



Apache Junction FRS, looking E towards the Superstition Mountains, 09-29-2019, FCD O&M Staff

Flood Control District of Maricopa County

Flood Warning Branch

MSP Verification Report & Season Recap: Monsoon Season 2019



TABLE OF CONTENTS

INTRODUCTION 3

MSP PRODUCT DESCRIPTION 4

2019 MONSOON SEASON RECAP 6

MSP VERIFICATION METRICS AND CRITERIA11

OUTLOOK VERIFICATION15

MESSAGE VERIFICATION.....17

LAKE ALERT VERIFICATION19

QPF STORM TOTAL PRECIPITATION VERIFICATION20

SUMMARY22

APPENDIX A: MSP OUTLOOKS - VERIFICATION TABLES24

APPENDIX B: MSP MESSAGES - VERIFICATION TABLES63

APPENDIX C: MSP LAKE ALERTS - VERIFICATION TABLES73

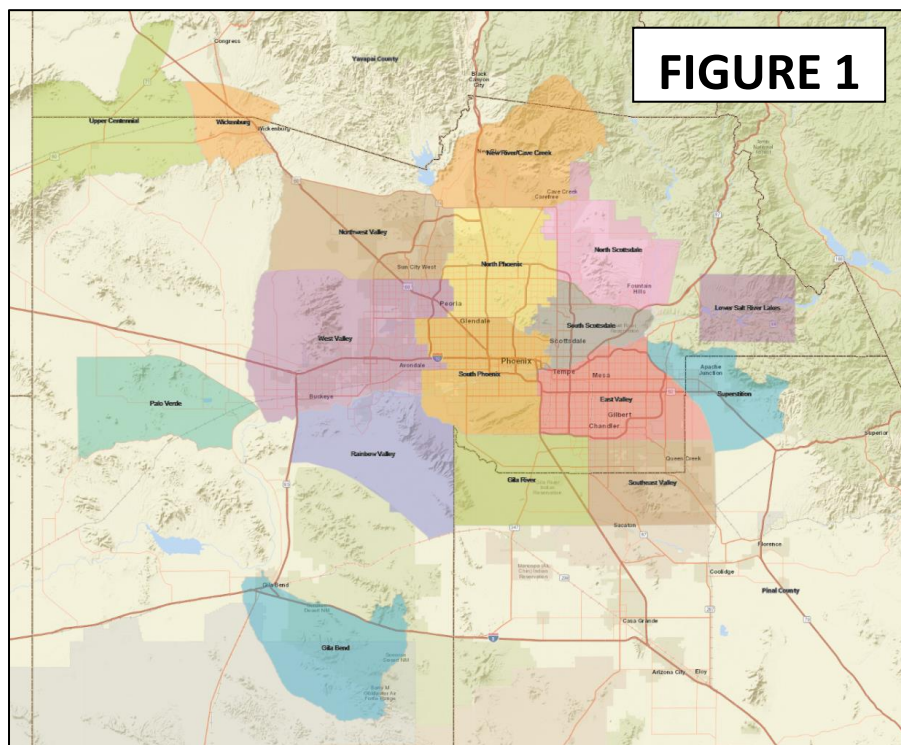
APPENDIX E: QPF STORM TOTAL PRECIPITATION - VERIFICATION TABLES75

INTRODUCTION

This report was generated by the Flood Warning Branch of the Flood Control District of Maricopa County (FCDMC). It covers the length of the monsoon season as defined by the National Weather Service Phoenix WFO: June 15th- September 30th. This report includes daily records on Weather Outlooks and Statements issued by the Meteorological Services Program (MSP) as well as a complete verification and summary of these products.

The Flood Warning Branch of the FCDMC operates a year-round MSP that's purpose is to provide detailed meteorological forecasts and support to county, city, and other local agencies. The program covers 5,400 square miles encompassing Maricopa County and surrounding watersheds. The goal of the Flood Control District's MSP is to reduce response time for emergency managers by providing timely and accurate weather information, primarily regarding the potential for flood-producing rainfall. During the length of the Monsoon season the MSP goes on a weekly rotating 24/7 manned schedule. A Duty Officer is selected for each day who is responsible for issuing MSP products, providing support to clients, and serves as the on-call supervisor during non-business hours. A supporting officer is also named and can be available to the duty officer in the case of a significant weather event. All MSP forecast products are disseminated via email and text alerts. Emergency managers may also be notified by telephone to aid in decision making.

The MSP has broken down the 5,400 square mile operational area into 17 forecast zones. These zones are the primary warning areas identified by emergency management officials. A map of the forecast zone locations is shown below in Figure 1.



MSP PRODUCT DESCRIPTION

Weather Outlook:

The Weather Outlook is disseminated to clients daily no later than 2PM during the monsoon season. This product covers the today through tomorrow period and occasionally the following 2-3 days where appropriate. Occasionally, due to unexpected weather pattern changes, Weather Outlooks will be updated throughout the day or first thing the following morning. Weather Outlooks include a synopsis of expected weather conditions; the “probability of occurrence” of rain; the expected “prime time” for the bulk of the rain; and the amount of rain expected during the prime time period. Temperature forecasts and trends are included as well as a forecast of peak wind speeds. Click [here](#) for an example.

Message 1 – Alert:

When it is believed developing weather conditions may lead to heavy rain and/or minor to moderate flooding an Alert is issued. Lead time will generally be less than an hour in advance of the expected event. The Alert will normally identify the affected zone(s), the time frame of the event (valid time), rainfall potential, and the type of areas that will be impacted, such as roads and/or washes. Click [here](#) for an example.

Message 2 – Flash Flood Watch:

When it appears the developing weather event may lead to flash flooding a Watch is issued for the possible affected areas. Lead time will generally be 1 to 2 hours in advance of the expected event, but can stretch to a day or more with reliable guidance. The Watch will include the time frame it will be in effect (valid time), and a section describing what may take place (comments). Click [here](#) for an example.

Message 3 – Flash Flood Warning:

When it appears that significant flash flooding is imminent or has started to take place, a Warning will be issued for the affected areas. Lead time will generally be less than an hour. The Warning will normally identify the affected zone(s), a time frame of the event, rainfall potential, and a section describing what is expected to take place (comments). Click [here](#) for an example.

Message 1, 2 and 3 Update:

This product, issued as needed, will update an existing Alert, Watch or Warning. Click [here](#) for an example.

Message 4 – Cancel:

When an event (Watch or Warning) no longer poses a threat, and the expiration time has not been reached, a Cancel message may be issued. Click [here](#) for an example.

Lake Alerts:

In addition to the above MSP program, weather guidance is provided for Maricopa County lakes/reservoirs from June 15 through September 30. Lake Alerts are issued as needed to inform of approaching adverse weather conditions. Emphasis in these statements is on expected wind gusts and lightning activity. Click [here](#) for an example.

Additional Products:

At the request of clients, site specific products may be issued to support unusual or special operations, such as specific wind forecasts to aid in the fighting of fires, or forecasting for special events at the County lakes or parks, or District construction projects.

Additional information and data regarding the FCDMC can be found online [here](#)

2019 MONSOON SEASON RECAP

According to the FCDMC ALERT rain gage network, the 2019 monsoon season was characterized as being drier than normal. When averaged across 287 of the oldest county mesonet rain gages, 2.59" of rain fell which was 88% of the mean value of 2.97". An image showing a 37 year period of record can be viewed [here](#). It's worth noting below average rainfall was recorded at Sky Harbor Airport for the fourth season in a row. The official rain total as reported by the NWS Phoenix office was 0.66" which was 2.05" below the period average of 2.71" and also ranked as the fifth driest on record. Click [here](#) to see a technical summary plot from Sky Harbor Airport covering the monsoon season courtesy of the University of Arizona CSAP/CLIMAS organization. Figure 2, below, offers a more comprehensive picture of the rainfall distribution across the MSP forecast area. This figure was generated using FCDMC ALERT rain gage data from around the county. The shaded contours depict precipitation totals from June 15th – September 30th.

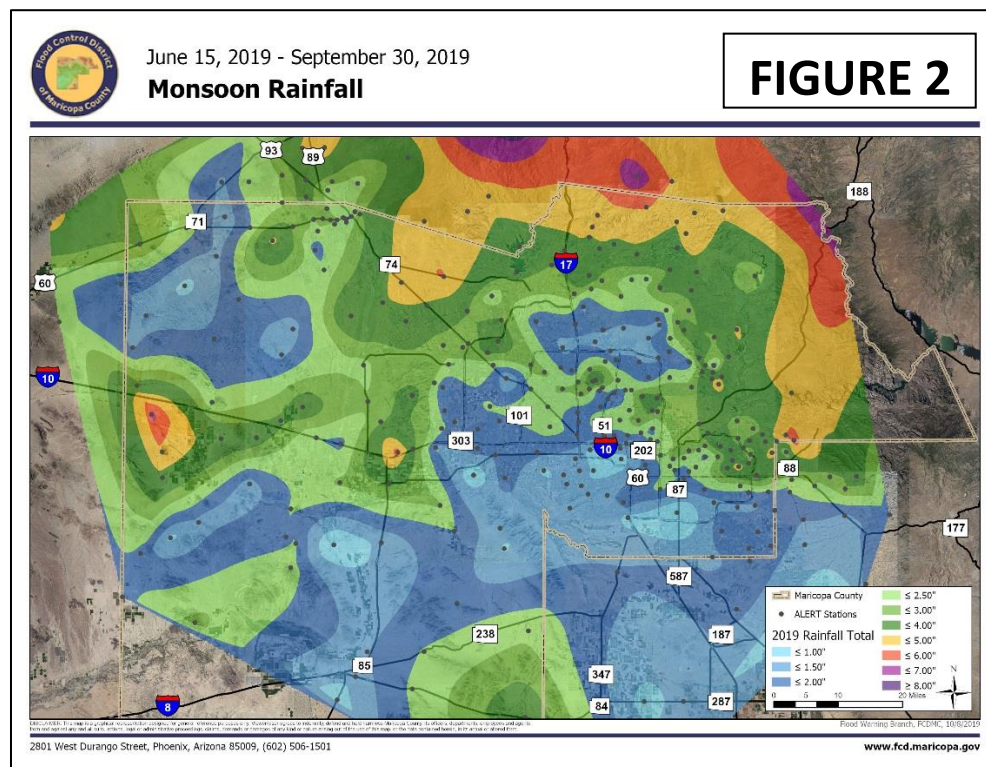
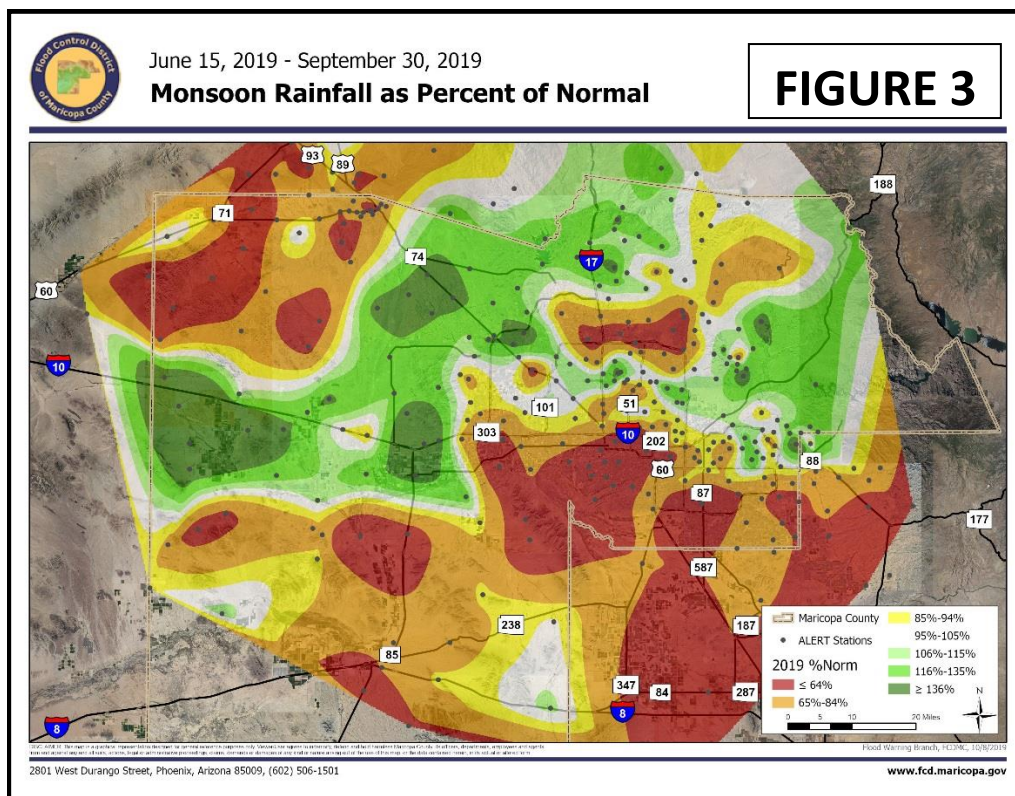


