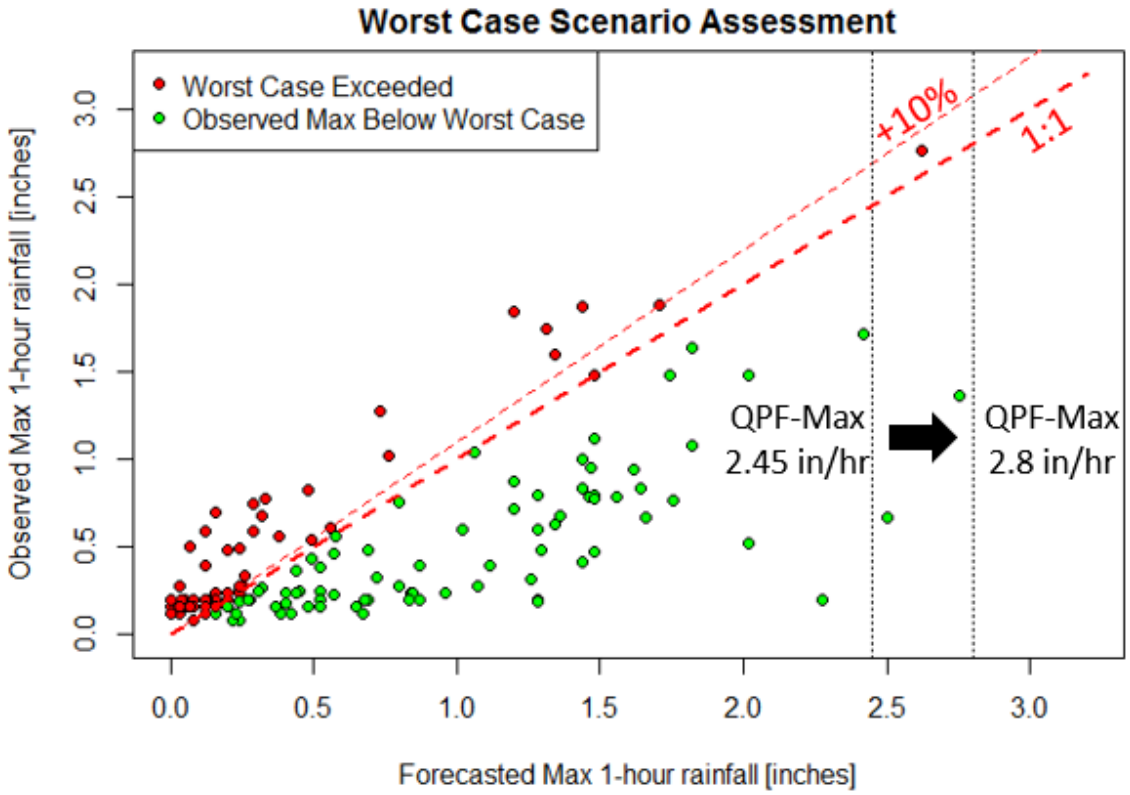


Figure 2: Comparison of bias-corrected daily 1-hour QPF-Max (i.e. "Realistic Worst-Case Scenario") and highest observed 1-hour rainfall across all Forecast Zones. Green dots show instances where QPF-Max was higher than observed, while red dots show where observed rainfall exceeded QPF-Max. The thick red dashed line shows a one-to-one relationship (while the light-dashed line shows a 10% buffer, for reference). Note that the highest allowable QPF-Max increased from 2.45 inches in 1 hour to 2.8 inches in 1 hour based on the two highest QPE values from prior seasons (see 2016 Technical Memo for further explanation).

Table 5 shows the number of days per month when moderate (0.75 inch in 1 hour) and heavy (1 inch in 1 hour) rainfall rates were observed, compared to climatology. Of the 33 days when moderate and heavy rainfall intensity were observed, 18 occurred during July and August, which is consistent with climatology. Of the 18 days with heavy rainfall intensity, 7 (39%) occurred during July, which is in line with climatology but higher than expected.

Table 5: Monthly statistics of heavy rainfall occurrence during the 2018 season.

	# of days with rainfall exceeding		Climatological daily probability of exceeding	
Month	**0.75 inch / hour**	**1 inch / hour**	**0.75 inch / hour**	**1 inch / hour**
May	5	2	5%	3%
June	5	3	7%	4%
July	11	7	20%	14%
August	6	2	13%	7%
September	5	3	4%	4%
Total	**33**	**18**	N/A	N/A

Table 6 shows the days when QPF-Max underestimated the observed rainfall in instances where QPE was over 1 inch. Of seven such days, QPF-Max was within 10% of the observed max rainfall intensity during two of the seven. On May 18th, only 5 of the 14 models were available for the morning update, which may have contributed to the underestimation of the QPF-Max. As mentioned above, QPF-Max was capped at 2.8 inches in 1 hour (the highest value allowable). Since no QPF-Max was capped this season (max 1-hour QPF - 2.75 inches) and a QPE value close to 2.8 inches in 1 hour was realized (max 1-hour QPE - 2.76 inches), 2.8 inches in 1 hour is considered a reasonable bias correction moving forward. Future implementation of data from Table 6 in the quantile mapping analysis will help better update the bias correction tables and reduce instances where 1-hour QPF-Max is underestimated.

Table 6: Summary of days when 1-hour QPF-Max underestimated rainfall intensity (only shown when QPE exceeded 1 inch in 1 hour).

Date	Max hourly observed	Hourly QPF-Max	# of Zones with > 1 in per hour
May 18	1.84 inches	1.2 inches	3
June 19	1.87	1.44	1
July 16	1.6	1.34	2
July 23	2.76	2.62	5
July 24	1.75	1.31	1
September 4	1.88	1.71	4
September 19	1.28	0.73	1

Contingency Table

The Contingency Table is a useful metric for evaluating the effectiveness of the Tool's forecasts; Table 7 summarizes the information that can be obtained from such a table. A day is categorized as a Flood Day when the Tool forecasts a non-zero threat level. In turn, a Flood Day is observed when maximum 1-hour rainfall across all the Forecast Zones exceeds 1 inch (note that this does not actually indicate that flooding occurred, but acting as a proxy for flooding).

Table 7: Flood Day Contingency Table.

		Flood Day Forecasted	
		YES	NO
Flood Day Observed	YES	HIT	MISS
	NO	FALSE ALARM	HIT

By adding up all of the total Hits and dividing by the number of total days (140), we find the "Accuracy" rate. Meanwhile, we are also interested in the quantifying the occurrence of Misses and False Alarms; these statistics are essential for guiding future refinement of the Tool. We run these calculations for each zone separately. For completeness and a reference point, we also calculate a contingency table across All Zones to answer the broader question: "if a threat was forecast anywhere in the domain, did it verify anywhere in the domain?" Such a domain-wide contingency table is likely to yield higher Accuracy numbers than each Zone since there is more leniency in the spatial dimension. However, it is still a useful metric given the imperfect nature of heavy rainfall prediction. An All Zone Contingency Table was also created using the 2017 equations to quantify the usefulness of updating the equations each season. One last Contingency Table was calculated for the HPOs to quantify the performance of the Tool (objective forecast) to a more subjective forecast.

Table 8 indicates the Tool's performance showed slight variation across the Forecast Zones, with accuracy ranging from 87.1% in Forecast Zone D (Central Metro) to 90% in Zone C (Palmer Ridge). Interestingly, the number of hits in the "no forecast, no observed" category went up for every zone from the 2017 season. This is likely due to the strong and persistent 500mb ridge pattern over the Desert Southwest during the month of July and August, which shuts down rainfall over the District. Normally, July and August are the wettest two months over the state and the axis of the ridge is located further eastward, which in turn promotes high precipitable water values and rainfall over the District. Table 5 suggests a similar conclusion as the number of 0.5 inch events during July and August went from 28 in 2017 to 17 in 2018. This atmospheric pattern is well simulated in mesoscale models, so this likely helped improve the accuracy of the Tool for the 2018 season by producing several correct negative forecasts.

As in 2017, it is encouraging to see that Tool's performance is highest when more events occur; however, no zone had more than 10 flood days, which is in contrast to 2017 where this occurred in two zones. Across all Forecast Zones (Table 8, panel f) Accuracy was about 86.4% with a 9.3% False Alarm Rate and a 36.4% Miss Rate. The Tool's Accuracy increased from 2017 (2017: 72.7%) and the False Alarm Rate largely decreased (2017: 32%). Again, note with the domain change in 2018, the comparison to the 2017 operational season is not perfectly identical. As is the trade off with decreasing the False Alarm Rate, the Miss Rate for 2018 increased from 7.1% to 36.4%. Once again, the optimal tradeoff between these two variables will be reassessed prior to the start of the 2019 season. Further conversations will continue to be held with UDFCD as minimizing the Miss Rate may be more of a priority than decreasing the False Alarm Rate. A general rule by the forecast community is that the False Alarm Rate should remain under 20% and the Miss Rate remain under 15%.

Table 8: Contingency Tables of the Tool's performance for each zone separately and for all zones together.

		Flood Day Forecasted		
	a)Zone A	**YES**	**NO**	Accuracy: 89.3 %
Flood Day Observed	**YES**	**4**	**2**	False Alarm: 9.7%
	NO	**13**	**121**	Misses: 33.3%

	b)Zone B	**YES**	**NO**	Accuracy: 89.3%
Flood Day Observed	**YES**	**5**	**0**	False Alarm: 11.1%
	NO	**15**	**120**	Misses: 0%

	c)Zone C	**YES**	**NO**	Accuracy: 90.0%
Flood Day Observed	**YES**	**8**	**4**	False Alarm: 7.8%
	NO	**10**	**118**	Misses: 33.3%

	d)Zone D	**YES**	**NO**	Accuracy: 87.1%
Flood Day Observed	**YES**	**7**	**6**	False Alarm: 9.4%
	NO	**12**	**115**	Misses: 46.2%

	e)Zone E	**YES**	**NO**	Accuracy: 87.9%
Flood Day Observed	**YES**	**3**	**6**	False Alarm: 8.4%
	NO	**12**	**120**	Misses: 66.7%

	f)All zones	**YES**	**NO**	Accuracy: 86.4%
Flood Day Observed	**YES**	**14**	**8**	False Alarm: 9.3%
	NO	**11**	**107**	Miss: 36.4%

Table 9 shows Contingency Tables for All Zones using the 2017 equations and for the HPOs delivered by Skyview each morning, for reference. As shown in the past, updating the equations at the beginning of the season improves the Accuracy of the Tool. In this case, the Tool's Accuracy increased by 3.5% and the False Alarm Rate when down 6.8%. However, the Miss Rate improved using the 2017 equations, dropping from 36.4% to 22.7%. When compared to the HPOs, the Tool had a much lower False Alarm Rate and improved Accuracy. However, the Miss Rate for the HPO was zero and on July 24th, the HPO was far superior to the Tool. During the afternoon hours, a lone thunderstorm popped up over Englewood and an ALERT gage in the area recorded 1.63 inches in 30-minutes (1.75 inches in 1 hour). The All Zones 1-hour QPF-Max was 1.31 inches for that day, but the POE for the 1 inch in 1 hour threshold was only at 14% (No Threat). There was a Moderate threat issued by the HPO, and unfortunately, the storm took the life of a young woman trapped in a flooded basement. While heavy rainfall prediction is still imperfect (although improving), it is worth looking into lowering the All-Zones Low threat threshold and possibly increasing the False Alarm Rate to capture events such as those on July 24th.

Table 9: (a) Contingency Table using 2017 equations. (b) Contingency Table for HPO.

		Flood Day Forecasted		
	All zones	**YES**	**NO**	Accuracy: 82.9%
(a)	**YES**	**17**	**5**	False Alarm: 16.1%
Flood Day Observed	**NO**	**19**	**99**	Miss: 22.7%

		Flood Day Forecasted		
	All zones	**YES**	**NO**	Accuracy: 76.4%
(b)	**YES**	**21**	**0**	False Alarm: 27.7%
Flood Day Observed	**NO**	**33**	**86**	Miss: 0%

Table 10 shows the Hit Rate (Accuracy) and False Alarm Rate as a function of the Tool threat level (for All Zones). An important feature of a good forecast system is the ability to discriminate between the lower and higher threat days. Indeed, Table 10 shows that the Hit Rate climbs from 53.3% for the Low threat to 55.6% and 100% for the Moderate and Very High threat. It should be noted that there were no High threats issued this season and only one day had a Very High threat, so it is impossible to make any conclusions about the higher-end threats. Using the High threat threshold from last year (64%), there would have been two High threat days and both would have verified for a 100% Hit Rate. This result implies it may be possible to lower the High threat threshold and maintain the 80% Hit Rate for next season, which will again be evaluated in the off season. There are two other important findings in Table 10. First, compared to 2017, the number of threats decrease as one moves to a higher threat level. It is possible that in 2017 many days had particularly threatening atmospheric ingredients that did not materialize into heavy rainfall, which is why the number of High threat days forecast (24) exceeded the number of Low threat days (13) forecast. However, it is also viable that the post-processing techniques or POE thresholds were better adjusted for 2018 season resulting in a more properly proportioned threat level system. Adding an additional 153 days of data to the 2018 analysis is a huge improvement when only 306 days were available for the 2017 analysis. It is also possible decreasing the southern and western extent of the Tool's domain helped hone in the Tool's capability for more reliable and accurate District probabilistic forecast.

Table 10: Hit and False Alarm Rate as a function of threat level across All Zones (compare with **Table 8**, panel f).