Figure 3, on the next page, shows the ratio of 2019 monsoon precipitation versus average monsoon precipitation. Similar to Figure 2, contours were generated using FCDMC ALERT rain gage data from around the county. Most of the southern half of Maricopa County including Avondale east through Phoenix and into the Southeast Valley (Tempe, Chandler, Gilbert, etc) saw below to well below average rainfall totals for the season. Similarly, far northwest locations such as Wickenburg and Aguila were equally as dry. Above average rain fell along the I-10 corridor from Buckeye west to the county line and from Sun City northwest into Morristown. Far

north Phoenix and Anthem also had a wet summer. Some parts of the East Valley including Mesa and Utery Mountains were also wetter than average. These two figures serve as a strong reminder to the importance of having a widely distributed rain gage network in order to fully capture the distribution of monsoon rains.



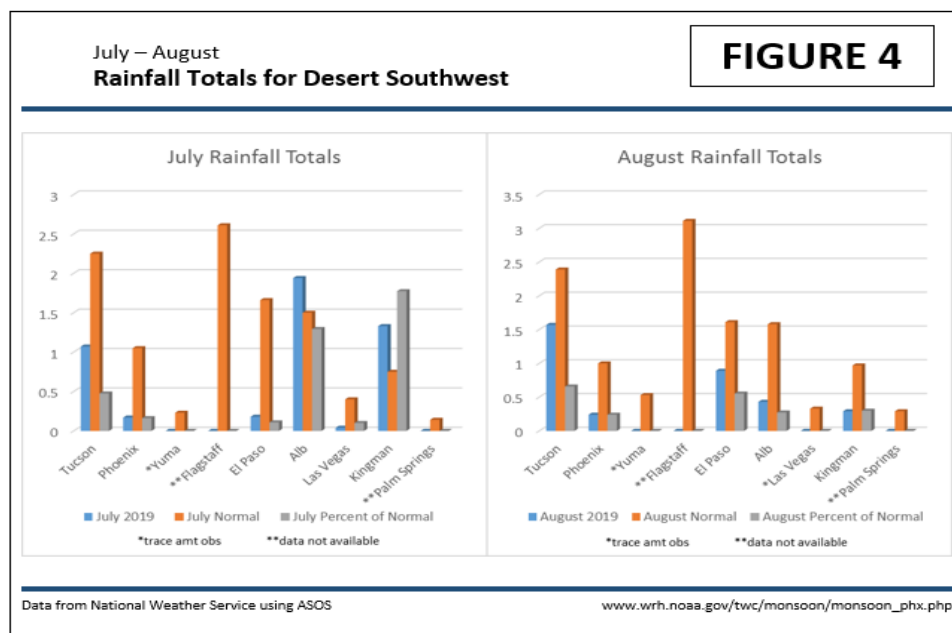
After an abnormally wet winter, the onset of the 2019 monsoon season was rather late, holding off until the fourth week of July. It tied for the 2nd latest start date according to NWS records going back to 1948. Monsoon statistics for Phoenix Sky Harbor can be found [here](#). The initial setup of the subtropical ridge over the four corners region occurred during the second week in July. After this, the dew point temperatures spiked but then dropped below the seasonal norms as the high-pressure system migrated further south. Daily thunderstorm activity mostly remained outside of Maricopa County after the initial moisture surge for a couple of weeks before finally moving over the Phoenix metro area. Starting July 21, high pressure re-established over the Four Corners region allowing enough moisture to infiltrate the Valley to finally kick off Monsoon season 2019 for Phoenix as elevated dew points remained consistent for the next three weeks according to the daily dew point tracker which can be found [here](#).

The first widespread rainfall event for the Valley occurred on July 22nd. While not a particularly impressive setup, several locations received over a half-inch of rain and the first MSP statement was issued due to localized strong thunderstorms and heavy rainfall for the East Valley and Scottsdale South zones. July was also a hot one. The Valley saw 11 days with a high of at least 110°F whereas the normal is 8 days, according to National Weather Service records going back to 1960, which can be accessed [here](#). Overall the month finished out

relatively quiet with only a few noteworthy days where storms made it into the Valley. Precipitation amounts generally totaled below 0.50" but some localized areas received as much as 1.50".

Overall, August was another extremely quiet month with the Valley remaining relatively storm-free for all but a couple of days. The monsoon went on hiatus as the ridge shifted further east over Texas/NM, leaving AZ high and dry for ten days during the middle of the month. Surface dewpoints for Phoenix during this time plummeted down into the 30s allowing temperatures to soar with average daily highs over 110°F. In late August, another pattern shift allowed for moisture-rich southerly flow to redevelop. Widespread t-storms developed across the greater Phoenix Valley during the evening of August 28th. Activity aided by colliding outflow boundaries moved from the Southeast Valley into portions of Phoenix and Scottsdale before expanding west into Peoria and Surprise. These areas saw anywhere from 0.25" to 1.10" of rain. A favorable pattern persisted the next several days but a lack of forcing for storms meant that the Valley missed out on typical thunderstorm activity. Despite some localized monthly totals over the 1.00" mark, the majority of ALERT stations registered less than half an inch August. An overall lack of rain left us longing for more as it seemed that monsoon season was all but over.

Approximately 70% of the monsoon rainfall for the Desert Southwest occurs during the months of July and August. In Phoenix, this number is slightly higher at around 76%. On average, locations around the County typically realize about 2.00" of rain during these two months. When looking across the entire ALERT network, only nine gauges had received 2.00" or greater (Note that four of these were located in Yavapai County in the Bradshaw Mtns). Furthermore, there were only thirty-eight gauges that registered 1.50" or greater during this period. Out of the 356 rain gauges scattered throughout Maricopa and surrounding counties, less than 5% received near average rainfall during what is usually the peak of the monsoon! Figure 4 below compares the July/August rainfall from 2019 vs normal at different cities across the Desert Southwest and further highlights how dry the region was.



Activity picked up during the first part of September thanks to the return of the monsoon ridge over the Four Corners region promoting deep E/SE flow. On September 1st higher terrain regions near the outskirts of the county saw up to two inches of rain and resulted in some flooding in the southwestern zones including Sand Tank Wash near Gila Bend and Centennial Wash. Some of the more urban areas only received a trace but outflow boundaries produced a noteworthy dust storm near the southern end of the Valley which overtook South Mountain. A couple of disturbances mid-month brought more storms to the Valley. First, on September 14th an inverted trough moved up from Sonora bringing rain and a dust storm to the East Valley followed by a Pacific Low on September 16th that was highlighted by heavy precipitation in Buckeye. The Buckeye FRS #2 gauge, near I-10 and Highway 85, received 2.44” with just over 1.50” coming in an hour. The third week of the month was uneventful as storms took a break and average temperatures persisted, thus preceding the most significant event of the year with Hurricane Lorena forming in the Eastern Pacific on September 17th.

The transition event that occurred from September 22nd – 26th was the biggest precipitation and severe weather producer of the season across southcentral AZ. In fact when averaged across all the ALERT rain gauges, the rain from this event accounted for 40% of the total rain that fell during the monsoon! The remnants of former Hurricane Lorena over northern Mexico provided ample moisture, and upper-level dynamics came from a vigorous Pacific system that formed into a cutoff low over the Great Basin. The closed low stalled out for several days over northern Baja and interacted with Lorena's remnant moisture which resulted in multiple rounds of severe weather and widespread rainfall. The first areas were hit in the early morning hours of the 23rd with the East Valley receiving anywhere from 0.50” – 3.50+” in under 12 hours. East Mesa and Apache Junction experienced severe flash flooding where multiple water rescues took place and water behind the Apache Junction FRS reached historic levels. Storms continued throughout the day with the peak activity shifting further west with equally impressive totals. Several severe storms that developed resulted in reports of wind damage across the Valley, quarter size hail in North Scottsdale and even a [tornado](#) touching down in New River north of Phoenix. A complete storm overview of this event was generated by the FCDMC and can be viewed [here](#). The last few days of September finished on a quiet note marking the official close of the monsoon season.

MSP Issued Products Recap:

A total of seventy-eight forecast zone-specific messages were issued by the MSP spread across twelve different days during the length of the monsoon season. Table 1, below, shows the monthly break down by forecast zone of messages issued including season totals.

TABLE 1: MSP Messages Issued - 2019 Monsoon Season					
Forecast Zone	June	July	August	September	Total
Gila Bend	0	0	0	2	2
Gila River	0	0	0	2	2
Palo Verde	0	0	0	4	4

TABLE 1: MSP Messages Issued - 2019 Monsoon Season					
Forecast Zone	June	July	August	September	Total
Rainbow Valley	0	0	0	4	4
West Valley	0	0	1	7	8
Northwest Valley	0	0	1	6	7
Upper Centennial	0	0	1	2	3
Wickenburg	0	0	1	4	5
New River/Cave Creek	0	0	0	3	3
Phoenix North	0	0	0	3	3
Phoenix South	0	0	1	5	6
Scottsdale North	0	0	1	8	9
Scottsdale South	0	1	2	4	7
East Valley	0	2	0	5	7
Southeast Valley	0	0	0	2	2
Lower Salt River Lakes	0	0	0	2	2
Superstition	0	1	0	3	4
All Zones	0	4	8	66	78

Of the seventy-eight Messages issued, fifty were Message-1 Alerts, seventeen were Message-2 Flash Flood Watches, eleven were Message-3 Flash Flood Warnings, and zero Message-4 Cancel. Table 2, below, shows the monthly break down by forecast zone of Lake Alerts issued including season totals. Only eighteen Lake Alert statements were issued for the County Lakes Program including Lake Pleasant, Bartlett Lake, Saguaro Lake, Canyon Lake, and Apache Lake. The Alert Operation Center (AOC) was not activated during this monsoon season as none of the rain events ended up posing any serious threat to county/city dams or District flood control facilities.

TABLE 2: MSP Lake Alerts Issued - 2019 Monsoon Season					
Recreational Zone	June	July	August	September	Total
Lake Pleasant	0	0	2	0	2
Horseshoe Lake	0	0	0	0	0
Bartlett Lake	0	0	2	3	5
Saguaro Lake	0	0	1	3	4
Canyon Lake	0	1	1	3	5
Apache Lake	0	0	0	2	2
All Zones	0	1	6	11	18

MSP VERIFICATION METRICS AND CRITERIA

Several key verification metrics and a clear set of operational based criteria were adopted in order to conduct a thorough and complete verification of MSP products issued during the 2019 monsoon season. This chapter is broken down into five sections: Outlooks, Messages, Lake Alerts, and Storm Total Precipitation. Each section discusses the verification metrics used and the criteria followed to compute the statistics displayed in the summary chapter sections. A list of frequently used terms including definitions and acronyms as used throughout this report is listed below.

Observed Rainfall: the amounts of total rainfall gathered from either ALERT rain gages, gage corrected radar estimations, or local storm reports (LSRs).

Operationally Significant Event (OSE): a rain event within a MSP forecast zone with observed rainfall equal or greater than 0.50”.

Hit: considered a correct forecast.

Miss: considered an incorrect forecast.

Correct Negative: considered a correct forecast ex. no rain forecast and no rain observed.

Forecast Accuracy: a measure of the ability to correctly forecast daily rainfall potential. Given in percent and calculated using Equation 1 below:

$$(1) \text{ Forecast Accuracy} = \left(\frac{\text{Correct Forecasts}}{\text{Total Forecasts}} \right) \times 100$$

Probability of Detection (POD): a measure of the ability to correctly discriminate heavy rain days (OSEs) from non-rain/minor rain days. Given in percent and calculated using Equation 2 below:

$$(2) \text{ POD} = \left(\frac{\text{OSEs Correctly Detected}}{\text{Total OSEs}} \right) \times 100$$

False Alarm: occurs when an OSE is forecast for a location but does not occur.

False Alarm Rate: measures the number of false alarms compared to forecast days i.e. over-forecasting. Given in percent and calculated using the Equation 3 below:

$$(3) \text{ FAR} = \left(\frac{\text{False Alarms}}{\text{Total Forecasts}} \right) \times 100$$

Threat Score: measures the fraction of observed and/or forecast events that were correctly predicted. TS can be thought of as forecast accuracy when correct negatives have been removed from consideration. Given in percent and calculated using Equation 4 below.

$$(4) \quad TS = \left(\frac{Hits}{Hits + Misses + False\ Alarms} \right) \times 100$$

Percent Error: a measure of relative error given in percent. Calculated using Equation 4 below:

$$(5) \quad \% \text{ Error} = \left(\frac{Forecast - Observed}{Observed} \right) \times 100$$

Quantitative Precipitation Forecast (QPF): forecast zone or basin specific rainfall forecast including a rainfall amount given in inches and/or intensity.

in percent, that rainfall that could occur within a forecast zone or basin, usually given in conjunction with a QPF.

Gage Adjusted Quantitative Precipitation Estimate (GAQPE): radar estimated rainfall total, product provided by WDT Inc.

Lead Time: the amount of time between when the forecast statement was issued/valid and the onset of the event (observable).

Qualifying Event: an issued statement/QPF that counts in the verification process.

The following five sections explain the development of verification statistics as tabulated in Appendix A-E.

OUTLOOKS:

Forecast Accuracy:

Either a hit or a miss was selected for each day. A hit was assigned when observed rainfall met or exceeded the QPF. A miss was assigned when rainfall was observed and no QPF was made or if observed rainfall failed to reasonably meet the QPF. In some cases a hit was assigned when the QPF was not reasonably met by observed rainfall. In these cases the probability of occurrence was 30% or less and the QPF was below the OSE threshold. Values were then populated for each forecast zone and all zones combined. Forecast accuracy was then calculated by month.

Probability of Detection:

A dash was assigned to all days when observed rainfall was below the OSE threshold. On days when observed rainfall met or exceeded the OSE threshold either a hit or a miss was assigned. A hit was selected when the observed rainfall reasonably met the QPF. A miss was assigned when observed rainfall greatly exceeded the QPF or if no QPF was issued. Values were then populated for each forecast zone and all zones combined. A probability of detection was calculated by month and season total.

False Alarm Rate:

False alarms were denoted by an “x”. A false alarm was assigned on days where the observed rainfall failed to meet the OSE threshold, yet the QPF called for an OSE with a high probability of occurrence. The two relationships below outline the above criteria.

*Probability $\geq 40\%$ and QPF ≥ 0.50 ” **AND** Observed Rain < 0.50 ”*

*Probability = 30% and QPF ≥ 1.00 ” **AND** Observed Rain < 0.50 ”*

Values were then populated for each forecast zone and all zones combined. False alarm rate was then calculated by month and season total.

Threat Score:

Similar to Forecast Accuracy, a Threat Score or Critical Success Index was calculated. Threat score is only concerned with forecasts that count (days with observable rain) and assumes correct negatives are not important. Values were populated for each forecast zone and all zones combined for the length of the season.

Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP daily Outlooks can be found in [Appendix A](#).

MESSAGES:Forecast Accuracy:

A hit was assigned if a rain, stream, or dam alarm was triggered during the valid period of the issued Message and/or if observed rainfall reasonably met the QPF during the valid period. Conversely a miss was assigned if neither of these two criteria were met. Values were then populated for each forecast zone and all zones combined. Forecast accuracy was then calculated by month and season total.

Lead Time:

Lead time was calculated for each issued Message when possible. Time was measured from Message issuance to the first ALERT alarm triggered (rain, stream, or impoundment).

Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP Messages can be found in [Appendix B](#).

LAKE ALERTS:Forecast Accuracy:

A hit was assigned if any of the following observations occurred during the valid period of the issued Lake Alert: lightning within the recreational area boundary, wind > 30 mph, or hail/heavy rain. Conversely a miss was assigned if none of these three criteria were observed. Values were then populated for each recreational zone and all zones combined. Forecast accuracy was then calculated by month and season total.

Lead Time:

Lead time was calculated for each issued Lake Alert when possible. Time was measured from the Lake Alert issuance to the first observation (lightning within the recreational area boundary, wind > 30mph, or hail/heavy rain).

Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP Lake Alerts can be found in [Appendix C](#).

STORM TOTAL PRECIPITATION:**Forecast Accuracy:**

Only message statements where a QPF storm total precipitation amount was provided were evaluated. Observational data used for this verification included Maricopa County ALERT rain gages, local storm reports, and/or radar GAQPE. Either a hit or a miss was selected for each qualifying event. A hit was assigned if the percent error was less than or equal to 25%. Conversely a miss was assigned if the percent error was greater than 25%. Values were then populated for each forecast zone and all zones combined. Forecast accuracy was then calculated by month and season.

Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP Messages can be found in [Appendix E](#).

OUTLOOK VERIFICATION

Table 3, below, shows the Outlook verification seasonal totals for each Forecast Zone (FZ). Complete data tables for each FZ, separated by month, can be viewed in [Appendix A](#): Table A-1. Overall, Outlook forecast accuracy during the length of the monsoon season for all FZs combined was excellent at 90.1%. Forecast accuracy remained above the 86% threshold for each FZ. Furthermore, ten out of the seventeen FZs accuracy was above 90%. A late start to the monsoon onset and subsequent dry July and August assisted in the overall forecast accuracy for each of the FZs.

TABLE 3: MSP Weather Outlook Verification - SEASON TOTALS, 2019							
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)	TS (%)
Gila Bend	98/108	90.7%	14/17	82.4%	0/108	n/a	83.1%
Gila River	96/108	88.9%	5/8	62.5%	1/108	1%	78.3%
Palo Verde	99/108	91.7%	7/9	77.8%	0/108	n/a	84.7%
Rainbow Valley	95/108	88%	6/10	60%	0/108	n/a	78%
West Valley	93/108	86.1%	5/8	62.5%	0/108	n/a	74.6%
Northwest Valley	99/108	91.7%	5/8	62.5%	0/108	n/a	84.7%
Upper Centennial	98/108	90.7%	6/11	54.6%	0/108	n/a	83.1%
Wickenburg	98/108	90.7%	5/6	83.3%	0/108	n/a	83.1%
New River/Cave Creek	93/108	86.1%	8/12	66.7%	1/108	1%	73.3%
Phoenix North	98/108	90.7%	7/9	77.8%	0/108	n/a	83.1%
Phoenix South	98/108	90.7%	4/10	40%	1/108	1%	81.7%
Scottsdale North	104/108	96.3%	9/9	100%	0/108	n/a	93.2%
Scottsdale South	100/108	92.6%	4/9	44.4%	0/108	n/a	86.4%
East Valley	99/108	91.7%	5/6	83.3%	2/108	1.9%	82%
Southeast Valley	97/108	89.8%	6/6	100%	2/108	1.9%	78.7%
Lower Salt River Lakes	93/108	86.1%	9/9	100%	3/108	2.8%	71%
Superstition	96/108	88.9%	8/8	100%	2/108	1.9%	77%
All Zones	1654/1836	90.1%	113/155	72.9%	12/1836	0.7%	80.9%

The next metric computed was probability of detection. This metric was quite important because it distinguished how well MSP forecasters detected operationally significant events. Operationally significant events were defined as having 0.50" of rainfall or more. The POD during the length of the monsoon season for all FZs combined was 72.9%. In general, a POD of over 50% is considered sufficient and over 75% excellent in the forecast community. Fifteen out of the seventeen FZs were above the 50% accuracy threshold with nine meeting or exceeding the 75% accuracy threshold. The next metric included in Table 3 was False Alarm Rate (FAR). It is important to keep track of how often MSP forecasters predicted an operationally significant day that did not occur. Too many false alarms can degrade user confidence in the forecasts. In general a FAR below 50% is sufficient and below 25% is

considered excellent within the forecast community. The overall FAR for all zones during the length of the monsoon season was exceptionally low at 0.7% with none of the forecast zones exceeding 3%. A large part of the low FARs throughout the zones had to do with a much slower and drier monsoon as there were many fewer potential rain days.

The final metric included in Table 2 was Threat Score (TS). The monsoon season officially runs from June 15th through September 30th of each year, yet the operational season (active weather days) tends to be much shorter beginning sometime in early July and finishing by mid-September. TS is thought to serve as a better metric for overall forecast skill as it removes correct negatives that are not important when computing forecast accuracy i.e. dry days before and after the active monsoon season. This year forty-nine dry days were removed from 108 day total length of the monsoon season. Overall, forecast skill was quite good at 80.9% for all FZs over the length of the active season. Fourteen of the seventeen FZs exceeded the 75% accuracy threshold, while the remaining three FZs remained above the 71% threshold.

MESSAGE VERIFICATION

The MSP messages carry a higher priority threat-wise than the daily outlooks. These statements (Alerts, Watches, and Warnings) serve as the most critical products issued by the MSP during the monsoon season to our clients. A high level of accuracy is required when forecasting these types of events as the information they provide is directly applicable to the potential or imminent flooding situation. All of the messages issued fall under the category of operationally significant events.