Threat Level	# Cases	Hit Rate	False Alarm
Low	15	53.3%	46.7%
Moderate	9	55.6%	44.4%
High	0	N/A	N/A
Very High	1	100%	0%
Total	25	64%	36%

CONCLUSIONS

The UDFCD Heavy Rainfall Guidance Tool concluded its fourth season of operation on September 30th, 2018. The Tool incorporates a large number of state-of-the-art high-resolution weather models to objectively estimate the chances of seeing heavy rainfall across the District. The Tool's methodology has undergone two upgrades since the inaugural 2015 season. In 2016, model bias correction and post-processing was included, which resulted in a notable drop in the False Alarm Rate but a rise in the Miss Rate. In 2017, flow dependent post-processing was included, as well as an estimate of the threat level across all Forecast Zones. While this improved the Miss Rate, the False Alarm Rate increased. For the 2018 season, the southern and western edge of the district were cutback and the remaining 5 forecast zones were adjusted to be more equal in area and fall on county lines. The updating of the post-processing equations and adjustment of threat level thresholds decreased the False Alarm Rate, while only slightly increasing the Miss Rate. Part of the increased Accuracy for 2018 was likely due to the models ability to capture the anomalously strong ridge over the Desert Southwest, which allowed for the Tool to produce several correct negative forecasts.

Compared to 2017, there was less spatial variation in heavy rainfall occurrence and the Northern and Southern Foothills had the fewest number of days with rainfall greater than 0.5 inches in 1 hour. The number of events greater than 0.5 inches decreased across All Zones from 64 to 49 days. As for threats forecast, the largest number of threats issued were over the southern half of the District with the Northern Foothills and Northern Metro only having 14 threats forecast. While all zones improved in Accuracy (> 87%), the False Alarm Rate was greatest over Zone A and B (9.7% and 11.1%, respectively). This is not surprising considering the heavy rainfall occurrence statistics; however, the False Alarm Rate decreased quite a bit from 2017 where it was 28.8% and 27.4% for Zones A and B, respectively.

The Tool continued to provide a good estimate of the *realistic* worst-case scenario of the daily heavy rainfall threat, one of the key metrics that it was designed to forecast. This was manifested by its forecasted 1-hour maximum rainfall rates (QPF-Max) being at or above those that were observed 61% of the time (63% with allowance of a 10% error margin) during situations where observed rainfall intensity exceeded 0.5 inches. This percentage was still at 47% (53% with allowance of a 10% error margin) when limiting to days when at least 1 inch in 1 hour accumulations were observed. This decreased from 67% (81% with allowance of a 10% error margin) from the 2017 season. Unfortunately, the increase in allowable QPF-Max to 2.8 inches in 1 hour did not help improve this metric. Heavy rainfall (1 inch in 1 hour or more) occurrence was seasonally distributed in a manner consistent with climatology, with 7 of 18 days occurring during July. Of the seven events where the Tool underestimated observed rainfall intensity, two of the events the forecast max intensity was within 10%. One of the remaining five events had 5 of the 14 models available for analysis, which may have caused underestimation in the QPF-Max.

Contingency tables monitoring Hits, False Alarms and Misses showed that the Hit rate (or Accuracy rate) was about 86.4%, which is up from 73% in 2017, 80% in 2016 and 69% in 2015. The most notable reason for this is the processing algorithms, changes in the threshold of the Probability of Exceedance (see Table 2) and decrease in area size of the Tool. The Miss Rate increased from 7.1% (2017) to 36.4% (2018), but the False Alarm Rate decreased to 9.3% which is down from 32% in 2017 and 15.6% in 2016. This trade-off between False Alarm Rate and Miss Rate can be expected, but optimizing this relationship is of utmost importance. Our experience suggests the need to minimize the Miss Rate as being of more importance as shown on July 24th. Given the increase in Miss Rate, it is recommended that any refinement work for 2019 operations focus on lowering the Miss Rate though it might increase the False Alarm Rate. Of course the Tool performance is highest when more events occur, and performance is expected to increase as more data is ingested into the post-processing equations (increase from 3 to 4 years).

In conclusion, the findings of this Final Report suggest the Heavy Rainfall Guidance Tool continues to show value in increasing lead time and accuracy of heavy rainfall forecasts for the District. The improved metrics during the 2018 operational season were an encouraging result, especially after losing 18 models during the off-season. Utility of the Tool continues to improve each season and updates to methodology to include the latest data are a large part of the Tool's success. Incorporating the latest science and data in the Tool should continue to a priority before each operational season.

RECOMMENDATIONS

It is recommended that post-processing methods be re-assessed before 2019 operations in order to (i) incorporate 2018 observations, (ii) investigate the sensitivity between decreasing the Miss Rate while maintaining or only slightly increasing the False Alarm Rate, and (iii) test the threat level thresholds to determine if changes are necessary to keep the Hit Rate near 75% for High threats. It is also recommended to add in the HRRR 00Z and 06Z runs into the morning update and the HRRR 12Z into the N2 and N3 updates for the full 24-hour forecast period. Prior to 2018, work had begun to do an evening update (N4) in hopes to capture the end of the diurnal convection cycle during the monsoon season. This update would also alert the end-user if the heavy rainfall threat continued overnight, which sometimes occurs with post-frontal upslope flow. It is suggested that this update be completed before the start of next operational season. It may also be beneficial to incorporate the Texas Tech high-resolution WRF modeling system, which is run every 6 hours and would provide 2 additional models to the morning update. Lastly, with four seasons of data, it may also be possible to begin to look at incorporating seasonality, atmospheric flow and topography into the bias corrections.

REFERENCES

Dewberry, 2016: UDFCD Heavy Rainfall Guidance Tool – Upgrades for 2016 Operational Season. Submitted to the Urban Drainage and Flood Control District on May 27, 2016, revised on July 26, 2016.

Perica et al., 2013: Precipitation-Frequency Atlas of the United States, Volume 8. National Oceanic and Atmospheric Administration, United States Department of Commerce, Silver Spring, MD.

APPENDIX A – DISTRICT-WIDE FORECASTS AND OBSERVATIONS

The table below show daily summary of observations and forecasts for all zones. See Appendix B for zone-specific information. Column names are described below:

Column	Units	Description
A	N/A	Date
B	Inches	Max 24-hour from CoCoRaHS gages.
C	#	Number of CoCoRaHS gages exceeding 1 inch.
D	#	Number of CoCoRaHS gages with measurable precipitation.
E	Inches	ALERT max 30 minute precipitation.
F	Inches	ALERT max 1-hour precipitation.
G	Inches	ALERT max 2-hour precipitation.
H	Inches	ALERT second highest 1-hour precipitation.
I	Inches	ALERT max 24-hour precipitation.
J	#	Number of ALERT gages exceeding 1 inch in 1 hour.
K	Inches	NOAA Stage IV max 1-hour precipitation.
L	Inches	NOAA Stage IV max 2-hour precipitation.
M	Inches	NOAA Stage IV max 24-hour precipitation. Note that this can be lower than column (L) because more gages are used during the 24-hour gage adjustment.
N	Yes/No	First guess at whether or not a Flood Day (QPE exceeding 1 inch in 1 hour) is observed.
O	Yes/No	Reassessment of (N) after manual quality control.
NZones	#	Number of zones where a Flood Day was observed.
P	Threat, %	Tool threat level (color), and probability of exceeding 1 inch in 1 hour.

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification			Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Nzones	P
5/14	2.7	4	237	0.76	0.88	1.04	0.88	2.12	0	1	1.81	1.39	YES	YES	1	37
5/15	0.7	0	60	0.56	0.6	0.6	0.28	0.6	0	0.63	1.14	0.69	YES			41
5/16	0.01	0	1	0.12	0.16	0.16	0.04	0.16	0	0.4	0.76	0				2
5/17	0.06	0	11	0.12	0.12	0.12	0.08	0.12	0	0.26	0.41	0.26				3
5/18	2.77	24	252	1.6	1.84	2.2	1.72	2.4	6	1.37	2.53	2.21	YES	YES	3	35
5/19	0.99	0	255	0.16	0.2	0.32	0.16	0.8	0	0.33	1.18	0.64	YES			4
5/20	0.6	0	230	0.4	0.4	0.44	0.32	0.44	0	0.39	0.72	0.51				25
5/21	0.1	0	31	0.12	0.12	0.12	0.08	0.12	0	0.25	0.49	0.24				9
5/22	0.86	0	187	0.36	0.48	0.52	0.32	0.52	0	0.76	1.47	0.85	YES			20
5/23	0.8	0	67	0.16	0.16	0.16	0.16	0.16	0	0.44	0.84	0.4				6
5/24	0.06	0	9	0.28	0.28	0.28	0.2	0.28	0	0.06	0.11	0.06				3
5/25	0	0	0	0.12	0.12	0.12	0.12	0.2	0	0.02	0.04	0				1
5/26	0	0	0	0.12	0.16	0.16	0.12	0.2	0	0	0	0				2
5/27	0.21	0	65	0.08	0.08	0.08	0.08	0.16	0	0.49	0.61	0.49				8
5/28	1.5	1	279	0.8	0.8	0.8	0.76	0.8	0	0.52	0.98	1.18				57
5/29	0.26	0	16	0.16	0.2	0.2	0.16	0.32	0	0.09	1.01	0.09	YES			4
5/30	1.06	1	160	0.88	0.88	0.92	0.6	0.96	0	0.56	1.05	1.08	YES	YES	1	46
5/31	0.04	0	3	0.35	0.35	0.35	0.2	0.28	0	0.7	1.32	0	YES			3
6/1	0.01	0	1	0.2	0.2	0.2	0.08	0.2	0	0	0	0				2
6/2	0	0	0	0.16	0.2	0.2	0.16	0.2	0	0	0	0				1
6/3	0.02	0	3	0.12	0.12	0.12	0.12	0.12	0	0.09	0.19	0.25				14
6/4	0.03	0	1	0.12	0.12	0.12	0.12	0.12	0	0.08	0.19	0.01				1
6/5	0.02	0	2	0.08	0.08	0.12	0.08	0.2	0	0.08	0.13	0.08				2
6/6	0.22	0	129	0.16	0.2	0.2	0.12	0.2	0	0.11	0.17	0.52				15
6/7	0.01	0	3	0.75	0.75	0.75	0.08	0.2	0	0.49	1.35	0.05	YES			2
6/8	0	0	0	0.2	0.2	0.2	0.12	0.36	0	0	0	0				1
6/9	0.01	0	1	0.16	0.2	0.2	0.12	0.2	0	0	0.39	0.02				2
6/10	0	0	0	0.12	0.16	0.16	0.12	0.24	0	0	0	0				1
6/11	0	0	0	0.12	0.16	0.16	0.12	0.28	0	0	0	0				2
6/12	0.1	0	4	0.16	0.24	0.24	0.16	0.24	0	0.01	0.02	0.28				8
6/13	0.06	0	13	0.16	0.16	0.16	0.12	0.16	0	0.27	0.53	0.3				4
6/14	0.05	0	21	0.16	0.24	0.24	0.12	0.24	0	0.14	0.27	0.12				2
6/15	0.25	0	87	0.24	0.24	0.28	0.16	0.4	0	0.21	0.37	0.38				7
6/16	0.85	0	131	0.6	0.6	0.64	0.44	0.64	0	0.36	0.65	0.52				53
6/17	2.51	27	287	0.8	0.84	1.12	0.84	1.52	0	0.72	1.25	2.1	YES	YES	2	59
6/18	4.84	19	240	1	1	1.08	0.8	1.56	0	1.04	2.03	6.51	YES	YES	2	36
6/19	1.71	3	234	1.04	1.2	1.28	0.76	1.28	1	1.87	3.6	1.38	YES	YES	1	35
6/20	0.02	0	8	0.12	0.12	0.12	0.08	0.12	0	0.68	1.33	0.05	YES			2
6/21	0.18	0	40	0.2	0.2	0.24	0.16	0.2	0	0.07	0.13	0.24				4
6/22	0.08	0	46	0.24	0.24	0.24	0.2	0.24	0	0.24	0.44	0.39				1