Table 4, on the next page, shows the issued message verification broken down by FZ and month. Complete data tables for each FZ can be viewed in [Appendix B](#): Tables B-1, B-2, and B-3. There were seventy-eight qualifying messages (updates and M-4s not included) issued over the length of the season. Forecast accuracy for all FZs combined, over the length of the season, was exceptional at 92.3%. Fourteen out of seventeen FZs met or exceeded the 75% accuracy threshold with the remaining three coming in right at the 50% threshold.

Overall, it ended up being a drier than normal Monsoon. On average, 131 qualifying message statements are typically issued during the length of the monsoon (based on MSP Verification Reports since 2012). There were significantly fewer number of operationally significant days (twelve) and as a result there were only seventy-eight messages issued. Eleven out of the seventeen FZs had five or fewer messages issued and four zones only had two issued messages each including all three FZs that had forecast accuracy at the 50% threshold.

No messages were issued in the month of June. The majority of July was very dry and as a result the first messages of the season were issued on the evening of July 22nd for portions of the East Valley. Only two more messages were issued in July and both fell on July 30th again across portions of the East Valley. All four messages verified. August was equally as dry across the region and only eight messages were issued. August 28th was the most active day in the month with five messages issued for widespread t-storms that moved across the heart of the Valley. All of the issued messages in August verified.

September was easily the busiest month with sixty-six messages issued across seven operationally significant days. Overall forecast accuracy for the month for all FZs combined was 89.4%. There were six false alarms (misses) in September the first two of the operational season didn't occur until September 3rd. July 23rd was the most active day from an operational perspective with forty-six message issued. A Flash Flood Watch (Message-2) was issued for all FZs. All but two of these messages (Gila Bend and Gila River) verified. Lead time was the final metric included for message statement verification this year. The average lead time (data in [Appendix B](#), Table B-3) for all M-1 Alerts combined over the length of the monsoon season was thirty-two minutes. The average lead time for M-2 Flash Flood Watches was just over six and half hours.

TABLE 4: MSP Issued Statements Verification, broken down by month and Forecast Zone - Monsoon Season 2019

	June		July		August		September		Season Totals	
Forecast Zone	Correct Statements	AOF (%)	Correct Statements	AOF (%)	Correct Statements	AOF (%)	Correct Statements	AOF (%)	Correct Statements	AOF (%)
Gila Bend	0/0	n/a	0/0	n/a	0/0	n/a	1/2	50%	1/2	50%
Gila River	0/0	n/a	0/0	n/a	0/0	n/a	1/2	50%	1/2	50%
Palo Verde	0/0	n/a	0/0	n/a	0/0	n/a	4/4	100%	4/4	100%
Rainbow Valley	0/0	n/a	0/0	n/a	0/0	n/a	4/4	100%	4/4	100%
West Valley	0/0	n/a	0/0	n/a	1/1	100%	7/7	100%	8/8	100%
Northwest Valley	0/0	n/a	0/0	n/a	1/1	100%	6/6	100%	7/7	100%
Upper Centennial	0/0	n/a	0/0	n/a	1/1	100%	2/2	100%	3/3	100%
Wickenburg	0/0	n/a	0/0	n/a	1/1	100%	4/4	100%	5/5	100%
New River/Cave Creek	0/0	n/a	0/0	n/a	0/0	n/a	3/3	100%	3/3	100%
Phoenix North	0/0	n/a	0/0	n/a	0/0	n/a	3/3	100%	3/3	100%
Phoenix South	0/0	n/a	0/0	n/a	1/1	100%	5/5	100%	6/6	100%
Scottsdale North	0/0	n/a	0/0	n/a	1/1	100%	7/8	87.5%	8/9	88.9%
Scottsdale South	0/0	n/a	1/1	100%	2/2	100%	3/4	75%	6/7	85.7%
East Valley	0/0	n/a	2/2	100%	0/0	n/a	4/5	80%	6/7	85.7%
Southeast Valley	0/0	n/a	0/0	n/a	0/0	n/a	1/2	50%	1/2	50%
Lower Salt River Lakes	0/0	n/a	0/0	n/a	0/0	n/a	2/2	100%	2/2	100%
Superstition	0/0	n/a	1/1	100%	0/0	n/a	3/3	100%	4/4	100%
All Zones	0/0	n/a	4/4	100%	8/8	100%	59/66	89.4%	72/78	92.3%

LAKE ALERT VERIFICATION

Weather guidance is provided to Maricopa County lakes/reservoirs and the recreational zones which encompass them in the form of lake alerts. These statements are issued as needed to inform staff/personnel of approaching adverse weather conditions with an emphasis on wind gusts and lightning activity and then to a lesser degree hail/heavy rainfall. A high level of accuracy is required when forecasting these types of events as lake alerts are considered warnings to the recreational community (staff, boaters, hikers, and campers).

Table 5, below, shows the issued lake alert verification broken down by recreational zone and month. Complete data tables for each recreational zone can be viewed in [Appendix C: Table C-1](#). There were only eighteen lake alerts issued over the length of the season with the majority of them occurring in September. No statements were issued for the Horseshoe Lake recreational zone for the entire season due to a lack of water in the reservoir. Forecast accuracy for the remaining five recreational zones combined, over the length of the season, was 83.3%. Four out of the five zones met or exceeded the 75% accuracy threshold with the lowest forecast accuracy of 50% recorded at Lake Pleasant. As stated earlier, 50% accuracy is considered sufficient and 75% and above is considered excellent within the forecast community. The average lead time (not shown) for all lakes/reservoirs combined over the length of the monsoon season was just over 20 minutes.

TABLE 5: MSP Lake Alerts Issued - 2019 Monsoon Season										
	June		July		August		September		Season Totals	
Recreational Zone	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)
Lake Pleasant	0/0	n/a	0/0	n/a	2/2	100%	0/0	n/a	1/2	50%
Horseshoe Lake	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a
Bartlett Lake	0/0	n/a	0/0	n/a	1/2	50%	3/3	100%	4/5	80%
Saguaro Lake	0/0	n/a	0/0	n/a	1/1	100%	3/3	100%	4/4	100%
Canyon Lake	0/0	n/a	0/1	100%	0/1	0%	3/3	100%	4/5	80%
Apache Lake	0/0	n/a	0/0	n/a	0/0	n/a	2/2	100%	2/2	100%
All Zones	0/0	n/a	0/1	0%	4/6	66.7%	11/11	100%	15/18	83.3%

QPF STORM TOTAL PRECIPITATION VERIFICATION

The MSP has placed added emphasis on including QPF information within message statements, specifically M-1 Alerts. These messages are normally issued before the onset of rain events and precede warning issuance in order to maximize lead time for affected locations. Providing STP that will likely accompany thunderstorms moving through a FZ is intended to help clients make well-informed and proactive decisions.

Figure 6, below, is a scatter plot depicting forecast versus observed storm total precipitation. An accurate forecast will have points on or near the solid black diagonal line. Two black dashed lines were also included that show the “+/-” 25 percent error thresholds used in the verification process (discussed in the [MSP Verification Metrics and Criteria](#) section). All events that fall between the upper and lower thresholds were considered hits. There were forty-six qualifying message events that counted towards the verification of the STP forecasts and thirty-seven events fell within the error threshold.

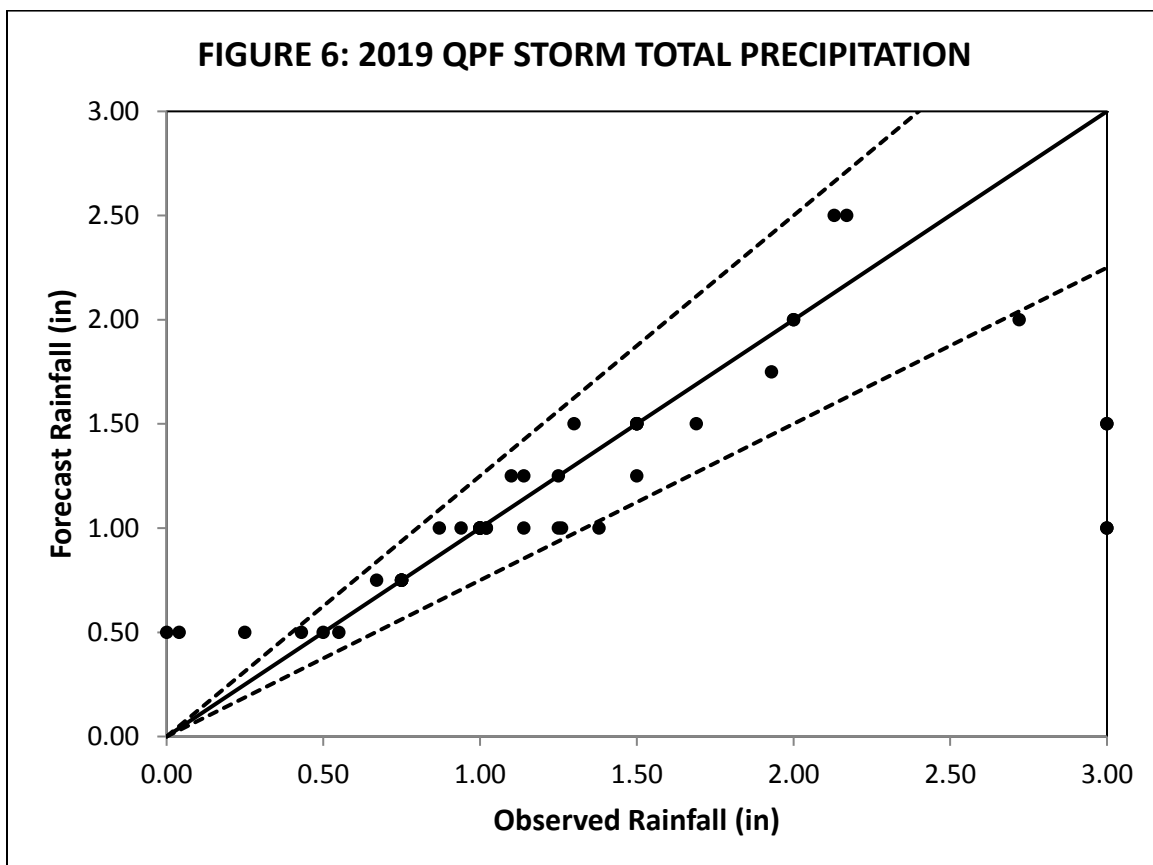


Table 7, on the next page, shows the issued message verification broken down by FZ and month. Complete data tables for each FZ can be viewed in [Appendix E: Table E-1](#). Forecast accuracy for all FZs combined, over the length of the season, was 80.4%. There were no qualifying events in June. Accuracy in July came in at 100% but with only four qualifying

events spread over two different storm days. Accuracy in August continued at 100% across four qualifying events and two operational days. The sample size in both July and August was very small due to meager storm activity. September happened to have the largest number of qualifying events with thirty-eight spread across seven storm days. Forecast accuracy in September came in at 76.3%. Forecast accuracy remained at or above 75% threshold for ten FZs. There were no qualifying events across the Lower Salt River Lakes FZ. Gila River and Southeast Valley each only had one qualifying event neither of which verified.

It is important to remember observed storm total rainfall data is typically gathered from either ALERT rain gages or provided from local storm reports. In either case, accurate measurements of peak rainfall are contingent upon a thunderstorm rain core directly passing over a gage site. In this case, gage adjusted radar rainfall estimates (e.g. GAQPE) were used to fill in the gaps that would otherwise be missed in the FZs.

TABLE 7: QPF Storm Total Precipitation Verification - Monsoon Season 2019

	June		July		August		September		Season Totals	
Forecast Zone	Correct QPF	AOF (%)	Correct QPF	AOF (%)	Correct QPF	AOF (%)	Correct QPF	AOF (%)	Correct QPF	AOF (%)
Gila Bend	0/0	n/a	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%
Gila River	0/0	n/a	0/0	n/a	0/0	n/a	0/1	0%	0/1	0%
Palo Verde	0/0	n/a	0/0	n/a	0/0	n/a	2/2	100%	2/2	100%
Rainbow Valley	0/0	n/a	0/0	n/a	0/0	n/a	3/3	100%	3/3	100%
West Valley	0/0	n/a	0/0	n/a	1/1	100%	2/4	50%	3/4	75%
NW Valley	0/0	n/a	0/0	n/a	0/0	n/a	2/3	66.7%	2/3	66.7%
Upper Centennial	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%	2/2	100%
Wickenburg	0/0	n/a	0/0	n/a	1/1	100%	2/2	100%	3/3	100%
New River/Cave Creek	0/0	n/a	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%
Phoenix North	0/0	n/a	0/0	n/a	0/0	n/a	2/2	100%	2/2	100%
Phoenix South	0/0	n/a	0/0	n/a	0/0	n/a	3/4	75%	3/4	75%
Scottsdale North	0/0	n/a	0/0	n/a	0/0	n/a	4/6	66.7%	4/6	66.7%
Scottsdale South	0/0	n/a	1/1	100%	1/1	100%	3/3	100%	5/5	100%
East Valley	0/0	n/a	2/2	100%	0/0	n/a	2/3	66.7%	4/5	80%
Southeast Valley	0/0	n/a	0/0	n/a	0/0	n/a	0/1	0%	0/1	0%
Lower Salt River Lakes	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a
Superstition	0/0	n/a	1/1	100%	0/0	n/a	1/1	100%	2/2	100%
All Zones	0/0	n/a	4/4	100%	4/4	100%	29/38	76.3%	37/46	80.4%

SUMMARY

The Flood Warning Branch of the FCDMC operates a year round Meteorological Services Program (MSP) that's purpose is to provide detailed weather forecasts and support to county, city, and other local agencies encompassing Maricopa County and its contributing watersheds. In particular, during the length of the monsoon season, it is the specific the goal of the MSP to reduce response time for emergency managers by providing timely and accurate weather information, primarily regarding the potential for flood-producing rainfall. This report provides a compiled set of verification statistics based on products issued by the MSP during the length of the 2019 monsoon season. Outlooks, Messages, Lake Alerts, and QPF Storm Total Precipitation were the four products analyzed in this report.

Verification of daily outlooks was conducted using four metrics: forecast accuracy, probability of detection, false alarm rate, and threat score. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 90.1%, probability of detection was 72.9%, the false alarm rate was 0.7%, and the Threat Score was 80.9%. All metrics fell into the "excellent" category except for probability of detection, which was still considered "satisfactory" when equating these results with accepted values within the forecast community.

Verification of messages was conducted using forecast accuracy. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 92.3%. Any value of over 75% is considered "excellent" within the forecast community. Forecast skill was consistent across July and August though there was a very small sample size due to below average storm activity. September had significantly larger number of qualifying events (sixty-six) and Forecast Accuracy was still very good at 89.4%. The average lead time for all M-1 Alerts and M-3 Flash Flood Warnings combined over the length of the Monsoon season was thirty-two minutes. The average lead time for M-2 Flash Flood Watches was just over six and half hours. Both lead time metrics were on par with previous years'.

Verification of lake alerts was conducted using forecast accuracy. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 83.3% spread across only eighteen events. It's worth noting again that no lake alerts were issued for Horseshoe Lake this monsoon season as the reservoir remained mostly empty through the summer months. The average lead time for all lakes/reservoirs combined over the length of the season was just over twenty minutes, which is in-line with previous years'.

Verification of QPF storm total precipitation was conducted using forecast accuracy. Forecast accuracy was determined using computed percent error when looking at forecasts versus observational data sets. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 80.4%. The addition of gage corrected radar rainfall estimation and cooperative rain gage sites in the verification process has proven to be critical for FZs with greater spatial gaps between gage sites.

TABLE 8: Historic Monsoon Season Verification Comparison										
	Outlooks				Messages		Lake Alerts		QPF STP	
Year	AOF	POD	FAR	TS	Events	AOF	Events	AOF	Events	AOF
2012	79.1%	79.6%	8.9%	n/a	102	86.3%	n/a	n/a	n/a	n/a
2013	79.8%	78.7%	6.2%	n/a	137	88.0%	56	89.3%	54	72.2%
2014	77.7%	76.9%	7.1%	67.4%	263	80.2%	57	84.2%	76	72.4%
2015	74.8%	60.3%	2.8%	67.9%	118	75.4%	40	95%	56	82.1%
2016	84.9%	78%	2.6%	77.5%	112	90.2%	46	82.6%	53	88.7%
2017	83.1%	77.9%	1.8%	72.4%	111	86.5%	53	90.6%	67	93.1%
2018	86.1%	82.2%	1.6%	75.6%	129	89.9%	41	82.9%	110	84.5%
2019	90.1%	72.9%	0.7%	80.9%	78	92.3%	18	83.3%	46	80.4%

Table 8, above, was included to add more historical perspective in the verification process. Verification metrics for Outlooks, Messages, Lake Alerts, and QPF STP were included for all previous years. Most Outlook forecast metrics improved in 2019 when compared to 2018. Of note forecast accuracy, false alarm rate, and threat score were the best of any of the previous seasons sampled.

Forecast skill for issued messages improved from the 2018 season and was the highest forecast skill for issued messages since we've been keeping records. However, the number of issued messages was significantly lower than any other season due to limited storm activity. Forecast accuracy for Lake Alerts improved slightly from 2018 but came in well below the season average of 86.8%. Similar to message events, lake alert events were significantly reduced to due to the quiet monsoon. The smaller sample size in each instance could have affected forecast skill. STP skill came in below the long term average and was the lowest since 2014. Similar to other metrics, STP saw the fewest number of qualifying events this summer. It's important to forecast skill still came in well above the 75% threshold.

When all was said and done, the 2019 monsoon season was considered below normal in terms of rainfall and record fewest number of products were issued by the MSP. It is hoped that this report serves as quantifiable tool used to evaluate forecast performance on a year to year basis. This report will be continued in subsequent years focusing not only the present year's statistical data, but will also serve as a historical comparison to measure future year's performance.

APPENDIX A: MSP OUTLOOKS - VERIFICATION TABLES

TABLE A-1: This table shows the raw verification data of MSP issued precipitation forecasts contained in the daily Outlooks for the 2019 monsoon season. The valid period for rainfall each day is from 2PM same day through 12PM the following day. The table is broken down by date and MSP Forecast Zone. For brevity two Forecast Zones are included for each day. The columns from left to right are defined as follows:

Prob. – Percent probability of measureable rain within the Forecast Zone from 0% to 100% over the period.

QPF – Total forecast rainfall in inches within the Forecast Zone over the period.

ALERT – Peak total observed ALERT gage rainfall value in inches within the Forecast Zone over the period.

GAQPE – Radar rainfall estimate (see [Verification Metrics and Criteria](#) section for more details).

AOF – Forecast accuracy, assigned an “h” for a hit and “m” for a miss.

POD – Probability of detection, assigned an “h” for a hit, “m” for a miss, or “-” for non-significant rainfall.

FA – False alarms, assigned an “x”.