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification			Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Nzones	P
6/23	0.23	0	61	0.12	0.16	0.16	0.12	0.2	0	0.25	0.43	0.48				3
6/24	1.45	2	263	1.12	1.12	1.12	0.76	1.12	1	0.58	1.17	0.64	YES	YES	2	13
6/25	0	0	0	0.16	0.16	0.16	0.16	0.32	0	0.05	0.17	0				1
6/26	0	0	0	0.12	0.2	0.2	0.08	0.2	0	0	0	0				1
6/27	0.05	0	8	0.24	0.24	0.24	0.2	0.24	0	0.04	0.07	0.23				7
6/28	0	0	0	0.24	0.24	0.24	0.12	0.24	0	0.23	0.36	0				2
6/29	0.03	0	1	0.16	0.2	0.2	0.12	0.32	0	0.01	0.03	0.01				3
6/30	0.22	0	105	0.24	0.28	0.28	0.16	0.28	0	0.17	0.34	0.26				19
7/1	0.06	0	4	0.12	0.16	0.16	0.12	0.28	0	0.19	0.44	0				6
7/2	0.35	0	58	0.56	0.56	0.56	0.56	0.56	0	0	0.01	0.45				3
7/3	0.04	0	6	0.24	0.24	0.24	0.16	0.24	0	0.34	0.63	0.05				2
7/4	0.51	0	96	0.36	0.36	0.36	0.36	0.44	0	0.47	0.92	0.65				25
7/5	0.95	0	169	1.28	1.72	1.72	1.32	1.92	4	1.1	2.15	3.09	YES	YES	2	74
7/6	0.04	0	3	0.16	0.2	0.2	0.16	0.28	0	0.48	0.76	0.36				19
7/7	0.75	0	72	0.36	0.4	0.44	0.32	0.44	0	0.36	0.61	0.46				10
7/8	0.86	0	60	0.75	0.75	0.75	0.67	0.75	0	0.33	0.63	0.54				7
7/9	0	0	0	0.59	0.59	0.59	0.39	0.59	0	0.43	0.8	0.02				2
7/10	0	0	0	0.12	0.16	0.16	0.12	0.16	0	0.01	0.01	0.01				4
7/11	0.01	0	1	0.16	0.24	0.24	0.12	0.64	0	0.11	0.2	0.11				3
7/12	2.24	2	90	0.84	0.84	0.84	0.6	0.88	0	0.75	1.44	1.77	YES			19
7/13	0.1	0	8	0.2	0.32	0.32	0.16	0.32	0	0.17	0.49	0.18				12
7/14	1.11	1	3	0.24	0.24	0.24	0.2	0.36	0	0.21	0.32	0.38				4
7/15	2.53	13	292	0.96	1.36	1.56	1.2	2.08	5	1.01	1.5	1.27	YES	YES	2	82
7/16	1.38	1	53	1.28	1.6	1.6	0.72	1.6	1	1.05	1.89	1.2	YES	YES	2	11
7/17	1.98	11	94	1.28	1.48	1.52	1.28	1.52	3	1.03	2.01	1.45	YES	YES	1	41
7/18	0	0	0	0.16	0.2	0.2	0.16	0.4	0	0.5	0.97	0				1
7/19	0	0	0	0.16	0.16	0.16	0.12	0.16	0	0	0	0				1
7/20	0.19	0	1	0.16	0.2	0.2	0.12	0.24	0	0.05	0.12	0.12				2
7/21	0.24	0	76	0.6	0.6	0.6	0.52	0.6	0	0.72	1.35	0.82	YES			23
7/22	0.98	0	282	0.56	0.56	0.6	0.52	0.68	0	0.79	1.48	0.97	YES			31
7/23	2.16	58	297	1.92	2.76	2.76	2.36	2.92	26	1.5	2.86	1.92	YES	YES	5	93
7/24	1.96	16	153	1.63	1.75	1.75	1.49	2.17	5	0.73	1.45	1.17	YES	YES	1	14
7/25	1.56	14	305	1.44	1.48	1.8	1.28	2	3	1.01	1.99	1.31	YES	YES	3	19
7/26	1.1	1	159	0.76	0.8	0.8	0.32	0.8	0	0.94	1.74	0.85	YES	YES	1	29
7/27	1.31	1	181	0.72	0.72	0.72	0.52	1.08	0	0.95	1.55	1.01	YES	YES	1	12
7/28	0.52	0	166	0.2	0.24	0.24	0.2	0.28	0	0.42	0.78	0.61				19
7/29	0.44	0	62	0.16	0.2	0.24	0.12	0.48	0	0.09	1.05	0.47	YES			24
7/30	0	0	0	0.16	0.24	0.24	0.12	0.44	0	0.46	0.85	0				3
7/31	0	0	0	0.16	0.16	0.16	0.16	0.32	0	0	0	0				1
8/1	0.08	0	1	0.16	0.2	0.24	0.16	0.44	0	0.04	0.07	0.04				8

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification			Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Nzones	P
8/2	0.31	0	8	0.4	0.48	0.48	0.16	0.52	0	0.02	0.04	0.71				5
8/3	0.63	0	250	0.44	0.44	0.52	0.4	0.52	0	0.6	1.2	0.5	YES			12
8/4	0.62	0	103	0.12	0.12	0.12	0.08	0.2	0	0.23	0.45	0.31				7
8/5	0.7	0	155	0.48	0.52	0.52	0.48	0.6	0	0.56	1.09	0.9	YES			10
8/6	0.46	0	102	0.6	0.6	0.6	0.44	0.64	0	0.67	1.3	0.68	YES			33
8/7	1.5	1	40	0.72	0.76	0.76	0.32	0.76	0	0.77	1.51	0.91	YES	YES	1	37
8/8	0.05	0	8	0.16	0.16	0.16	0.08	0.24	0	0.68	1.36	0.18	YES			15
8/9	0	0	0	0.16	0.16	0.16	0.08	0.28	0	0.01	0.01	0.03				5
8/10	0	0	0	0.83	0.83	0.83	0.08	0.83	0	0.04	0.36	0.07				3
8/11	0	0	0	0.08	0.08	0.08	0.08	0.08	0	0.01	0.02	0.01				1
8/12	0	0	0	0.2	0.24	0.24	0.2	0.4	0	0.09	0.13	0.09				2
8/13	0.05	0	1	0.08	0.08	0.08	0.08	0.08	0	0.06	0.1	0.14				1
8/14	1.91	11	292	1.48	1.48	1.48	1.4	1.48	6	0.95	1.82	1.69	YES	YES	4	38
8/15	0.1	0	3	0.12	0.16	0.16	0.12	0.32	0	0.78	1.43	0.15	YES			2
8/16	0.06	0	6	0.16	0.2	0.24	0.16	0.32	0	0.1	0.2	0.09				5
8/17	1	0	44	0.6	0.6	0.6	0.4	0.6	0	0.67	1.24	0.89	YES			58
8/18	1.64	15	285	1.08	1.08	1.08	0.92	1.08	1	0.45	0.89	1.14	YES	YES	1	23
8/19	0.4	0	69	0.12	0.12	0.12	0.08	0.12	0	0.61	1.21	0.18	YES			1
8/20	0.09	0	39	0.28	0.28	0.28	0.16	0.28	0	0.03	0.08	0.13				2
8/21	0.71	0	232	0.56	0.64	1.08	0.48	1.28	0	0.79	1.51	1.21	YES			33
8/22	1.02	1	72	0.52	0.52	0.52	0.52	0.52	0	0.29	0.56	0.61				38
8/23	0.1	0	2	0.16	0.16	0.16	0.08	0.16	0	0.59	1.11	0.1	YES			1
8/24	0.07	0	15	0.12	0.12	0.16	0.04	0.2	0	0.06	0.15	0.05				1
8/25	0.24	0	28	0.12	0.12	0.2	0.08	0.2	0	0.37	0.65	0.45				3
8/26	0.25	0	60	0.16	0.16	0.2	0.08	0.2	0	0.25	0.59	0.33				3
8/27	0.02	0	1	0.12	0.12	0.12	0.08	0.16	0	0.19	0.37	0.02				2
8/28	0.01	0	1	0.16	0.16	0.24	0.16	0.32	0	0.02	0.04	0.02				2
8/29	0.01	0	1	0.16	0.2	0.24	0.08	0.4	0	0.02	0.03	0.01				1
8/30	0	0	0	0.16	0.2	0.2	0.16	0.32	0	0	0	0.01				1
8/31	0.29	0	96	0.39	0.39	0.39	0.16	0.28	0	0.28	0.54	0.46				3
9/1	0.34	0	36	0.76	0.8	0.88	0.28	0.92	0	0.57	1.05	0.96	YES			14
9/2	0.04	0	2	0.16	0.16	0.16	0.16	0.28	0	0.07	0.13	0.17				2
9/3	0.46	0	21	0.16	0.28	0.32	0.16	0.32	0	0.2	0.77	0.41				7
9/4	2.14	22	280	1.52	1.88	1.88	1.4	2.12	10	0.26	0.61	1.91	YES	YES	4	22
9/5	2.25	16	223	1.52	1.64	1.76	1.48	1.92	3	1.31	2.61	2.26	YES	YES	4	32
9/6	0.63	0	162	0.44	0.48	0.52	0.24	0.52	0	0.78	1.47	1.14	YES			37
9/7	0.04	0	12	0.16	0.16	0.16	0.12	0.28	0	0.54	1.05	0.21	YES			2
9/8	0.25	0	63	0.2	0.2	0.2	0.16	0.36	0	0.04	0.12	0.19				2
9/9	0.09	0	14	0.16	0.16	0.16	0.16	0.28	0	0.18	0.35	0.21				2
9/10	0.1	0	4	0.16	0.16	0.16	0.12	0.16	0	0.16	0.27	0.16				1

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification			Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Nzones	P
9/11	0.06	0	19	0.2	0.2	0.2	0.16	0.32	0	0.17	0.33	0.21				2
9/12	0	0	0	0.2	0.2	0.2	0.12	0.28	0	0.02	0.03	0				1
9/13	0	0	0	0.12	0.12	0.12	0.12	0.12	0	0	0	0				1
9/14	0	0	0	0.2	0.2	0.2	0.16	0.32	0	0	0	0				1
9/15	0	0	0	0.28	0.28	0.28	0.28	0.32	0	0.02	0.07	0				2
9/16	0.01	0	1	0.16	0.16	0.16	0.16	0.32	0	0.03	0.05	0.08				1
9/17	0.03	0	2	0.2	0.2	0.2	0.16	0.28	0	0.06	0.11	0.11				1
9/18	0	0	0	0.12	0.2	0.2	0.12	0.2	0	0.03	0.05	0				1
9/19	1.44	7	266	1.28	1.28	1.28	1.12	1.28	2	0.55	0.98	0.73	YES	YES	1	9
9/20	0.03	0	3	0.28	0.28	0.28	0.16	0.28	0	0.48	0.94	0.05				1
9/21	0	0	0	0.16	0.16	0.16	0.08	0.16	0	0	0	0				2
9/22	0	0	0	0.16	0.16	0.16	0.08	0.28	0	0	0	0				1
9/23	0.04	0	4	0.12	0.12	0.12	0.12	0.24	0	0	0	0.03				2
9/24	0.1	0	60	0.12	0.12	0.12	0.08	0.2	0	0.11	0.18	0.23				4
9/25	0.01	0	2	0.16	0.16	0.16	0.16	0.28	0	0.03	0.06	0				1
9/26	0	0	0	0.16	0.16	0.16	0.12	0.24	0	0	0	0				1
9/27	0	0	0	0.16	0.2	0.2	0.12	0.24	0	0	0	0				1
9/28	0.02	0	4	0.16	0.16	0.16	0.16	0.32	0	0	0	0				2
9/29	0.03	0	7	0.16	0.16	0.16	0.16	0.2	0	0	0	0				1
9/30	0.02	0	20	0.12	0.12	0.12	0	0.12	0	0	0	0.01				3

APPENDIX B – ZONE SPECIFIC FORECASTS AND OBSERVATIONS

The tables below show daily summaries of observations and forecasts for each of the five forecast zones (i.e. analogous to Appendix A, but for each forecast zone separately). Column names are described below:

Column	Units	Description
A	N/A	Date
B	Inches	Max 24-hour from CoCoRaHS gages.
C	#	Number of CoCoRaHS gages exceeding 1 inch.
D	#	Number of CoCoRaHS gages with measurable precipitation.
E	Inches	ALERT max 30 minute precipitation.
F	Inches	ALERT max 1-hour precipitation.
G	Inches	ALERT max 2-hour precipitation.
H	Inches	ALERT second highest 1 hour precipitation.
I	Inches	ALERT max 24-hour precipitation.
J	#	Number of ALERT gages exceeding 1 inch in 1 hour.
K	Inches	NOAA Stage IV max 1-hour precipitation.
L	Inches	NOAA Stage IV max 2-hour precipitation.
M	Inches	NOAA Stage IV max 24-hour precipitation. Note that this can be lower than column (L) because more gages are used during the gage adjustment of radar estimates.
N	Yes/No	First guess at whether or not a Flood Day (QPE exceeding 1 inch in 1 hour) is observed.
O	Yes/No	Reassessment of (N) after manual quality control.
P	Threat, %	Tool threat level (color), and probability of exceeding 1 inch in 1 hour.

a) Forecast Zone A: North Foothills

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
5/14	0.11	0	25	0.16	0.24	0.24	0.16	0.24	0	0.51	0.92	0.47			7
5/15	0.06	0	9	0.04	0.04	0.04	0.04	0.04	0	0.37	0.8	0.33			15
5/16	0	0	0	0	0	0	0	0	0	0	0	0			1
5/17	0	0	0	0	0	0	0	0	0	0	0	0			1
5/18	0.72	0	26	1.32	1.4	1.44	0.44	1.52	1	0.47	0.74	0.75	YES	YES	5
5/19	0.99	0	25	0.16	0.2	0.32	0.16	0.8	0	0.23	0.45	0.64			1
5/20	0.43	0	21	0.28	0.36	0.36	0.2	0.44	0	0.17	0.4	0.41			6
5/21	0	0	0	0	0	0	0	0	0	0.07	0.13	0.06			2
5/22	0.67	0	21	0.32	0.48	0.52	0.32	0.52	0	0.42	0.69	0.75			6
5/23	0.8	0	14	0.12	0.12	0.12	0.12	0.12	0	0.44	0.84	0.22			1
5/24	0.03	0	3	0.16	0.16	0.16	0	0.24	0	0	0	0.02			0
5/25	0	0	0	0.12	0.12	0.12	0.12	0.04	0	0.02	0.02	0			0
5/26	0	0	0	0	0	0	0	0	0	0	0	0			1
5/27	0.01	0	1	0	0	0	0	0	0	0.01	0.02	0.02			3
5/28	0.22	0	26	0.16	0.2	0.24	0.2	0.24	0	0.29	0.43	0.37			11
5/29	0.01	0	3	0.04	0.04	0.04	0	0.04	0	0.05	0.16	0.09			1
5/30	0.46	0	13	0.88	0.88	0.88	0.6	0.88	0	0.35	0.53	0.4			9
5/31	0.04	0	2	0.35	0.35	0.35	0.16	0.16	0	0.01	0.02	0			1
6/1	0	0	0	0.12	0.12	0.12	0	0.12	0	0	0	0			1
6/2	0	0	0	0	0	0	0	0	0	0	0	0			0
6/3	0.02	0	2	0	0	0	0	0	0	0.06	0.09	0.23			9
6/4	0	0	0	0	0	0	0	0	0	0.08	0.19	0.01			0
6/5	0.02	0	1	0.04	0.04	0.04	0	0.04	0	0.08	0.13	0.08			3
6/6	0.06	0	4	0.12	0.12	0.12	0	0.12	0	0.01	0.03	0.21			5
6/7	0	0	0	0.08	0.08	0.08	0	0.08	0	0.17	0.33	0			2
6/8	0	0	0	0	0	0	0	0	0	0	0	0			1
6/9	0	0	0	0	0	0	0	0	0	0	0	0			1
6/10	0	0	0	0	0	0	0	0	0	0	0	0			1
6/11	0	0	0	0	0	0	0	0	0	0	0	0			0
6/12	0	0	0	0	0	0	0	0	0	0	0	0			0
6/13	0.01	0	1	0	0	0	0	0	0	0	0	0.07			1
6/14	0	0	0	0	0	0	0	0	0	0.07	0.13	0.04			1
6/15	0.24	0	16	0.24	0.24	0.28	0.16	0.32	0	0.21	0.37	0.38			2
6/16	0.19	0	27	0.24	0.24	0.36	0.2	0.4	0	0.23	0.32	0.46			32
6/17	1.42	8	30	0.24	0.28	0.4	0.28	1.2	0	0.27	0.47	1.66			31