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
	Gila Bend							Gila River						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	1.50-2.00	m	m	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	0.50	0.00	0.25-0.50	h	-	-	30	1.00	0.00	0.25-0.50	m	-	x
07/23/19	20	0.50	0.47	1.50-2.00	h	h	-	20	0.40	0.24	0.75-1.00	m	m	-
07/24/19	10	0.10	0.00	0.01-0.10	h	-	-	10	0.20	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/25/19	10	0.50	0.00	0.25-0.50	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/19	20	0.10	0.00	0.01-0.10	h	-	-	20	0.10	0.00	0.10-0.25	h	-	-
07/30/19	40	1.50	0.20	0.75-1.00	h	h	-	40	1.25	0.51	2.50-3.00	h	h	-
07/31/19	10	1.00	0.00	0.75-1.00	h	h	-	0	0.00	0.00	0.00	h	-	-
31 days					30	3/4	0					29	1/2	1
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/19	10	0.50	0.00	0.25-0.50	h	-	-	0	0.00	0.00	0.25-0.50	m	-	-
08/04/19	10	0.50	0.00	1.50-2.00	m	h	-	0	0.00	0.00	0.00	h	-	-
08/05/19	20	0.50	0.00	0.25-0.50	h	-	-	20	0.40	0.00	0.25-0.50	h	-	-
08/06/19	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/19	40	1.00	0.55	1.25-1.50	h	h	-	20	0.25	0.00	0.10-0.25	h	-	-
08/08/19	10	0.50	0.00	0.75-1.00	h	h	-	0	0.00	0.00	0.10-0.25	m	-	-
08/09/19	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/10/19	20	0.50	0.00	0.75-1.00	h	h	-	20	0.75	0.00	0.10-0.25	m	-	-
08/11/19	10	0.50	0.00	0.01-0.10	m	-	-	10	0.25	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.04	0.50-0.75	m	m	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/22/19	10	0.25	0.00	0.25-0.50	h	-	-	10	0.25	0.00	0.25-0.50	h	-	-
08/23/19	10	0.10	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/19	10	0.50	0.16	0.50-0.75	h	h	-	10	0.25	0.16	0.50-0.75	m	m	-
08/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	0	0.00	0.08	0.75-1.00	m	m	-	0	0.00	0.00	0.04-0.10	m	-	-
31 days					28	5/6	0					25	0/2	0
09/01/19	30	1.00	1.22	1.50-2.00	h	h	-	10	0.30	0.00	0.04-0.10	h	-	-
09/02/19	10	0.50	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/19	10	0.30	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/19	30	0.75	0.00	0.00	m	-	-	10	0.25	0.00	0.00	h	-	-
09/05/19	10	0.25	0.00	0.25-0.50	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/19	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
09/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.10	m	-	-
09/09/19	10	0.10	0.00	0.00	h	-	-	20	0.10	0.00	0.00	m	-	-
09/10/19	0	0.00	0.00	0.10-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/19	20	0.50	0.00	1.25-1.50	m	h	-	20	0.25	0.04	0.50-0.75	h	-	-
09/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/19	30	0.30	0.20	0.75-1.00	m	m	-	30	0.35	0.08	0.10-0.25	h	-	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	10	0.50	0.00	0.50-0.75	h	h	-	20	0.50	0.31	1.50-2.00	m	h	-
09/23/19	40	0.50	0.20	0.50-0.75	h	h	-	60	0.50	0.04	0.50-0.75	h	h	-
09/24/19	80	0.50	0.00	0.04	m	-	-	40	0.25	0.00	0.00	m	-	-
09/25/19	60	1.00	0.12	1.00-1.25	h	h	-	50	0.75	0.00	0.50-0.75	h	h	-
09/26/19	50	1.00	0.47	3.00-4.00	m	h	-	40	0.50	0.28	0.50-0.75	h	h	-
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days	3.00				24	6/7	0					26	4/4	0
	Palo Verde							Rainbow Valley						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	0.40	0.00	0.50-0.75	h	m	-	30	0.75	0.00	0.10-0.25	m	-	-
07/23/19	20	0.20	0.47	0.50-0.75	m	m	-	20	0.40	0.20	0.50-0.75	h	m	-
07/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/19	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/19	20	0.10	0.00	0.10-0.25	h	-	-	20	0.10	0.00	0.01-0.10	h	-	-
07/30/19	30	0.75	1.50	2.00-2.50	m	h	-	40	1.00	0.24	0.75-1.00	h	h	-
07/31/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					29	1/3	0					30	1/2	0
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.10-0.25	m	-	-
08/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/19	10	0.25	0.00	0.01-0.10	h	-	-	20	0.35	0.00	0.00	m	-	-
08/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/19	30	0.75	0.00	0.00	m	-	-	30	0.50	0.04	0.50-0.75	h	h	-
08/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.25-.50	m	-	-
08/09/19	10	0.40	0.00	0.00	h	-	-	0	0.00	0.04	0.01-0.10	m	-	-
08/10/19	10	0.25	0.00	0.00	h	-	-	20	0.75	0.00	0.00	m	-	-
08/11/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/22/19	0	0.00	0.00	0.00	h	-	-	10	0.10	0.00	0.25-0.50	m	-	-
08/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/19	0	0.00	0.00	0.10-0.025	m	-	-	0	0.00	0.39	1.50-2.00	m	m	-
08/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	0	0.00	0.04	0.04-0.10	m	-	-	0	0.00	0.00	0.04-0.10	m	-	-
31 days					28	0	0					23	1/2	0
09/01/19	20	0.75	0.87	1.50-2.00	h	h	-	10	0.30	0.20	0.75-1.00	m	m	-
09/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/19	30	0.75	0.16	1.00-1.25	h	h	-	20	0.50	0.00	0.00	m	-	-
09/05/19	10	0.25	0.00	0.25-0.50	h	-	-	0	0.00	0.00	1.25-1.50	m	m	-
09/06/19	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/19	10	0.10	0.00	0.00	h	-	-	20	0.25	0.00	0.00	m	-	-
09/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/19	20	0.25	0.00	0.00	m	-	-	30	0.35	0.00	0.10-0.25	h	-	-
09/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/19	30	0.50	0.35	0.75-1.00	h	h	-	30	0.70	0.63	0.50-0.75	h	h	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	0	0.00	0.00	0.50-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/23/19	40	0.75	3.07	6.00-8.00	m	h	-	60	1.00	0.91	1.25-1.50	h	h	-
09/24/19	30	0.50	0.00	0.00	m	-	-	20	0.25	0.00	0.04	h	-	-
09/25/19	50	1.00	0.79	1.25-1.50	h	h	-	60	0.75	0.87	2.00-2.50	h	h	-
09/26/19	50	0.50	0.12	0.50-0.75	h	h	-	50	0.50	0.20	0.75-1.00	h	h	-
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					26	6/6	0					26	4/6	0
	West Valley							Northwest Valley						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	0.75	0.16	0.25-0.50	h	-	-	30	0.40	0.71	0.75-1.00	h	m	-
07/23/19	20	0.40	0.43	0.50-0.75	h	m	-	30	0.50	0.83	0.50-0.75	h	h	-
07/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/29/19	20	0.10	0.20	0.25-0.50	h	-	-	20	0.10	0.16	0.25-0.50	h	-	-
07/30/19	40	1.00	0.47	0.75-1.00	h	h	-	40	1.25	0.31	1.00-1.25	h	h	-
07/31/19	0	0.00	0.00	0.00	h	-	-	10	0.75	0.00	0.00	m	-	-
31 days					31	1/2	0					30	2/3	0
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/19	0	0.00	0.28	0.50-0.75	m	m	-	10	0.35	0.43	0.25-0.50	h	-	-
08/04/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/05/19	20	0.25	0.00	0.00	m	-	-	20	0.35	0.04	0.10-0.25	h	-	-
08/06/19	0	0.00	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
08/07/19	30	0.50	0.00	0.10-0.25	m	-	-	30	0.50	0.12	0.25-0.50	h	-	-
08/08/19	0	0.00	0.12	0.25-0.50	m	-	-	0	0.00	0.04	0.10-0.25	m	-	-
08/09/19	0	0.00	0.04	0.10-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
08/10/19	20	0.75	0.00	0.00	m	-	-	10	0.50	0.00	0.00	h	-	-
08/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/19	10	0.25	0.98	0.75-1.00	m	m	-	0	0.00	1.18	1.25-1.50	m	m	-
08/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.04	0.00	h	-	-
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					24	0/2	0					29	0/1	0
09/01/19	10	0.30	0.24	0.25-0.50	h	-	-	20	0.50	0.00	0.10-0.25	m	-	-
09/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/19	20	0.35	0.00	0.00	m	-	-	30	0.50	0.04	0.25-0.50	h	-	-
09/05/19	0	0.00	0.00	0.25-0.50	m	-	-	0	0.00	0.00	0.00	h	-	-
09/06/19	0	0.00	0.00	0.04-0.10	m	-	-	0	0.00	0.00	0.50-0.75	m	m	-
09/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00-0.04	m	-	-
09/09/19	20	0.10	0.00	0.00	m	-	-	30	0.25	0.00	0.00	m	-	-
09/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/19	30	0.35	0.00	0.10-0.25	h	-	-	20	0.35	0.00	0.25-0.50	h	-	-
09/15/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
09/16/19	30	0.50	2.48	1.00-1.25	m	h	-	30	0.25	0.20	0.25-0.50	h	-	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	0	0.00	0.08	0.10-0.25	m	-	-	0	0.00	0.08	0.10-0.25	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/23/19	60	1.50	1.57	3.00-4.00	h	h	-	70	2.50	3.19	3.00-4.00	h	h	-
09/24/19	40	0.10	0.00	0.00	m	-	-	40	0.10	0.00	0.00	m	-	-
09/25/19	60	0.75	1.89	2.00-2.50	m	h	-	60	1.00	1.93	2.50-3.00	h	h	-
09/26/19	40	0.75	0.79	1.00-1.25	h	h	-	40	0.75	0.71	1.25-1.50	h	h	-
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					22	4/4	0					24	3/4	0
	Upper Centennial							Wickenburg						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	1.25-1.50	m	m	-	0	0.00	0.00	0.10-0.25	m	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.10-0.25	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	0.10-0.25	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	0.30	0.24	0.50-0.75	h	m	-	30	0.40	0.28	0.50-0.75	h	m	-
07/23/19	20	0.50	0.04	0.10-0.25	h	-	-	20	0.50	0.24	0.25-0.50	h	-	-
07/24/19	10	0.10	0.00	0.01-0.10	h	-	-	10	0.10	0.04	0.00	h	-	-
07/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/19	10	0.10	0.00	0.10-0.25	h	-	-	10	0.10	0.00	0.25-0.50	m	-	-
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/19	20	0.10	0.00	0.10-0.25	h	-	-	20	0.10	0.20	0.10-0.25	h	-	-
07/30/19	40	1.50	0.04	0.75-1.00	h	h	-	40	1.50	1.18	1.50-2.00	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/31/19	10	1.00	0.04	0.00	m	-	-	10	1.00	0.04	0.25-0.50	m	-	-
31 days					29	1/3	0					28	1/2	0
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/19	10	0.50	0.00	0.01-0.10	m	-	-	10	0.50	0.35	0.25-0.50	h	-	-
08/04/19	10	0.50	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
08/05/19	20	0.50	0.00	0.00	m	-	-	20	0.50	0.00	0.01-0.10	m	-	-
08/06/19	10	0.25	0.00	0.10-0.25	h	-	-	10	0.25	0.12	0.01-0.10	h	-	-
08/07/19	30	1.00	1.93	1.25-1.50	h	h	-	30	1.00	1.30	1.00-1.25	h	h	-
08/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/19	20	0.50	0.00	0.25-0.50	h	-	-	20	0.50	0.00	0.00	m	-	-
08/10/19	10	0.25	0.00	0.50-0.75	m	m	-	10	0.25	0.00	0.00	h	-	-
08/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					28	1/2	0					29	1/1	0
09/01/19	30	1.00	0.55	1.00-1.25	h	h	-	30	0.75	0.08	0.25-0.50	h	-	-
09/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/19	30	0.75	0.00	0.00	m	-	-	30	0.50	0.00	0.04-0.10	m	-	-
09/05/19	20	0.45	0.08	2.50-3.00	m	m	-	20	0.45	0.00	0.04-0.10	m	-	-
09/06/19	10	0.25	0.00	0.75-1.00	m	m	-	10	0.25	0.00	0.25-0.50	h	-	-
09/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/19	30	0.10	0.00	0.00	m	-	-	30	0.25	0.00	0.00	m	-	-
09/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/19	20	0.50	0.04	0.25-0.50	h	-	-	20	0.50	0.04	0.75-1.00	h	h	-
09/15/19	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
09/16/19	20	0.10	0.04	0.10-0.25	h	-	-	20	0.25	0.24	0.10-0.25	h	-	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/19	90	2.00	1.73	2.00-2.50	h	h	-	90	2.00	1.61	1.50-2.00	h	h	-
09/24/19	30	0.10	0.00	0.00	m	-	-	20	0.10	0.00	0.00	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/25/19	50	1.00	1.02	2.00-2.50	h	h	-	50	1.00	1.61	1.50-2.00	h	h	-
09/26/19	40	1.00	0.91	0.75-1.00	h	h	-	40	0.25	0.04	0.00	m	-	-
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					25	4/6	0					25	3/3	0
	New River/Cave Creek							Phoenix North						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	0.50-0.75	m	m	-	0	0.00	0.00	0.00	h	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	0.50	0.79	0.75-1.00	h	h	-	30	0.50	0.39	0.25-0.50	h	-	-
07/23/19	30	0.50	0.35	0.50-0.75	h	h	-	20	0.40	0.43	0.25-0.50	h	-	-
07/24/19	20	0.25	0.04	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
07/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/19	10	0.10	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/19	20	0.10	0.28	0.25-0.50	m	-	-	20	0.10	0.04	0.10-0.25	h	-	-
07/30/19	40	1.50	0.67	1.00-1.25	h	h	-	40	1.25	0.47	0.50-0.75	h	h	-
07/31/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					28	2/3	0					31	1/1	0