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
6/18	1.24	2	29	1	1	1.08	0.8	1.2	0	1.03	1.73	1.47	YES	YES	5
6/19	0.42	0	20	0.48	0.48	0.48	0.4	0.48	0	0.8	1.33	0.64	YES		2
6/20	0.02	0	3	0.04	0.04	0.04	0.01	0.04	0	0.03	0.03	0			0
6/21	0.05	0	8	0.08	0.08	0.08	0.04	0.08	0	0.05	0.09	0.05			0
6/22	0.08	0	13	0.04	0.04	0.04	0.04	0.04	0	0.23	0.44	0.39			0
6/23	0.11	0	18	0.12	0.12	0.12	0.08	0.12	0	0.05	0.12	0.12			0
6/24	0.58	0	25	0.36	0.44	0.48	0.44	0.48	0	0.58	1.08	0.61	YES		1
6/25	0	0	0	0	0	0	0	0	0	0.05	0.11	0			0
6/26	0	0	0	0.12	0.12	0.12	0	0.12	0	0	0	0			0
6/27	0.05	0	3	0	0	0	0	0	0	0.04	0.07	0.15			2
6/28	0	0	0	0	0	0	0	0	0	0.12	0.23	0			1
6/29	0	0	0	0	0	0	0	0	0	0	0	0			1
6/30	0.07	0	14	0.24	0.28	0.28	0.12	0.28	0	0.12	0.22	0.2			0
7/1	0	0	0	0.01	0.01	0.01	0	0.01	0	0	0	0			0
7/2	0	0	0	0	0	0	0	0	0	0	0	0			0
7/3	0.04	0	5	0.08	0.08	0.08	0	0.08	0	0.04	0.08	0.05			1
7/4	0.13	0	7	0.2	0.2	0.2	0.12	0.2	0	0.03	0.05	0.65			25
7/5	0.03	0	4	0.2	0.2	0.2	0.12	0.2	0	0.56	0.91	0.34			72
7/6	0.02	0	2	0	0	0	0	0	0	0.18	0.26	0.28			9
7/7	0.07	0	11	0.28	0.32	0.32	0.04	0.32	0	0.32	0.61	0.34			4
7/8	0.55	0	8	0.12	0.12	0.12	0.04	0.12	0	0.33	0.63	0.54			2
7/9	0	0	0	0	0	0	0	0	0	0.23	0.45	0.02			1
7/10	0	0	0	0	0	0	0	0	0	0	0	0			4
7/11	0	0	0	0.08	0.08	0.08	0	0.08	0	0	0.01	0			1
7/12	2.24	2	29	0.32	0.4	0.44	0.36	0.52	0	0.75	1.44	1.77	YES		7
7/13	0.1	0	5	0.12	0.12	0.12	0.12	0.12	0	0.13	0.25	0.18			4
7/14	0	0	0	0	0	0	0	0	0	0	0	0.05			2
7/15	0.57	0	30	0.48	0.56	0.68	0.48	0.76	0	0.26	0.48	0.48			35
7/16	0.05	0	18	0.12	0.12	0.12	0.12	0.16	0	0.18	0.35	0.26			9
7/17	0.2	0	16	0.12	0.12	0.12	0.12	0.12	0	0.33	0.63	0.56			7
7/18	0	0	0	0	0	0	0	0	0	0.01	0.02	0			0
7/19	0	0	0	0.16	0.16	0.16	0.08	0.16	0	0	0	0			0
7/20	0.19	0	1	0	0	0	0	0	0	0	0	0			0
7/21	0.18	0	22	0.32	0.32	0.32	0.16	0.32	0	0.54	1.02	0.58	YES		6
7/22	0.73	0	28	0.52	0.52	0.6	0.52	0.68	0	0.67	1.29	0.97	YES		4
7/23	1.24	2	30	0.6	0.6	0.64	0.6	1.12	0	0.55	1.08	0.99	YES	YES	43
7/24	0.19	0	19	0.16	0.16	0.16	0.12	0.2	0	0.51	1	0.35	YES		2

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
7/25	0.57	0	32	0.52	0.6	0.6	0.44	0.96	0	0.77	1.44	1.31	YES		3
7/26	0.1	0	23	0.12	0.12	0.12	0.08	0.12	0	0.37	0.78	0.26			1
7/27	0.17	0	21	0.2	0.2	0.2	0.12	0.2	0	0.38	0.72	0.38			1
7/28	0.3	0	13	0.12	0.12	0.12	0.08	0.12	0	0.21	0.36	0.36			1
7/29	0.03	0	5	0.04	0.04	0.04	0.04	0.04	0	0.02	0.06	0.05			1
7/30	0	0	0	0	0	0	0	0	0	0	0	0			0
7/31	0	0	0	0	0	0	0	0	0	0	0	0			0
8/1	0	0	0	0.08	0.08	0.08	0.08	0.08	0	0.02	0.05	0.03			0
8/2	0.02	0	2	0	0	0	0	0	0	0.01	0.01	0.04			1
8/3	0.21	0	29	0.12	0.16	0.16	0.12	0.2	0	0.09	0.17	0.48			2
8/4	0.05	0	18	0.04	0.04	0.04	0	0.04	0	0.23	0.45	0.17			2
8/5	0.13	0	23	0.04	0.04	0.04	0.04	0.04	0	0.38	0.71	0.46			1
8/6	0.01	0	2	0	0	0	0	0	0	0.14	0.24	0.17			1
8/7	0.06	0	2	0	0	0	0	0	0	0.35	0.48	0.51			1
8/8	0.01	0	1	0.04	0.04	0.04	0.04	0.04	0	0.12	0.18	0.12			5
8/9	0	0	0	0	0	0	0	0	0	0	0	0			1
8/10	0	0	0	0	0	0	0	0	0	0	0.01	0			1
8/11	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01			1
8/12	0	0	0	0	0	0	0	0	0	0	0	0			1
8/13	0	0	0	0.08	0.08	0.08	0.08	0.08	0	0.03	0.06	0.07			0
8/14	1.91	1	31	0.52	0.52	0.64	0.44	0.68	0	0.72	1.36	1.24	YES	YES	13
8/15	0	0	0	0.12	0.12	0.12	0.08	0.12	0	0.16	0.26	0			0
8/16	0.01	0	1	0.04	0.04	0.04	0	0.04	0	0.04	0.07	0.09			1
8/17	0.02	0	4	0	0	0	0	0	0	0.16	0.31	0.17			16
8/18	1.13	1	31	0.84	0.84	0.84	0.36	0.84	0	0.09	0.18	0.55			1
8/19	0.06	0	15	0.12	0.12	0.12	0.08	0.12	0	0.32	0.48	0.06			0
8/20	0.09	0	19	0.04	0.04	0.04	0.04	0.04	0	0.03	0.08	0.13			0
8/21	0.21	0	28	0.12	0.12	0.12	0.12	0.16	0	0.22	0.38	0.54			2
8/22	0.07	0	9	0.04	0.04	0.04	0	0.04	0	0.11	0.25	0.11			3
8/23	0.1	0	1	0	0	0	0	0	0	0.09	0.14	0.1			0
8/24	0.04	0	5	0	0	0	0	0	0	0.06	0.15	0.05			0
8/25	0.1	0	2	0	0	0	0	0	0	0.06	0.1	0.06			1
8/26	0.25	0	16	0.16	0.16	0.2	0.04	0.2	0	0.1	0.16	0.29			1
8/27	0	0	0	0	0	0	0	0	0	0.19	0.37	0.02			0
8/28	0.01	0	1	0	0	0	0	0	0	0.02	0.04	0.02			0
8/29	0	0	0	0.01	0.01	0.01	0	0.01	0	0.02	0.03	0			0
8/30	0	0	0	0	0	0	0	0	0	0	0	0			0

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
8/31	0.03	0	8	0.08	0.08	0.08	0.08	0.08	0	0.21	0.42	0.22			1
9/1	0.34	0	17	0.04	0.08	0.08	0.04	0.08	0	0.17	0.32	0.2			5
9/2	0	0	0	0	0	0	0	0	0	0.03	0.07	0			1
9/3	0.02	0	3	0	0	0	0	0	0	0.07	0.14	0.1			1
9/4	1.91	2	27	1	1.32	1.48	1.24	2.12	3	0.26	0.61	1.91	YES	YES	17
9/5	0.75	0	20	0.28	0.32	0.44	0.28	0.52	0	1.12	1.42	0.83	YES	YES	18
9/6	0.57	0	27	0.44	0.48	0.52	0.24	0.52	0	0.53	1.02	0.55	YES		15
9/7	0.04	0	3	0.04	0.04	0.04	0.04	0.04	0	0.12	0.23	0.21			1
9/8	0.04	0	4	0.04	0.04	0.04	0.04	0.04	0	0.04	0.12	0.19			0
9/9	0.02	0	3	0.08	0.08	0.08	0.04	0.08	0	0.12	0.2	0.12			0
9/10	0	0	0	0	0	0	0	0	0	0	0.02	0			0
9/11	0.06	0	4	0	0	0	0	0	0	0.17	0.33	0.21			1
9/12	0	0	0	0.04	0.04	0.04	0	0.04	0	0.02	0.03	0			0
9/13	0	0	0	0	0	0	0	0	0	0	0	0			0
9/14	0	0	0	0	0	0	0	0	0	0	0	0			0
9/15	0	0	0	0	0	0	0	0	0	0.02	0.07	0			1
9/16	0.01	0	1	0	0	0	0	0	0	0.03	0.05	0.08			0
9/17	0.03	0	2	0	0	0	0	0	0	0.06	0.11	0.11			0
9/18	0	0	0	0	0	0	0	0	0	0.03	0.05	0			0
9/19	0.23	0	26	0.08	0.12	0.12	0.08	0.16	0	0.21	0.37	0.29			2
9/20	0.03	0	1	0.04	0.04	0.04	0.04	0.04	0	0.06	0.13	0.03			0
9/21	0	0	0	0	0	0	0	0	0	0	0	0			0
9/22	0	0	0	0	0	0	0	0	0	0	0	0			0
9/23	0.02	0	3	0	0	0	0	0	0	0	0	0.03			1
9/24	0.07	0	18	0.08	0.12	0.12	0	0.2	0	0.1	0.18	0.23			0
9/25	0.01	0	2	0	0	0	0	0	0	0.03	0.06	0			0
9/26	0	0	0	0	0	0	0	0	0	0	0	0			0
9/27	0	0	0	0	0	0	0	0	0	0	0	0			0
9/28	0.02	0	1	0	0	0	0	0	0	0	0	0			0
9/29	0	0	0	0.01	0.01	0.01	0	0.01	0	0	0	0			0
9/30	0	0	0	0	0	0	0	0	0	0	0	0.01			0

b) Forecast Zone B: South Foothills

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
5/14	0.76	0	24	0.32	0.36	0.44	0.32	0.52	0	0.68	1.04	1.15	YES		7
5/15	0.42	0	11	0.04	0.04	0.04	0.04	0.08	0	0.25	0.47	0.41			14
5/16	0.01	0	1	0.04	0.04	0.04	0	0.04	0	0.4	0.76	0			1
5/17	0	0	0	0	0	0	0	0	0	0	0	0			1
5/18	0.39	0	21	0.08	0.12	0.12	0.08	0.12	0	0.24	0.46	0.33			5
5/19	0.57	0	20	0.08	0.12	0.16	0.12	0.32	0	0.22	0.39	0.39			1
5/20	0.6	0	21	0.4	0.4	0.44	0.32	0.44	0	0.39	0.72	0.51			15
5/21	0.02	0	9	0.04	0.04	0.04	0	0.04	0	0.25	0.49	0.12			3
5/22	0.04	0	6	0.08	0.08	0.08	0.04	0.08	0	0.04	0.08	0.07			4
5/23	0.05	0	4	0.04	0.04	0.04	0	0.04	0	0.05	0.09	0.08			1
5/24	0	0	0	0	0	0	0	0	0	0	0	0.02			1
5/25	0	0	0	0	0	0	0	0	0	0.02	0.03	0			0
5/26	0	0	0	0	0	0	0	0	0	0	0	0			1
5/27	0	0	0	0	0	0	0	0	0	0	0	0			2
5/28	0.96	0	22	0.44	0.52	0.6	0.48	0.64	0	0.49	0.96	1.18			15
5/29	0.01	0	2	0.04	0.04	0.04	0.04	0.04	0	0.09	0.17	0.06			1
5/30	0.12	0	17	0.08	0.08	0.08	0.04	0.08	0	0.18	0.36	0.29			15
5/31	0	0	0	0	0	0	0	0	0	0	0.01	0			1
6/1	0	0	0	0	0	0	0	0	0	0	0	0			0
6/2	0	0	0	0	0	0	0	0	0	0	0	0			0
6/3	0	0	0	0	0	0	0	0	0	0.09	0.19	0.25			6
6/4	0	0	0	0	0	0	0	0	0	0.06	0.15	0.01			1
6/5	0	0	0	0	0	0	0	0	0	0.02	0.03	0.02			2
6/6	0.19	0	21	0.16	0.2	0.2	0.08	0.2	0	0.02	0.04	0.52			6
6/7	0	0	0	0	0	0	0	0	0	0.49	0.88	0.01			2
6/8	0	0	0	0	0	0	0	0	0	0	0	0			1
6/9	0	0	0	0	0	0	0	0	0	0	0	0.02			1
6/10	0	0	0	0	0	0	0	0	0	0	0	0			1
6/11	0	0	0	0	0	0	0	0	0	0	0	0			0
6/12	0	0	0	0	0	0	0	0	0	0	0	0			1
6/13	0.01	0	1	0	0	0	0	0	0	0.03	0.05	0.03			1
6/14	0	0	0	0	0	0	0	0	0	0.03	0.04	0.04			1
6/15	0.13	0	14	0.08	0.08	0.08	0.04	0.08	0	0.11	0.2	0.19			3
6/16	0.07	0	10	0.04	0.04	0.04	0.04	0.04	0	0.06	0.12	0.06			45
6/17	1.68	8	25	0.56	0.6	0.64	0.52	1.28	0	0.72	1.25	1.55	YES	YES	34
6/18	0.24	0	22	0.16	0.16	0.2	0.12	0.32	0	0.25	0.49	0.15			6