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.10-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
08/03/19	20	0.50	0.51	0.50-0.75	h	h	-	10	0.25	0.39	1.00-1.25	m	m	-
08/04/19	10	0.50	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/19	30	0.50	0.08	0.25-0.50	h	-	-	30	0.35	0.00	0.00	m	-	-
08/06/19	10	0.25	0.00	0.01-0.10	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/19	0	0.00	0.08	0.10-0.25	m	-	-	20	0.25	0.00	0.00	m	-	-
08/08/19	0	0.00	0.00	0.10-0.25	m	-	-	0	0.00	0.00	0.10-0.25	m	-	-
08/09/19	10	0.25	0.00	0.00	h	-	-	0	0.00	0.20	0.25-0.50	m	-	-
08/10/19	20	1.00	0.00	0.00	m	-	-	20	1.00	0.00	0.00	m	-	-
08/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/19	20	0.50	0.91	1.25-1.50	h	h	-	20	0.35	1.22	1.00-1.25	m	m	-
08/29/19	0	0.00	0.12	0.50-0.75	m	m	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					26	2/3	0					24	0/2	0
09/01/19	30	0.75	0.04	0.25-0.50	h	-	-	20	0.50	0.04	0.50-0.75	h	h	-
09/02/19	10	0.35	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/19	10	0.20	0.16	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/19	30	0.50	0.00	0.25-0.50	h	-	-	20	0.40	0.00	0.25-0.50	h	-	-
09/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/19	0	0.00	0.00	0.04-0.10	m	-	-	0	0.00	0.00	0.25-0.50	m	-	-
09/07/19	20	0.33	0.31	0.50-0.75	h	m	-	10	0.33	0.00	0.00	h	-	-
09/08/19	20	0.33	0.00	0.00	m	-	-	10	0.33	0.00	0.00	h	-	-
09/09/19	60	1.50	0.43	1.00-1.25	h	h	-	40	1.00	0.16	0.25-0.50	m	-	-
09/10/19	30	0.30	0.04	0.04-0.10	m	-	-	0	0.00	0.00	0.00	h	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/19	40	1.00	0.39	0.75-1.00	h	h	-	40	0.50	0.47	0.50-0.75	h	h	-
09/15/19	20	0.50	0.00	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
09/16/19	30	0.25	0.04	0.10-0.25	h	-	-	30	0.50	0.35	0.25-0.50	h	-	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	30	1.00	0.24	0.25-0.50	m	-	x	30	0.50	0.43	0.50-0.75	h	h	-
09/23/19	100	3.00	3.15	3.00-4.00	h	h	-	90	2.00	1.77	2.50-3.00	h	h	-
09/24/19	50	0.25	0.00	0.04	m	-	-	20	0.10	0.00	0.00	m	-	-
09/25/19	80	1.50	0.79	1.50-2.00	h	h	-	70	0.50	0.35	0.50-0.75	h	h	-
09/26/19	50	0.25	1.18	1.00-1.25	m	m	-	30	0.75	0.79	1.25-1.50	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					23	4/6	1					27	6/6	0
	Phoenix South							Scottsdale North						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	0.75	0.04	0.25-0.50	h	-	-	30	0.50	0.12	0.25-0.50	h	-	-
07/23/19	20	0.30	0.31	0.50-0.75	h	m	-	30	0.50	0.75	1.00-1.25	h	h	-
07/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/19	20	0.10	0.04	0.10-0.25	h	-	-	20	0.10	0.12	0.25-0.50	h	-	-
07/30/19	30	1.00	0.59	1.00-1.25	h	h	-	50	1.50	0.63	0.75-1.00	h	h	-
07/31/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					31	1/2	0					31	2/2	0
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/03/19	0	0.00	0.43	0.50-0.75	m	m	-	10	0.50	0.39	0.25-0.50	h	-	-
08/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/19	20	0.25	0.00	0.00	m	-	-	30	0.50	0.00	0.10-0.25	h	-	-
08/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/19	20	0.25	0.00	0.01-0.10	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/19	0	0.00	0.04	0.10-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
08/09/19	0	0.00	0.04	0.01-0.10	m	-	-	0	0.00	0.00	0.00	h	-	-
08/10/19	30	1.00	0.00	0.10-0.25	m	-	x	30	1.50	0.00	0.00	m	-	x
08/11/19	10	0.10	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/19	10	0.25	0.75	0.75-1.00	m	m	-	20	0.50	0.59	0.75-1.00	h	h	-
08/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
31 days					25	0/2	1					30	1/1	0
09/01/19	10	0.30	0.16	0.75-1.00	m	m	-	30	0.75	0.16	1.50-2.00	h	h	-
09/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/19	20	0.25	0.12	0.00	h	-	-	20	0.40	0.00	0.04-0.10	m	-	-
09/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/19	0	0.00	0.00	0.00	h	-	-	10	0.33	0.00	0.00	h	-	-
09/08/19	0	0.00	0.00	0.00	h	-	-	10	0.33	0.00	0.00	h	-	-
09/09/19	30	0.30	0.00	0.00	m	-	-	60	1.25	0.20	0.50-0.75	h	h	-
09/10/19	0	0.00	0.00	0.00	h	-	-	25	0.30	0.00	0.00	m	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/19	40	0.40	0.08	0.50-0.75	h	m	-	50	1.00	0.39	1.00-1.25	h	h	-
09/15/19	0	0.00	0.08	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
09/16/19	30	0.25	0.20	0.25-0.50	h	-	-	30	0.25	0.00	0.10-0.25	h	-	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	20	0.25	0.51	1.25-1.50	m	m	-	20	0.50	0.47	0.50-0.75	h	h	-
09/23/19	70	1.50	1.65	2.50-3.00	h	h	-	80	3.00	3.35	4.00-5.00	h	h	-
09/24/19	20	0.10	0.00	0.00	m	-	-	30	0.25	0.00	0.04	m	-	-
09/25/19	60	0.50	0.39	0.50-0.75	h	h	-	80	0.75	0.31	0.50-0.75	h	h	-
09/26/19	30	0.75	0.59	1.00-1.25	h	h	-	40	0.10	0.16	0.10-0.25	h	-	-
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					26	3/6	0					27	6/6	0
	Scottsdale South							East Valley						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	0.75	0.59	0.75-1.00	h	h	-	30	0.75	0.59	0.75-1.00	h	h	-
07/23/19	20	0.30	0.43	0.50-0.75	h	m	-	20	0.50	0.31	0.50-0.75	h	m	-
07/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/19	20	0.10	0.00	0.01-0.10	h	-	-	20	0.10	0.00	0.10-0.25	h	-	-
07/30/19	30	1.00	0.51	1.00-1.25	h	h	-	40	1.25	1.14	1.00-1.25	h	h	-
07/31/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					31	2/3	0					31	2/3	0
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/19	0	0.00	0.51	1.00-1.25	m	m	-	10	0.25	0.47	0.25-0.50	h	-	-
08/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/05/19	20	0.35	0.00	0.00	m	-	-	20	0.50	0.00	0.01-0.10	m	-	-
08/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.10-0.25	m	-	-
08/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/10/19	30	1.00	0.00	0.00	m	-	x	30	1.25	0.00	0.00	m	-	x
08/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.43	0.50-0.75	m	m	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/22/19	0	0.00	0.00	0.00	h	-	-	10	0.10	0.00	0.10-0.25	h	-	-
08/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/19	10	0.25	0.71	0.75-1.00	m	m	-	20	0.50	1.06	1.00-1.25	m	h	-
08/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	0	0.00	0.00	0.00	h	-	-	10	0.05	0.00	0.00	h	-	-
31 days					27	0/2	0					26	0/1	1
09/01/19	10	0.30	0.12	1.25-1.50	m	m	-	10	0.50	0.00	0.10-0.25	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/19	10	0.25	0.04	0.10-0.25	h	-	-	10	0.25	0.00	0.10-0.25	h	-	-
09/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
09/08/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.25-0.50	h	-	-
09/09/19	30	0.50	0.00	0.10-0.25	h	-	-	40	0.50	0.04	0.10-0.25	h	-	-
09/10/19	20	0.25	0.00	0.00	m	-	-	25	0.25	0.00	0.00	m	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/19	40	0.50	0.16	0.50-0.75	h	h	-	50	0.75	0.12	0.50-0.75	h	h	-
09/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/19	30	0.25	0.20	0.25-0.50	h	-	-	40	0.30	0.08	0.10-0.25	h	-	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	20	0.25	0.83	0.75-1.00	m	m	-	30	0.75	2.60	2.00-2.50	m	h	-
09/23/19	70	1.50	1.93	2.50-3.00	h	h	-	90	2.00	1.34	1.00-1.25	h	h	-
09/24/19	40	0.10	0.00	0.00	m	-	-	40	0.25	0.00	0.04	m	-	-
09/25/19	60	0.25	0.16	0.10-0.25	h	-	-	70	0.75	0.04	0.10-0.25	m	-	x
09/26/19	30	0.10	0.12	0.25-0.50	h	-	-	30	0.25	0.55	0.25-0.50	h	-	-
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
30 days					26	2/4	0					26	3/3	1
	Southeast Valley							Lower Salt River Lakes						
06/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0	0					16	0	0
07/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/10/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/19	30	1.00	0.20	0.50-0.75	h	h	-	30	1.00	0.00	0.10-0.25	m	-	x
07/23/19	20	0.50	0.51	0.75-1.00	h	h	-	30	0.50	0.04	1.25-1.50	m	h	-
07/24/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/19	20	0.10	0.00	0.10-0.25	h	-	-	20	0.10	0.00	0.01-0.10	h	-	-
07/30/19	40	1.25	1.22	2.50-3.00	h	h	-	50	1.50	0.31	1.50-2.00	h	h	-
07/31/19	0	0.00	0.00	0.00	h	-	-	10	0.75	0.00	0.00	m	-	-
31 days					31	3/3	0					28	3/3	1
08/01/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/19	10	0.25	0.08	0.25-0.50	h	-	-	20	0.50	0.12	0.50-0.75	h	h	-
08/04/19	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/05/19	30	0.50	0.00	0.01-0.10	m	-	-	30	0.50	0.00	0.25-0.50	h	-	-
08/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/07/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/19	0	0.00	0.00	0.10-0.25	m	-	-	0	0.00	0.00	0.10-0.25	m	-	-
08/09/19	10	0.25	0.04	0.10-0.25	h	-	-	0	0.00	0.00	0.10-0.25	m	-	-
08/10/19	30	1.50	0.00	0.01-0.10	m	-	x	40	2.00	0.00	0.01-0.10	m	-	x
08/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/19	0	0.00	0.04	0.10-0.025	m	-	-	0	0.00	0.00	0.00	h	-	-
08/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/22/19	10	0.10	0.00	0.25-0.50	m	-	-	10	0.25	0.00	0.04-0.10	m	-	-
08/23/19	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/24/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/19	20	0.50	0.08	0.50-0.75	h	h	-	20	0.50	0.00	0.25-0.50	h	-	-
08/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/19	10	0.05	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
31 days					26	1/1	1					27	1/1	1
09/01/19	10	0.50	0.00	0.10-0.25	h	-	-	30	0.75	0.00	2.00-2.50	m	h	-
09/02/19	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.04-0.10	m	-	-
09/03/19	10	0.20	0.04	0.04	h	-	-	10	0.50	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/04/19	10	0.25	0.00	0.00	h	-	-	20	0.50	0.00	0.10-0.25	h	-	-
09/05/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.10	m	-	-
09/07/19	20	0.25	0.00	0.00	m	-	-	20	0.25	0.00	0.25-0.50	h	-	-
09/08/19	0	0.00	0.00	0.25-0.50	m	-	-	20	0.25	0.00	0.00-0.04	m	-	-
09/09/19	30	0.50	0.00	0.00	m	-	-	70	1.50	0.00	1.50-2.00	h	h	-
09/10/19	0	0.00	0.00	0.00	h	-	-	60	0.50	0.16	0.10-0.25	h	-	-
09/11/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/19	0	0.00	0.00	0.00	h	-	-	10	0.33	0.00	0.00	h	-	-
09/14/19	20	0.75	0.00	0.25-0.50	h	-	-	60	1.25	0.04	0.25-0.50	m	-	x
09/15/19	0	0.00	0.00	0.00	h	-	-	20	0.50	0.00	0.00	m	-	-
09/16/19	40	0.30	0.04	0.04	m	-	-	40	0.25	0.00	0.10-0.25	h	-	-
09/17/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/19	30	0.75	0.94	1.50-2.00	h	h	-	40	1.00	2.20	4.00-5.00	m	h	-
09/23/19	90	1.50	0.16	0.50-0.75	h	h	-	100	3.00	2.32	3.00-4.00	h	h	-
09/24/19	50	0.50	0.00	0.00	m	-	-	60	0.50	0.00	0.00	m	-	-
09/25/19	70	0.75	0.08	0.10-0.25	m	-	x	80	0.75	0.12	0.75-1.00	h	h	-
09/26/19	30	0.25	0.04	0.04-0.10	h	-	-	40	0.30	0.04	0.25-0.50	h	-	-
09/27/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/19	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					24	2/2	1					22	5/5	1