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
6/19	0.36	0	18	0.83	0.83	0.83	0.24	0.99	0	0.63	1.22	0.88	YES		2
6/20	0.02	0	1	0.08	0.08	0.08	0.04	0.08	0	0.29	0.55	0.05			0
6/21	0.02	0	1	0.04	0.04	0.04	0	0.04	0	0.03	0.06	0			0
6/22	0.02	0	5	0	0	0	0	0	0	0.13	0.25	0.13			0
6/23	0.03	0	3	0	0	0	0	0	0	0.02	0.04	0.02			0
6/24	0.26	0	21	0.12	0.16	0.16	0.08	0.28	0	0.23	0.45	0.45			1
6/25	0	0	0	0	0	0	0	0	0	0	0	0			0
6/26	0	0	0	0	0	0	0	0	0	0	0	0			0
6/27	0	0	0	0.24	0.24	0.24	0.2	0.24	0	0.04	0.06	0.08			2
6/28	0	0	0	0.04	0.04	0.04	0	0.04	0	0.05	0.08	0			1
6/29	0	0	0	0	0	0	0	0	0	0	0	0			1
6/30	0	0	0	0	0	0	0	0	0	0	0.01	0			0
7/1	0	0	0	0	0	0	0	0	0	0	0	0			0
7/2	0	0	0	0.44	0.44	0.44	0.04	0.44	0	0	0.01	0.14			0
7/3	0	0	0	0	0	0	0	0	0	0.14	0.24	0.05			1
7/4	0.14	0	9	0.08	0.16	0.16	0.08	0.16	0	0.12	0.23	0.22			11
7/5	0.2	0	17	0.56	0.68	0.99	0.6	1.07	0	1.05	1.94	2.82	YES	YES	83
7/6	0	0	0	0	0	0	0	0	0	0.21	0.42	0.36			7
7/7	0.22	0	2	0	0	0	0	0	0	0.13	0.25	0.34			5
7/8	0.33	0	7	0	0	0	0	0	0	0.23	0.45	0.42			2
7/9	0	0	0	0	0	0	0	0	0	0.42	0.76	0			1
7/10	0	0	0	0	0	0	0	0	0	0.01	0.01	0.01			2
7/11	0.01	0	1	0	0	0	0	0	0	0.02	0.07	0.02			1
7/12	0.63	0	21	0.84	0.84	0.84	0.2	0.88	0	0.27	0.53	0.52			8
7/13	0.02	0	3	0	0	0	0	0	0	0.17	0.28	0.18			3
7/14	0	0	0	0	0	0	0	0	0	0.02	0.05	0			2
7/15	1.1	1	26	0.4	0.64	0.84	0.6	1	0	0.44	0.97	0.91			41
7/16	0.14	0	2	0.44	0.44	0.44	0.2	0.52	0	0.34	0.67	1.2			8
7/17	0.47	0	19	0.64	0.68	0.68	0.64	0.68	0	0.73	1.27	0.79	YES		12
7/18	0	0	0	0	0	0	0	0	0	0.11	0.22	0			0
7/19	0	0	0	0	0	0	0	0	0	0	0	0			0
7/20	0	0	0	0.04	0.04	0.04	0	0.04	0	0.05	0.12	0.12			0
7/21	0.22	0	17	0.24	0.24	0.24	0.12	0.24	0	0.72	1.24	0.76	YES		8
7/22	0.42	0	26	0.24	0.24	0.32	0.24	0.4	0	0.7	1.38	0.78	YES		7
7/23	1.37	4	26	1.52	1.6	1.68	1.08	1.84	2	0.99	1.87	1.35	YES	YES	47
7/24	0.69	0	22	0.32	0.32	0.32	0.24	0.32	0	0.73	1.45	1.17	YES		4
7/25	0.56	0	23	0.36	0.44	0.44	0.32	0.6	0	0.37	0.74	0.81			5
7/26	0.14	0	18	0.32	0.36	0.36	0.16	0.36	0	0.21	0.41	0.22			2

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
7/27	0.47	0	22	0.12	0.16	0.28	0.12	0.36	0	0.35	0.69	0.77			1
7/28	0.08	0	14	0.12	0.24	0.24	0.04	0.24	0	0.36	0.63	0.43			1
7/29	0.08	0	16	0.04	0.04	0.04	0.04	0.04	0	0.09	0.17	0.24			0
7/30	0	0	0	0.08	0.08	0.08	0	0	0	0	0	0			0
7/31	0	0	0	0	0	0	0	0	0	0	0	0			0
8/1	0	0	0	0	0	0	0	0	0	0.04	0.07	0.04			0
8/2	0	0	0	0.4	0.48	0.48	0	0.52	0	0.02	0.04	0.66			1
8/3	0.3	0	20	0.12	0.12	0.12	0.12	0.12	0	0.6	0.97	0.29			4
8/4	0.17	0	20	0.12	0.12	0.12	0.08	0.12	0	0.11	0.22	0.31			2
8/5	0.08	0	18	0.04	0.04	0.04	0.04	0.08	0	0.16	0.31	0.25			1
8/6	0.13	0	15	0.2	0.2	0.2	0.04	0.04	0	0.33	0.66	0.39			1
8/7	0	0	0	0.2	0.2	0.2	0.04	0.32	0	0.19	0.35	0.28			4
8/8	0.04	0	3	0.04	0.04	0.04	0	0.04	0	0.17	0.26	0.12			2
8/9	0	0	0	0	0	0	0	0	0	0.01	0.01	0.03			2
8/10	0	0	0	0	0	0	0	0	0	0.04	0.07	0.07			1
8/11	0	0	0	0	0	0	0	0	0	0	0	0			1
8/12	0	0	0	0	0	0	0	0	0	0.09	0.13	0.09			1
8/13	0	0	0	0	0	0	0	0	0	0.06	0.1	0.14			0
8/14	1.13	1	17	0.52	0.52	0.52	0.36	0.76	0	0.95	1.82	1.69	YES		14
8/15	0.01	0	1	0.04	0.04	0.04	0	0.04	0	0.45	0.89	0			0
8/16	0.06	0	5	0.04	0.04	0.04	0	0.04	0	0.06	0.11	0.07			2
8/17	0.01	0	1	0.08	0.08	0.08	0	0.08	0	0.67	1.24	0.73	YES		20
8/18	0.24	0	27	0.12	0.12	0.12	0.12	0.12	0	0.08	0.15	0.17			1
8/19	0.04	0	3	0.04	0.04	0.04	0.04	0.04	0	0.1	0.19	0			0
8/20	0	0	0	0	0	0	0	0	0	0.01	0.05	0.04			1
8/21	0.59	0	26	0.56	0.64	1.08	0.36	1.28	0	0.79	1.51	1.21	YES		4
8/22	0.38	0	12	0.16	0.16	0.16	0.04	0.16	0	0.29	0.56	0.3			13
8/23	0	0	0	0	0	0	0	0	0	0.03	0.12	0.03			0
8/24	0.07	0	9	0.04	0.04	0.04	0	0.04	0	0	0	0.04			0
8/25	0.24	0	15	0.04	0.04	0.04	0.04	0.04	0	0.13	0.25	0.26			1
8/26	0.01	0	2	0.04	0.04	0.04	0	0.04	0	0.17	0.32	0.27			1
8/27	0	0	0	0	0	0	0	0	0	0.11	0.2	0.01			0
8/28	0	0	0	0	0	0	0	0	0	0	0	0			0
8/29	0	0	0	0	0	0	0	0	0	0	0	0			0
8/30	0	0	0	0	0	0	0	0	0	0	0	0			0
8/31	0.13	0	20	0.08	0.08	0.08	0.08	0.12	0	0.18	0.35	0.19			1
9/1	0.19	0	11	0.08	0.08	0.08	0.04	0.08	0	0.1	0.2	0.18			4
9/2	0	0	0	0	0	0	0	0	0	0.07	0.13	0.17			2

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
9/3	0	0	0	0	0	0	0	0	0	0.13	0.23	0.08			2
9/4	1.69	3	26	1.04	1.12	1.2	1.04	1.28	2	0.08	0.15	1.24	YES	YES	10
9/5	2.25	4	24	0.76	1	1.36	0.96	1.92	0	1.31	2.31	2.26	YES	YES	28
9/6	0.63	0	23	0.35	0.35	0.35	0.16	0.35	0	0.52	0.94	0.81			11
9/7	0.02	0	1	0	0	0	0	0	0	0.35	0.65	0.11			0
9/8	0.14	0	4	0	0	0	0	0	0	0.02	0.04	0.12			0
9/9	0	0	0	0	0	0	0	0	0	0.07	0.14	0.07			0
9/10	0	0	0	0	0	0	0	0	0	0.1	0.16	0.1			0
9/11	0.05	0	5	0	0	0	0	0	0	0.09	0.16	0.12			1
9/12	0	0	0	0	0	0	0	0	0	0.01	0.02	0			0
9/13	0	0	0	0	0	0	0	0	0	0	0	0			0
9/14	0	0	0	0	0	0	0	0	0	0	0	0			0
9/15	0	0	0	0	0	0	0	0	0	0.02	0.07	0			1
9/16	0	0	0	0	0	0	0	0	0	0	0	0.01			0
9/17	0	0	0	0	0	0	0	0	0	0.04	0.08	0.08			0
9/18	0	0	0	0	0	0	0	0	0	0.01	0.02	0			0
9/19	0.16	0	23	0.24	0.32	0.32	0.12	0.32	0	0.2	0.31	0.38			2
9/20	0	0	0	0	0	0	0	0	0	0.08	0.16	0			0
9/21	0	0	0	0	0	0	0	0	0	0	0	0			0
9/22	0	0	0	0	0	0	0	0	0	0	0	0			0
9/23	0	0	0	0	0	0	0	0	0	0	0	0.02			1
9/24	0.06	0	7	0	0	0	0	0	0	0.05	0.09	0.12			0
9/25	0	0	0	0	0	0	0	0	0	0.02	0.03	0			0
9/26	0	0	0	0	0	0	0	0	0	0	0	0			0
9/27	0	0	0	0	0	0	0	0	0	0	0	0			0
9/28	0	0	0	0	0	0	0	0	0	0	0	0			0
9/29	0	0	0	0	0	0	0	0	0	0	0	0			0
9/30	0	0	0	0	0	0	0	0	0	0	0	0			0

c) Forecast Zone C: Palmer Divide

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
5/14	2.7	3	36	0.76	0.88	1.04	0.68	2.12	0	0.49	0.89	0.7			15
5/15	0.7	0	23	0.56	0.6	0.6	0.28	0.6	0	0.63	1.14	0.69	YES		10
5/16	0	0	0	0	0	0	0	0	0	0.25	0.56	0			1
5/17	0.04	0	6	0	0	0	0	0	0	0	0	0			1
5/18	0.45	0	35	0.28	0.4	0.44	0.2	0.44	0	0.3	0.58	0.39			12
5/19	0.14	0	32	0.08	0.08	0.12	0.08	0.2	0	0.08	0.15	0.31			1
5/20	0.11	0	22	0.24	0.24	0.28	0.08	0.28	0	0.29	0.48	0.37			6
5/21	0.1	0	4	0	0	0	0	0	0	0.08	0.1	0.16			3
5/22	0.14	0	16	0.08	0.08	0.08	0.08	0.16	0	0.03	0.04	0.1			2
5/23	0.09	0	2	0	0	0	0	0	0	0.09	0.14	0.04			1
5/24	0	0	0	0.04	0.04	0.04	0	0.04	0	0	0	0.01			1
5/25	0	0	0	0	0	0	0	0	0	0.01	0.03	0			0
5/26	0	0	0	0.04	0.04	0.04	0	0.04	0	0	0	0			1
5/27	0.05	0	29	0	0	0	0	0	0	0.07	0.13	0.07			1
5/28	0.8	0	42	0.8	0.8	0.8	0.76	0.8	0	0.52	0.98	0.68			38
5/29	0.26	0	5	0.08	0.08	0.08	0.04	0.08	0	0.07	0.14	0.05			1
5/30	1.06	1	21	0.8	0.8	0.92	0.28	0.96	0	0.56	1.05	0.73	YES	YES	34
5/31	0	0	0	0	0	0	0	0	0	0.01	0.02	0			1
6/1	0	0	0	0.16	0.16	0.16	0	0.16	0	0	0	0			0
6/2	0	0	0	0	0	0	0	0	0	0	0	0			0
6/3	0.01	0	1	0	0	0	0	0	0	0	0	0.04			6
6/4	0.03	0	1	0	0	0	0	0	0	0.04	0.07	0			0
6/5	0	0	0	0.08	0.08	0.08	0.08	0.08	0	0	0	0			2
6/6	0.22	0	24	0.04	0.04	0.04	0.04	0.04	0	0.11	0.17	0.28			5
6/7	0	0	0	0.75	0.75	0.75	0	0	0	0.28	0.54	0.05			2
6/8	0	0	0	0	0	0	0	0	0	0	0	0			1
6/9	0.01	0	1	0	0	0	0	0	0	0	0	0			1
6/10	0	0	0	0	0	0	0	0	0	0	0	0			1
6/11	0	0	0	0	0	0	0	0	0	0	0	0			0
6/12	0.1	0	4	0.08	0.08	0.12	0.04	0.12	0	0.01	0.02	0.28			2
6/13	0.06	0	8	0.16	0.16	0.16	0.08	0.16	0	0.27	0.53	0.3			2
6/14	0	0	0	0	0	0	0	0	0	0.03	0.05	0.04			1
6/15	0.02	0	6	0	0	0	0	0	0	0.05	0.1	0.06			2
6/16	0.06	0	12	0.04	0.04	0.04	0.04	0.04	0	0.05	0.09	0.06			45
6/17	2.51	11	49	0.8	0.84	1.12	0.84	1.52	0	0.64	1.15	2.1	YES	YES	30

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
6/18	0.04	0	22	0.12	0.12	0.12	0.08	0.12	0	0.56	0.96	0.09			2
6/19	0.59	0	35	0.84	0.84	0.84	0.68	0.84	0	0.75	1.48	0.76	YES		7
6/20	0.01	0	1	0	0	0	0	0	0	0.4	0.8	0.03			0
6/21	0.18	0	1	0.16	0.16	0.16	0.04	0.16	0	0.07	0.13	0.24			0
6/22	0.03	0	3	0.04	0.04	0.04	0.04	0.04	0	0.24	0.43	0.17			0
6/23	0.1	0	2	0	0	0	0	0	0	0.25	0.43	0.48			0
6/24	0.6	0	40	0.76	0.8	0.8	0.56	0.88	0	0.47	0.92	0.64			1
6/25	0	0	0	0	0	0	0	0	0	0	0	0			0
6/26	0	0	0	0	0	0	0	0	0	0	0	0			0
6/27	0.01	0	2	0	0	0	0	0	0	0	0	0.08			2
6/28	0	0	0	0	0	0	0	0	0	0.04	0.06	0			1
6/29	0	0	0	0	0	0	0	0	0	0	0	0			1
6/30	0.22	0	7	0.04	0.04	0.04	0.04	0.04	0	0.14	0.26	0.26			1
7/1	0	0	0	0	0	0	0	0	0	0.19	0.32	0			1
7/2	0.35	0	8	0.16	0.16	0.16	0.08	0.16	0	0	0	0.29			0
7/3	0	0	0	0	0	0	0	0	0	0.28	0.48	0			1
7/4	0.51	0	41	0.36	0.36	0.36	0.36	0.44	0	0.17	0.24	0.48			13
7/5	0.95	0	42	1.28	1.72	1.72	1.32	1.92	4	1.1	2.15	3.09	YES	YES	84
7/6	0	0	0	0	0	0	0	0	0	0.48	0.76	0			4
7/7	0.29	0	8	0.28	0.28	0.28	0.24	0.28	0	0.36	0.5	0.41			5
7/8	0.25	0	9	0.55	0.55	0.55	0.55	0.55	0	0.19	0.36	0.45			2
7/9	0	0	0	0	0	0	0	0	0	0.37	0.68	0			1
7/10	0	0	0	0	0	0	0	0	0	0	0	0			1
7/11	0	0	0	0.08	0.08	0.08	0	0.08	0	0.11	0.2	0.11			1
7/12	0.22	0	3	0.72	0.72	0.8	0.6	0.8	0	0.36	0.69	0.61			3
7/13	0	0	0	0	0	0	0	0	0	0	0	0			0
7/14	0	0	0	0.04	0.04	0.04	0	0.04	0	0.21	0.32	0.38			2
7/15	2.53	4	44	0.88	1.12	1.28	0.84	2.08	1	1.01	1.5	1.27	YES	YES	47
7/16	0.46	0	19	0.84	0.84	0.84	0.72	0.84	0	1.05	1.89	1.09	YES	YES	7
7/17	1.98	11	26	1.28	1.48	1.52	1.28	1.52	3	1.03	2.01	1.45	YES	YES	10
7/18	0	0	0	0	0	0	0	0	0	0.21	0.33	0			0
7/19	0	0	0	0	0	0	0	0	0	0	0	0			0
7/20	0	0	0	0	0	0	0	0	0	0	0	0	YES		0
7/21	0.04	0	7	0.6	0.6	0.6	0.52	0.6	0	0.69	1.35	0.82	YES		4
7/22	0.65	0	43	0.28	0.4	0.4	0.24	0.52	0	0.72	1.11	0.77	YES		6
7/23	1.91	7	45	1.64	2	2	1.04	2	2	0.97	1.8	1.91	YES	YES	42
7/24	0.6	0	31	0.48	0.52	0.52	0.47	0.52	0	0.54	0.97	0.75			2

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
7/25	1.26	6	44	1.44	1.48	1.8	1.28	2	3	0.71	1.4	1.17	YES	YES	5
7/26	0.45	0	16	0.76	0.8	0.8	0.32	0.8	0	0.69	1.32	0.7	YES		3
7/27	1.31	1	28	0.72	0.72	0.72	0.52	1.08	0	0.95	1.55	1.01	YES	YES	2
7/28	0.22	0	25	0.2	0.24	0.24	0.2	0.24	0	0.42	0.78	0.45			1
7/29	0.04	0	11	0.04	0.04	0.04	0.04	0.04	0	0.05	0.1	0.07			1
7/30	0	0	0	0	0	0	0	0	0	0	0	0			0
7/31	0	0	0	0	0	0	0	0	0	0	0	0			0
8/1	0	0	0	0.08	0.08	0.08	0.08	0	0	0.01	0.01	0.01			1
8/2	0.01	0	1	0.08	0.08	0.12	0.08	0.12	0	0	0	0.71			0
8/3	0.62	0	43	0.44	0.44	0.52	0.4	0.52	0	0.59	1.2	0.5	YES		2
8/4	0.62	0	17	0.12	0.12	0.12	0.04	0.12	0	0.15	0.27	0.18			1
8/5	0.7	0	22	0.48	0.52	0.52	0.48	0.6	0	0.56	1.09	0.9	YES		1
8/6	0.31	0	31	0.6	0.6	0.6	0.44	0.64	0	0.67	1.3	0.67	YES		6
8/7	1.5	1	16	0.72	0.76	0.76	0.32	0.76	0	0.66	1.32	0.66	YES	YES	7
8/8	0.05	0	3	0.04	0.04	0.04	0	0.04	0	0.17	0.34	0.18			3
8/9	0	0	0	0	0	0	0	0	0	0	0	0			1
8/10	0	0	0	0.83	0.83	0.83	0.04	0.83	0	0.01	0.02	0.02			1
8/11	0	0	0	0	0	0	0	0	0	0	0	0			1
8/12	0	0	0	0	0	0	0	0	0	0	0	0			0
8/13	0	0	0	0	0	0	0	0	0	0	0	0			0
8/14	1.41	3	43	1.48	1.48	1.48	1.16	1.48	2	0.45	0.88	1.14	YES	YES	14
8/15	0.1	0	2	0.04	0.04	0.04	0	0.04	0	0.78	1.43	0.15	YES		0
8/16	0	0	0	0.08	0.08	0.08	0	0.08	0	0.1	0.2	0.06			1
8/17	1	0	18	0.6	0.6	0.6	0.4	0.6	0	0.59	1.12	0.89	YES		50
8/18	0.64	0	39	0.44	0.52	0.52	0.36	0.64	0	0.45	0.89	0.52			7
8/19	0.06	0	8	0.04	0.04	0.04	0.04	0.04	0	0.18	0.34	0			0
8/20	0.01	0	1	0	0	0	0	0	0	0	0	0			0
8/21	0.71	0	40	0.36	0.64	0.68	0.48	0.76	0	0.41	0.83	0.88			5
8/22	1.02	1	30	0.52	0.52	0.52	0.52	0.52	0	0.19	0.3	0.61			27
8/23	0.01	0	1	0	0	0	0	0	0	0.59	1.11	0	YES		0
8/24	0	0	0	0	0	0	0	0	0	0	0	0			0
8/25	0.2	0	8	0.12	0.12	0.2	0.08	0.2	0	0.37	0.65	0.45			1
8/26	0.25	0	19	0.08	0.08	0.12	0.08	0.12	0	0.25	0.46	0.33			0
8/27	0	0	0	0	0	0	0	0	0	0.02	0.05	0			0
8/28	0	0	0	0	0	0	0	0	0	0	0	0			0
8/29	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01			0
8/30	0	0	0	0	0	0	0	0	0	0	0	0			0

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
8/31	0.29	0	31	0.2	0.24	0.28	0.12	0.28	0	0.28	0.54	0.46			1
9/1	0.25	0	4	0.76	0.8	0.88	0.28	0.92	0	0.57	1.05	0.96	YES		7
9/2	0.04	0	2	0.04	0.04	0.04	0.04	0.04	0	0.03	0.06	0.07			2
9/3	0.24	0	5	0.16	0.28	0.32	0	0.32	0	0.2	0.33	0.41			2
9/4	0.34	0	29	0.4	0.4	0.4	0.28	0.4	0	0.05	0.08	0.24			8
9/5	1.63	1	32	0.52	0.68	0.96	0.48	1.08	0	1.23	1.86	1.4	YES	YES	13
9/6	0.62	0	20	0.44	0.44	0.44	0.2	0.44	0	0.78	1.28	1.14	YES		12
9/7	0.01	0	6	0.04	0.04	0.04	0	0.04	0	0.54	1.05	0	YES		0
9/8	0.07	0	8	0.04	0.04	0.04	0.04	0.04	0	0	0	0.13			0
9/9	0.02	0	1	0	0	0	0	0	0	0.13	0.24	0.09			0
9/10	0.1	0	4	0	0	0	0	0	0	0.16	0.27	0.16			0
9/11	0.01	0	1	0	0	0	0	0	0	0.03	0.06	0.04			0
9/12	0	0	0	0	0	0	0	0	0	0	0	0			0
9/13	0	0	0	0	0	0	0	0	0	0	0	0			0
9/14	0	0	0	0	0	0	0	0	0	0	0	0			0
9/15	0	0	0	0	0	0	0	0	0	0	0	0			1
9/16	0	0	0	0	0	0	0	0	0	0	0	0			0
9/17	0	0	0	0	0	0	0	0	0	0	0	0			0
9/18	0	0	0	0	0	0	0	0	0	0	0	0			0
9/19	0.27	0	34	0.2	0.2	0.2	0.2	0.24	0	0.22	0.42	0.41			2
9/20	0.02	0	2	0.04	0.04	0.04	0	0.04	0	0.35	0.63	0.05			0
9/21	0	0	0	0	0	0	0	0	0	0	0	0			0
9/22	0	0	0	0	0	0	0	0	0	0	0	0			0
9/23	0	0	0	0	0	0	0	0	0	0	0	0			1
9/24	0.1	0	10	0.04	0.04	0.04	0.04	0.08	0	0.11	0.18	0.19			0
9/25	0	0	0	0	0	0	0	0	0	0.03	0.06	0			0
9/26	0	0	0	0	0	0	0	0	0	0	0	0			0
9/27	0	0	0	0	0	0	0	0	0	0	0	0			0
9/28	0	0	0	0	0	0	0	0	0	0	0	0			0
9/29	0	0	0	0	0	0	0	0	0	0	0	0			0
9/30	0	0	0	0	0	0	0	0	0	0	0	0			0

d) Forecast Zone D: Central Metro

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
5/14	1.15	1	93	0.72	0.88	0.92	0.88	0.96	0	1	1.81	1.39	YES	YES	20
5/15	0.29	0	15	0.2	0.2	0.2	0.2	0.2	0	0.37	0.62	0.44			25
5/16	0	0	0	0.12	0.16	0.16	0.04	0.16	0	0	0	0			1
5/17	0.06	0	5	0.12	0.12	0.12	0.08	0.12	0	0.01	0.01	0.01			1
5/18	1.35	1	79	1.36	1.68	1.68	0.64	1.68	1	0.66	1.18	1.04	YES	YES	14
5/19	0.25	0	92	0.16	0.16	0.2	0.16	0.36	0	0.16	0.88	0.33			1
5/20	0.32	0	84	0.28	0.36	0.4	0.2	0.4	0	0.15	0.29	0.25			6
5/21	0.09	0	15	0.12	0.12	0.12	0.08	0.12	0	0.19	0.41	0.24			4
5/22	0.86	0	54	0.16	0.16	0.2	0.16	0.2	0	0.05	0.08	0.18			4
5/23	0.71	0	23	0.16	0.16	0.16	0.16	0.16	0	0.4	0.5	0.4			1
5/24	0.02	0	2	0.2	0.2	0.2	0.2	0.24	0	0	0.02	0			0
5/25	0	0	0	0.12	0.12	0.12	0.08	0.2	0	0	0	0			0
5/26	0	0	0	0.12	0.16	0.16	0.12	0.2	0	0	0	0			1
5/27	0.21	0	34	0.08	0.08	0.08	0.08	0.16	0	0.49	0.61	0.49			2
5/28	1.5	1	97	0.68	0.72	0.72	0.64	0.72	0	0.45	0.85	0.54			29
5/29	0.01	0	4	0.16	0.2	0.2	0.16	0.32	0	0.03	1.01	0.02	YES		0
5/30	0.2	0	40	0.24	0.28	0.28	0.2	0.28	0	0.13	0.31	0.44			10
5/31	0	0	0	0.28	0.28	0.28	0.2	0.28	0	0.38	0.67	0			1
6/1	0	0	0	0.2	0.2	0.2	0.08	0.2	0	0	0	0			0
6/2	0	0	0	0.16	0.2	0.2	0.16	0.2	0	0	0	0			0
6/3	0	0	0	0.12	0.12	0.12	0.12	0.12	0	0	0	0			5
6/4	0	0	0	0.12	0.12	0.12	0.12	0.12	0	0	0	0			0
6/5	0	0	0	0.08	0.08	0.12	0.08	0.2	0	0	0	0			2
6/6	0.16	0	58	0.16	0.16	0.16	0.12	0.2	0	0	0	0.24			6
6/7	0.01	0	3	0.2	0.2	0.2	0.08	0.2	0	0.24	0.43	0.04			2
6/8	0	0	0	0.2	0.2	0.2	0.12	0.36	0	0	0	0			1
6/9	0	0	0	0.16	0.2	0.2	0.12	0.2	0	0	0.39	0			1
6/10	0	0	0	0.12	0.16	0.16	0.12	0.24	0	0	0	0			1
6/11	0	0	0	0.12	0.16	0.16	0.12	0.28	0	0	0	0			0
6/12	0	0	0	0.16	0.24	0.24	0.16	0.24	0	0	0	0			0
6/13	0.01	0	1	0.12	0.12	0.12	0.12	0.12	0	0.02	0.05	0.02			1
6/14	0.05	0	20	0.16	0.24	0.24	0.12	0.24	0	0.06	0.12	0.12			1
6/15	0.25	0	18	0.16	0.24	0.24	0.16	0.4	0	0.18	0.35	0.21			4
6/16	0.68	0	34	0.24	0.24	0.24	0.24	0.28	0	0.36	0.65	0.51			26
6/17	0.97	0	99	0.6	0.64	0.68	0.32	1	0	0.37	0.69	1			35

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
6/18	1.02	1	73	0.4	0.68	0.76	0.44	0.96	0	0.19	0.37	2.28			10
6/19	0.79	0	91	0.56	0.92	0.92	0.76	1	0	0.87	1.68	1.38	YES		19
6/20	0	0	0	0.12	0.12	0.12	0.08	0.12	0	0.68	1.33	0.03	YES		0
6/21	0.01	0	1	0.2	0.2	0.24	0.16	0.2	0	0.05	0.08	0.05			0
6/22	0.02	0	10	0.24	0.24	0.24	0.2	0.24	0	0.07	0.31	0.13			0
6/23	0.21	0	4	0.12	0.16	0.16	0.12	0.2	0	0.01	0.03	0.15			0
6/24	1	0	92	1.12	1.12	1.12	0.76	1.12	1	0.45	0.81	0.62	YES	YES	1
6/25	0	0	0	0.16	0.16	0.16	0.16	0.32	0	0.01	0.17	0			0
6/26	0	0	0	0.12	0.2	0.2	0.08	0.2	0	0	0	0			0
6/27	0.03	0	3	0.12	0.12	0.12	0.08	0.12	0	0	0	0.07			2
6/28	0	0	0	0.24	0.24	0.24	0.12	0.24	0	0.05	0.1	0			1
6/29	0.03	0	1	0.16	0.2	0.2	0.12	0.32	0	0	0.02	0			1
6/30	0.17	0	25	0.24	0.24	0.24	0.16	0.24	0	0.17	0.34	0.17			2
7/1	0.06	0	4	0.12	0.16	0.16	0.12	0.28	0	0.01	0.44	0			0
7/2	0.34	0	50	0.56	0.56	0.56	0.56	0.56	0	0	0	0.45			0
7/3	0	0	0	0.24	0.24	0.24	0.12	0.24	0	0.34	0.63	0			1
7/4	0.15	0	20	0.16	0.28	0.28	0.12	0.4	0	0.43	0.77	0.61			13
7/5	0.76	0	64	0.48	0.52	0.52	0.24	0.56	0	0.74	1.37	0.98	YES		78
7/6	0.04	0	1	0.16	0.2	0.2	0.16	0.28	0	0.1	0.21	0			3
7/7	0.75	0	50	0.36	0.4	0.44	0.32	0.44	0	0.34	0.55	0.46			1
7/8	0.86	0	36	0.75	0.75	0.75	0.67	0.75	2	0.3	0.48	0.46			1
7/9	0	0	0	0.59	0.59	0.59	0.39	0.59	0	0.43	0.8	0			1
7/10	0	0	0	0.12	0.16	0.16	0.12	0.16	0	0	0	0			1
7/11	0	0	0	0.16	0.24	0.24	0.12	0.64	0	0	0	0			1
7/12	0.03	0	2	0.2	0.28	0.28	0.2	0.48	0	0.09	0.25	0.11			1
7/13	0	0	0	0.2	0.32	0.32	0.16	0.32	0	0	0.49	0			0
7/14	1.11	1	3	0.24	0.24	0.24	0.2	0.36	0	0	0	0			1
7/15	1.58	8	108	0.96	1.36	1.56	1.2	1.56	4	0.58	1	1.11	YES	YES	44
7/16	1.38	1	10	1.28	1.6	1.6	0.52	1.6	1	0.74	1.39	1.18	YES	YES	5
7/17	0.16	0	8	0.16	0.24	0.24	0.16	0.24	0	0.77	1.5	0.18	YES		8
7/18	0	0	0	0.16	0.2	0.2	0.16	0.4	0	0.15	0.35	0			0
7/19	0	0	0	0.16	0.16	0.16	0.12	0.16	0	0	0	0			0
7/20	0	0	0	0.16	0.2	0.2	0.12	0.24	0	0	0	0			0
7/21	0.24	0	8	0.12	0.12	0.12	0.08	0.12	0	0.07	0.15	0.1			2
7/22	0.6	0	99	0.56	0.56	0.56	0.44	0.6	0	0.79	1.48	0.94	YES		5
7/23	2.16	22	105	1.92	2.76	2.76	2.36	2.92	21	1.5	2.86	1.92	YES	YES	24
7/24	1.96	16	64	1.63	1.75	1.75	1.49	2.17	5	0.71	1.37	1.07	YES	YES	2

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
7/25	1.54	3	109	0.84	0.92	0.92	0.88	1	0	1.01	1.99	0.96	YES	YES	2
7/26	1.1	1	41	0.16	0.16	0.16	0.16	0.16	0	0.94	1.74	0.85	YES	YES	5
7/27	0.06	0	38	0.2	0.24	0.28	0.08	0.28	0	0.76	1.36	0.29	YES		1
7/28	0.09	0	31	0.16	0.16	0.24	0.16	0.28	0	0.04	0.08	0.09			1
7/29	0.05	0	6	0.16	0.2	0.24	0.12	0.48	0	0.07	0.66	0.27			2
7/30	0	0	0	0.16	0.24	0.24	0.12	0.44	0	0.17	0.24	0			0
7/31	0	0	0	0.16	0.16	0.16	0.16	0.32	0	0	0	0			0
8/1	0.08	0	1	0.16	0.2	0.24	0.16	0.44	0	0.01	0.02	0.01			0
8/2	0.31	0	3	0.16	0.16	0.16	0.16	0.28	0	0	0	0			0
8/3	0.63	0	87	0.24	0.44	0.48	0.24	0.48	0	0.25	0.96	0.45			2
8/4	0.09	0	38	0.12	0.12	0.12	0.08	0.2	0	0.12	0.23	0.12			1
8/5	0.22	0	56	0.2	0.2	0.24	0.2	0.48	0	0.12	0.24	0.18			1
8/6	0.46	0	52	0.4	0.4	0.4	0.24	0.44	0	0.17	0.31	0.64			6
8/7	0.18	0	7	0.16	0.16	0.16	0.12	0.16	0	0.46	0.81	0.65			6
8/8	0.02	0	1	0.16	0.16	0.16	0.08	0.24	0	0.63	1.15	0	YES		1
8/9	0	0	0	0.16	0.16	0.16	0.08	0.28	0	0	0	0			1
8/10	0	0	0	0.24	0.24	0.24	0.08	0.24	0	0	0.28	0			0
8/11	0	0	0	0.08	0.08	0.08	0.08	0.08	0	0	0	0			1
8/12	0	0	0	0.2	0.24	0.24	0.2	0.4	0	0	0	0			0
8/13	0.05	0	1	0.08	0.08	0.08	0.04	0.04	0	0	0.09	0			0
8/14	1.37	5	110	1.44	1.44	1.44	1.4	1.44	4	0.67	1.33	0.86	YES	YES	13
8/15	0	0	0	0.12	0.16	0.16	0.12	0.32	0	0.66	1.28	0	YES		0
8/16	0	0	0	0.16	0.2	0.24	0.16	0.32	0	0	0	0.01			1
8/17	0.55	0	20	0.48	0.52	0.52	0.4	0.52	0	0.51	0.9	0.6			22
8/18	1.49	2	103	0.68	0.76	0.76	0.64	0.76	0	0.05	0.1	1.14			4
8/19	0.4	0	18	0.04	0.04	0.04	0.04	0.04	0	0.61	1.21	0.07	YES		0
8/20	0.03	0	3	0.28	0.28	0.28	0.16	0.28	0	0	0	0			0
8/21	0.65	0	78	0.36	0.36	0.4	0.28	0.56	0	0.39	0.72	0.62			4
8/22	0.15	0	17	0.12	0.12	0.12	0.12	0.16	0	0.05	0.13	0.05			5
8/23	0	0	0	0.16	0.16	0.16	0.08	0.16	0	0.04	0.06	0			0
8/24	0.02	0	1	0.12	0.12	0.16	0.04	0.2	0	0	0	0			0
8/25	0.21	0	3	0.12	0.12	0.12	0.04	0.12	0	0.01	0.04	0.05			1
8/26	0.07	0	11	0.16	0.16	0.16	0.08	0.2	0	0.23	0.59	0.25			0
8/27	0	0	0	0.12	0.12	0.12	0.08	0.16	0	0.08	0.18	0			0
8/28	0	0	0	0.16	0.16	0.24	0.16	0.32	0	0	0	0			0
8/29	0	0	0	0.16	0.2	0.24	0.08	0.4	0	0	0	0			0
8/30	0	0	0	0.16	0.2	0.2	0.16	0.32	0	0	0	0.01			0

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
8/31	0.15	0	29	0.39	0.39	0.39	0.16	0.28	0	0.07	0.13	0.08			1
9/1	0.01	0	3	0.16	0.16	0.16	0.16	0.32	0	0.05	0.28	0.06			4
9/2	0	0	0	0.16	0.16	0.16	0.16	0.28	0	0	0.03	0.02			1
9/3	0.46	0	13	0.16	0.16	0.2	0.16	0.24	0	0.04	0.39	0.1			2
9/4	2.14	11	104	1.52	1.88	1.88	1.4	1.92	4	0.1	0.38	1.43	YES	YES	10
9/5	2.15	11	85	1.52	1.64	1.76	1.48	1.92	3	1.18	2.03	1.32	YES	YES	14
9/6	0.33	0	18	0.12	0.12	0.12	0.12	0.12	0	0.77	1.46	0.98	YES		9
9/7	0	0	0	0.16	0.16	0.16	0.12	0.28	0	0.14	0.25	0.14			0
9/8	0.25	0	46	0.2	0.2	0.2	0.16	0.36	0	0	0	0.11			0
9/9	0	0	0	0.16	0.16	0.16	0.16	0.28	0	0.1	0.2	0.04			0
9/10	0	0	0	0.16	0.16	0.16	0.12	0.16	0	0	0	0			0
9/11	0.02	0	6	0.2	0.2	0.2	0.16	0.32	0	0.06	0.11	0.08			0
9/12	0	0	0	0.2	0.2	0.2	0.12	0.28	0	0	0	0			0
9/13	0	0	0	0.12	0.12	0.12	0.12	0.12	0	0	0	0			0
9/14	0	0	0	0.2	0.2	0.2	0.16	0.32	0	0	0	0			0
9/15	0	0	0	0.28	0.28	0.28	0.28	0.32	0	0	0	0			1
9/16	0	0	0	0.16	0.16	0.16	0.16	0.32	0	0	0	0			0
9/17	0	0	0	0.2	0.2	0.2	0.16	0.28	0	0.01	0.01	0.01			0
9/18	0	0	0	0.12	0.2	0.2	0.12	0.2	0	0	0	0			0
9/19	1.44	7	104	1.28	1.28	1.28	1.12	1.28	2	0.55	0.98	0.6	YES	YES	2
9/20	0	0	0	0.28	0.28	0.28	0.16	0.28	0	0.41	0.79	0			0
9/21	0	0	0	0.16	0.16	0.16	0.08	0.16	0	0	0	0			0
9/22	0	0	0	0.16	0.16	0.16	0.08	0.28	0	0	0	0			0
9/23	0	0	0	0.12	0.12	0.12	0.12	0.24	0	0	0	0			1
9/24	0.04	0	22	0.12	0.12	0.12	0.08	0.2	0	0.09	0.13	0.09			0
9/25	0	0	0	0.16	0.16	0.16	0.16	0.28	0	0.03	0.06	0			0
9/26	0	0	0	0.16	0.16	0.16	0.12	0.24	0	0	0	0			0
9/27	0	0	0	0.16	0.2	0.2	0.12	0.24	0	0	0	0			0
9/28	0	0	0	0.16	0.16	0.16	0.16	0.32	0	0	0	0			0
9/29	0.01	0	1	0.16	0.16	0.16	0.16	0.2	0	0	0	0			0
9/30	0.01	0	3	0.12	0.12	0.12	0	0.12	0	0	0	0			0

e) Forecast Zone E: North Metro

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
5/14	0.23	0	59	0.2	0.2	0.2	0.16	0.24	0	0.7	1.35	0.4	YES		8
5/15	0.01	0	2	0.08	0.08	0.08	0	0.12	0	0.29	0.6	0.01			10
5/16	0	0	0	0.04	0.04	0.04	0	0.04	0	0	0	0			1
5/17	0	0	0	0	0	0	0	0	0	0.26	0.41	0.26			2
5/18	2.77	23	91	1.6	1.84	2.2	1.72	2.4	4	1.37	2.53	2.21	YES	YES	17
5/19	0.69	0	86	0.08	0.16	0.28	0.12	0.76	0	0.33	1.18	0.63	YES		1
5/20	0.25	0	82	0.12	0.16	0.16	0.12	0.28	0	0.12	0.24	0.19			2
5/21	0.02	0	3	0.04	0.04	0.04	0	0.04	0	0.03	0.06	0			2
5/22	0.83	0	90	0.36	0.36	0.36	0.3	0.4	0	0.76	1.47	0.85	YES		7
5/23	0.16	0	24	0.12	0.12	0.12	0.08	0.12	0	0.37	0.69	0.36			2
5/24	0.06	0	4	0.28	0.28	0.28	0.08	0.28	0	0.06	0.11	0.06			0
5/25	0	0	0	0	0	0	0	0	0	0.02	0.04	0			0
5/26	0	0	0	0	0	0	0	0	0	0	0	0			1
5/27	0.02	0	1	0	0	0	0	0	0	0.03	0.58	0.05			2
5/28	0.55	0	92	0.08	0.08	0.08	0.08	0.12	0	0.41	0.84	0.46			17
5/29	0.06	0	2	0	0	0	0	0	0	0.03	0.59	0.02			1
5/30	0.39	0	69	0.32	0.4	0.4	0.36	0.4	0	0.28	0.64	1.08			8
5/31	0.02	0	1	0	0	0	0	0	0	0.7	1.32	0	YES		1
6/1	0.01	0	1	0	0	0	0	0	0	0	0	0			0
6/2	0	0	0	0	0	0	0	0	0	0	0	0			0
6/3	0	0	0	0	0	0	0	0	0	0	0	0			3
6/4	0	0	0	0	0	0	0	0	0	0	0	0			0
6/5	0.02	0	1	0	0	0	0	0	0	0	0	0			2
6/6	0.15	0	22	0	0	0	0	0	0	0	0	0.33			7
6/7	0	0	0	0	0	0	0	0	0	0.28	1.35	0	YES		2
6/8	0	0	0	0	0	0	0	0	0	0	0	0			1
6/9	0	0	0	0	0	0	0	0	0	0	0.01	0			1
6/10	0	0	0	0	0	0	0	0	0	0	0	0			1
6/11	0	0	0	0	0	0	0	0	0	0	0	0			0
6/12	0	0	0	0	0	0	0	0	0	0	0	0			0
6/13	0.01	0	2	0	0	0	0	0	0	0	0.19	0.14			1
6/14	0.02	0	1	0	0	0	0	0	0	0.14	0.27	0.01			1
6/15	0.13	0	33	0.08	0.08	0.08	0	0.12	0	0.14	0.25	0.17			5
6/16	0.85	0	48	0.6	0.6	0.64	0.44	0.64	0	0.36	0.59	0.52			37
6/17	0.85	0	84	0.28	0.44	0.48	0.32	0.88	0	0.16	0.3	0.81			24

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
6/18	4.84	16	94	0.64	0.68	0.92	0.6	1.56	0	1.04	2.03	6.51	YES	YES	9
6/19	1.71	3	70	1.04	1.2	1.28	0.5	1.28	1	1.87	3.6	1.2	YES	YES	6
6/20	0.01	0	3	0	0	0	0	0	0	0.29	0.56	0			0
6/21	0.06	0	29	0	0	0	0	0	0	0.03	0.08	0.05			0
6/22	0.02	0	15	0	0	0	0	0	0	0.07	0.36	0.08			0
6/23	0.23	0	34	0.04	0.04	0.04	0	0.04	0	0.01	0.02	0.35			0
6/24	1.45	2	85	0.08	0.08	0.08	0.05	0.08	0	0.57	1.17	0.64	YES	YES	1
6/25	0	0	0	0.08	0.08	0.08	0.08	0.08	0	0.05	0.14	0			0
6/26	0	0	0	0	0	0	0	0	0	0	0	0			0
6/27	0	0	0	0	0	0	0	0	0	0.01	0.03	0.23			2
6/28	0	0	0	0	0	0	0	0	0	0.23	0.36	0			1
6/29	0	0	0	0	0	0	0	0	0	0.01	0.03	0.01			1
6/30	0.18	0	59	0.04	0.04	0.04	0.04	0.08	0	0.13	0.26	0.22			1
7/1	0	0	0	0	0	0	0	0	0	0	0.36	0			0
7/2	0	0	0	0	0	0	0	0	0	0	0	0			0
7/3	0.02	0	1	0.2	0.2	0.2	0.16	0.2	0	0.01	0.02	0.01			1
7/4	0.2	0	19	0.04	0.04	0.04	0.04	0.04	0	0.47	0.92	0.6			7
7/5	0.56	0	42	0.12	0.12	0.12	0.08	0.12	0	0.41	0.8	0.57			80
7/6	0	0	0	0	0	0	0	0	0	0	0	0	YES		2
7/7	0.04	0	1	0	0	0	0	0	0	0.09	0.17	0.1			1
7/8	0	0	0	0	0	0	0	0	0	0.02	0.03	0.08			1
7/9	0	0	0	0	0	0	0	0	0	0	0.01	0			1
7/10	0	0	0	0	0	0	0	0	0	0	0	0			1
7/11	0	0	0	0.08	0.08	0.08	0	0.08	0	0	0	0			1
7/12	0.21	0	35	0	0	0	0	0	0	0.22	0.35	0.32			1
7/13	0	0	0	0	0	0	0	0	0	0	0.11	0			1
7/14	0	0	0	0	0	0	0	0	0	0	0	0			1
7/15	0.82	0	84	0.32	0.32	0.32	0.32	0.6	0	0.29	0.55	0.52			45
7/16	0.02	0	4	0	0	0	0	0	0	0.08	0.51	0.01			5
7/17	0.58	0	25	0.4	0.4	0.4	0.28	0.4	0	0.04	0.59	0.52			16
7/18	0	0	0	0	0	0	0	0	0	0.5	0.97	0			0
7/19	0	0	0	0.08	0.08	0.08	0.08	0.08	0	0	0	0			0
7/20	0	0	0	0	0	0	0	0	0	0	0	0			0
7/21	0.12	0	22	0.04	0.04	0.04	0.04	0.04	0	0.09	0.27	0.12			1
7/22	0.98	0	86	0.16	0.2	0.28	0.08	0.28	0	0.44	0.85	0.78			2
7/23	1.48	23	91	1.16	1.24	1.24	0.8	1.44	1	0.93	1.85	1.48	YES	YES	25
7/24	0.02	0	17	0.04	0.04	0.04	0	0	0	0.44	0.86	0.06			2

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
7/25	1.56	5	97	0.6	0.64	0.72	0.44	1.24	0	0.56	1.2	1.23	YES	YES	3
7/26	0.55	0	61	0.24	0.24	0.24	0.16	0.24	0	0.82	1.53	0.68	YES		4
7/27	0.13	0	72	0.12	0.16	0.16	0.12	0.16	0	0.63	1.21	0.19	YES		1
7/28	0.52	0	83	0.12	0.12	0.12	0.08	0.16	0	0.28	0.52	0.61			4
7/29	0.44	0	24	0	0	0	0	0	0	0.04	1.05	0.47	YES		3
7/30	0	0	0	0	0	0	0	0	0	0.46	0.85	0			0
7/31	0	0	0	0	0	0	0	0	0	0	0	0			0
8/1	0	0	0	0	0	0	0	0	0	0	0	0			0
8/2	0.02	0	2	0	0	0	0	0	0	0	0.01	0			0
8/3	0.1	0	71	0.04	0.04	0.04	0.04	0.04	0	0.09	0.49	0.16			1
8/4	0.05	0	10	0.04	0.04	0.04	0	0.04	0	0.09	0.16	0.09	YES		1
8/5	0.06	0	36	0.12	0.12	0.12	0	0.12	0	0.09	0.17	0.19			0
8/6	0.33	0	2	0	0	0	0	0	0	0.22	0.3	0.68			2
8/7	0.62	0	15	0.16	0.16	0.16	0	0.16	0	0.77	1.51	0.91	YES		3
8/8	0	0	0	0	0	0	0	0	0	0.68	1.36	0	YES		3
8/9	0	0	0	0	0	0	0	0	0	0	0	0			1
8/10	0	0	0	0	0	0	0	0	0	0	0.36	0			0
8/11	0	0	0	0	0	0	0	0	0	0	0	0			1
8/12	0	0	0	0	0	0	0	0	0	0	0	0			0
8/13	0	0	0	0	0	0	0	0	0	0	0	0			0
8/14	1.3	1	91	0.88	0.88	1	0.4	1.04	0	0.7	1.42	1.14	YES	YES	7
8/15	0	0	0	0.12	0.12	0.12	0.08	0.12	0	0.5	0.94	0			0
8/16	0	0	0	0	0	0	0	0	0	0	0	0			0
8/17	0.02	0	1	0	0	0	0	0	0	0.13	0.15	0.26			20
8/18	1.64	12	85	1.08	1.08	1.08	0.92	1.08	1	0.23	0.37	1.11	YES	YES	4
8/19	0.2	0	25	0.01	0.01	0.01	0	0.01	0	0.6	1.18	0.18	YES		0
8/20	0.03	0	16	0	0	0	0	0	0	0	0	0.03			0
8/21	0.07	0	60	0.04	0.04	0.04	0.04	0.04	0	0.1	0.2	0.11			7
8/22	0.05	0	4	0.08	0.08	0.08	0	0.08	0	0.03	0.06	0.02			3
8/23	0	0	0	0	0	0	0	0	0	0.01	0.02	0			0
8/24	0	0	0	0	0	0	0	0	0	0	0.01	0.01			0
8/25	0	0	0	0	0	0	0	0	0	0.01	0.05	0			1
8/26	0.04	0	12	0	0	0	0	0	0	0.07	0.35	0.11			0
8/27	0.02	0	1	0	0	0	0	0	0	0.06	0.16	0			0
8/28	0	0	0	0	0	0	0	0	0	0	0	0			0
8/29	0.01	0	1	0	0	0	0	0	0	0	0	0			0
8/30	0	0	0	0	0	0	0	0	0	0	0	0			0

	CoCoRaHS			ALERT						NOAA Stage IV			Flood Day Classification		Threat
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
8/31	0.1	0	8	0	0	0	0	0	0	0.1	0.18	0.14			0
9/1	0.02	0	1	0	0	0	0	0	0	0.01	0.02	0.01			4
9/2	0	0	0	0	0	0	0	0	0	0	0.03	0			1
9/3	0	0	0	0	0	0	0	0	0	0	0.77	0			1
9/4	1.95	6	94	1.28	1.4	1.44	0.48	1.44	1	0	0.07	1.57	YES	YES	6
9/5	0.07	0	62	0.04	0.04	0.08	0.04	0.08	0	1.25	2.61	0.22	YES		10
9/6	0.27	0	74	0.08	0.08	0.08	0.08	0.08	0	0.75	1.47	0.91	YES		6
9/7	0.01	0	2	0	0	0	0	0	0	0.01	0.01	0.01			0
9/8	0.01	0	1	0	0	0	0	0	0	0	0	0.02			0
9/9	0.09	0	10	0	0	0	0	0	0	0.18	0.35	0.21			0
9/10	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01			0
9/11	0.03	0	3	0	0	0	0	0	0	0.1	0.2	0.1			0
9/12	0	0	0	0	0	0	0	0	0	0.01	0.03	0			0
9/13	0	0	0	0.12	0.12	0.12	0.08	0.12	0	0	0	0			0
9/14	0	0	0	0	0	0	0	0	0	0	0	0			0
9/15	0	0	0	0	0	0	0	0	0	0	0	0			1
9/16	0	0	0	0	0	0	0	0	0	0	0	0.01			0
9/17	0	0	0	0	0	0	0	0	0	0.03	0.06	0.03			0
9/18	0	0	0	0	0	0	0	0	0	0	0	0			0
9/19	0.84	0	79	0.24	0.24	0.24	0.02	0.24	0	0.53	0.81	0.73			4
9/20	0	0	0	0.04	0.04	0.04	0	0.04	0	0.48	0.94	0.01			0
9/21	0	0	0	0	0	0	0	0	0	0	0	0			0
9/22	0	0	0	0	0	0	0	0	0	0	0	0			0
9/23	0.04	0	1	0	0	0	0	0	0	0	0	0			1
9/24	0.05	0	3	0	0	0	0	0	0	0.08	0.15	0.11			0
9/25	0	0	0	0	0	0	0	0	0	0	0.03	0			0
9/26	0	0	0	0	0	0	0	0	0	0	0	0			0
9/27	0	0	0	0	0	0	0	0	0	0	0	0			0
9/28	0.02	0	3	0	0	0	0	0	0	0	0	0			0
9/29	0.03	0	6	0	0	0	0	0	0	0	0	0			0
9/30	0.02	0	17	0	0	0	0	0	0	0	0	0			0