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
	Superstition													
06/15/19	0	0.00	0.00	0.00	h	-	-							
06/16/19	0	0.00	0.00	0.00	h	-	-							
06/17/19	0	0.00	0.00	0.00	h	-	-							
06/18/19	0	0.00	0.00	0.00	h	-	-							
06/19/19	0	0.00	0.00	0.00	h	-	-							
06/20/19	0	0.00	0.00	0.00	h	-	-							
06/21/19	0	0.00	0.00	0.00	h	-	-							
06/22/19	0	0.00	0.00	0.00	h	-	-							
06/23/19	0	0.00	0.00	0.00	h	-	-							
06/24/19	0	0.00	0.00	0.00	h	-	-							
06/25/19	0	0.00	0.00	0.00	h	-	-							
06/26/19	0	0.00	0.00	0.00	h	-	-							
06/27/19	0	0.00	0.00	0.00	h	-	-							
06/28/19	0	0.00	0.00	0.00	h	-	-							
06/29/19	0	0.00	0.00	0.00	h	-	-							
06/30/19	0	0.00	0.00	0.00	h	-	-							
16 days					16	0	0							
07/01/19	0	0.00	0.00	0.00	h	-	-							
07/02/19	0	0.00	0.00	0.00	h	-	-							
07/03/19	0	0.00	0.00	0.00	h	-	-							
07/04/19	0	0.00	0.00	0.00	h	-	-							
07/05/19	0	0.00	0.00	0.00	h	-	-							
07/06/19	0	0.00	0.00	0.00	h	-	-							
07/07/19	0	0.00	0.00	0.00	h	-	-							
07/08/19	0	0.00	0.00	0.00	h	-	-							
07/09/19	0	0.00	0.00	0.00	h	-	-							
07/10/19	0	0.00	0.00	0.00	h	-	-							
07/11/19	0	0.00	0.00	0.00	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/12/19	0	0.00	0.00	0.00	h	-	-							
07/13/19	0	0.00	0.00	0.00	h	-	-							
07/14/19	0	0.00	0.00	0.00	h	-	-							
07/15/19	0	0.00	0.00	0.00	h	-	-							
07/16/19	0	0.00	0.00	0.00	h	-	-							
07/17/19	0	0.00	0.00	0.00	h	-	-							
07/18/19	0	0.00	0.00	0.00	h	-	-							
07/19/19	0	0.00	0.00	0.00	h	-	-							
07/20/19	0	0.00	0.00	0.00	h	-	-							
07/21/19	0	0.00	0.00	0.00	h	-	-							
07/22/19	30	1.00	0.55	0.25-0.50	h	h	-							
07/23/19	30	0.50	0.31	0.50-0.75	h	h	-							
07/24/19	0	0.00	0.00	0.00	h	-	-							
07/25/19	0	0.00	0.00	0.00	h	-	-							
07/26/19	0	0.00	0.00	0.00	h	-	-							
07/27/19	0	0.00	0.00	0.00	h	-	-							
07/28/19	0	0.00	0.00	0.00	h	-	-							
07/29/19	20	0.10	0.00	0.00	m	-	-							
07/30/19	50	1.50	0.98	1.25-1.50	h	h	-							
07/31/19	10	0.75	0.04	0.00	m	-	-							
31 days					29	3/3	0							
08/01/19	0	0.00	0.00	0.00	h	-	-							
08/02/19	0	0.00	0.00	0.00	h	-	-							
08/03/19	20	0.50	0.35	0.25-0.50	h	-	-							
08/04/19	10	0.25	0.00	0.00	h	-	-							
08/05/19	30	0.50	0.00	0.10-0.25	h	-	-							
08/06/19	0	0.00	0.00	0.00	h	-	-							
08/07/19	0	0.00	0.00	0.00	h	-	-							
08/08/19	0	0.00	0.00	0.10-0.25	m	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/09/19	0	0.00	0.08	0.10-0.25	m	-	-							
08/10/19	40	1.50	0.00	0.00	m	-	x							
08/11/19	0	0.00	0.00	0.00	h	-	-							
08/12/19	0	0.00	0.00	0.00	h	-	-							
08/13/19	0	0.00	0.00	0.00	h	-	-							
08/14/19	0	0.00	0.00	0.00	h	-	-							
08/15/19	0	0.00	0.00	0.00	h	-	-							
08/16/19	0	0.00	0.00	0.00	h	-	-							
08/17/19	0	0.00	0.00	0.00	h	-	-							
08/18/19	0	0.00	0.00	0.00	h	-	-							
08/19/19	0	0.00	0.00	0.00	h	-	-							
08/20/19	0	0.00	0.00	0.00	h	-	-							
08/21/19	0	0.00	0.00	0.00	h	-	-							
08/22/19	10	0.25	0.28	0.50-0.75	m	-	-							
08/23/19	0	0.00	0.00	0.00	h	-	-							
08/24/19	0	0.00	0.00	0.00	h	-	-							
08/25/19	0	0.00	0.00	0.00	h	-	-							
08/26/19	0	0.00	0.00	0.00	h	-	-							
08/27/19	0	0.00	0.00	0.00	h	-	-							
08/28/19	30	0.50	0.24	0.75-1.00	h	h	-							
08/29/19	0	0.00	0.00	0.00	h	-	-							
08/30/19	0	0.00	0.00	0.00	h	-	-							
08/31/19	10	0.10	0.00	0.00	h	-	-							
31 days					27	1/1	1							
09/01/19	20	0.75	0.51	0.50-0.75	h	h	-							
09/02/19	10	0.25	0.00	0.00	h	-	-							
09/03/19	10	0.20	0.00	0.00	h	-	-							
09/04/19	20	0.50	0.12	0.25-0.50	h	-	-							
09/05/19	0	0.00	0.00	0.00	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2019														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/06/19	0	0.00	0.00	0.00	h	-	-							
09/07/19	20	0.25	0.20	0.10-0.25	h	-	-							
09/08/19	10	0.25	0.00	0.04-0.10	h	-	-							
09/09/19	60	1.25	0.04	0.10-0.25	m	-	x							
09/10/19	40	0.40	0.00	0.00	m	-	-							
09/11/19	0	0.00	0.00	0.00	h	-	-							
09/12/19	0	0.00	0.00	0.00	h	-	-							
09/13/19	10	0.25	0.00	0.00	h	-	-							
09/14/19	60	1.25	1.10	1.50-2.00	h	h	-							
09/15/19	20	0.25	0.00	0.00	m	-	-							
09/16/19	40	0.25	0.00	0.04	m	-	-							
09/17/19	0	0.00	0.00	0.00	h	-	-							
09/18/19	0	0.00	0.00	0.00	h	-	-							
09/19/19	0	0.00	0.00	0.00	h	-	-							
09/20/19	0	0.00	0.00	0.00	h	-	-							
09/21/19	0	0.00	0.00	0.00	h	-	-							
09/22/19	40	1.00	2.95	3.00-4.00	m	h	-							
09/23/19	100	2.00	1.34	1.00-1.25	h	h	-							
09/24/19	40	0.50	0.00	0.00	m	-	-							
09/25/19	80	0.75	0.31	0.25-0.50	h	-	-							
09/26/19	40	0.25	0.04	0.10-0.25	h	-	-							
09/27/19	0	0.00	0.00	0.00	h	-	-							
09/28/19	0	0.00	0.00	0.00	h	-	-							
09/29/19	0	0.00	0.00	0.00	h	-	-							
09/30/19	0	0.00	0.00	0.00	h	-	-							
30 days					24	4/4	1							

TABLE A-2: This table shows the verification data of MSP issued precipitation forecasts contained in the daily Outlooks for the 2019 Monsoon Season. It is a monthly tally of the data contained in Table A-1. The table is broken down by month and MSP Forecast Zone. The columns from left to right are defined as follows:

Accurate Forecasts – Number of correct forecasts days out of total days in the month.

Accuracy – Accuracy of forecasts in percent.

Op. Sig. Events Detected – Number of operationally significant days detected correctly.

POD – Probability of detection in percent.

False Alarms – Number of false alarms that month.

FAR – False alarm rate in percent.

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2019						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
JUNE						
Gila Bend	16/16	100%	0/0	n/a	0/16	0%
Gila River	16/16	100%	0/0	n/a	0/16	0%
Palo Verde	16/16	100%	0/0	n/a	0/16	0%
Rainbow Valley	16/16	100%	0/0	n/a	0/16	0%
West Valley	16/16	100%	0/0	n/a	0/16	0%
Northwest Valley	16/16	100%	0/0	n/a	0/16	0%
Upper Centennial	16/16	100%	0/0	n/a	0/16	0%
Wickenburg	16/16	100%	0/0	n/a	0/16	0%
New River/Cave Creek	16/16	100%	0/0	n/a	0/16	0%
Phoenix North	16/16	100%	0/0	n/a	0/16	0%
Phoenix South	16/16	100%	0/0	n/a	0/16	0%
Scottsdale North	16/16	100%	0/0	n/a	0/16	0%
Scottsdale South	16/16	100%	0/0	n/a	0/16	0%
East Valley	16/16	100%	0/0	n/a	0/16	0%
Southeast Valley	16/16	100%	0/0	n/a	0/16	0%
Lower Salt River Lakes	16/16	100%	0/0	n/a	0/16	0%

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2019						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
Superstition	16/16	100%	0/0	n/a	0/16	0%
All Zones	272/272	100%	0/0	n/a	0/272	0%
JULY						
Gila Bend	30/31	96.8%	3/4	75%	0/31	n/a
Gila River	29/31	93.5%	1/2	50%	1/31	3.2%
Palo Verde	29/31	93.5%	1/3	33.3%	0/31	n/a
Rainbow Valley	30/31	96.8%	1/2	50%	0/31	n/a
West Valley	31/31	100%	1/2	50%	0/31	n/a
Northwest Valley	30/31	96.8%	2/3	66.7%	0/31	n/a
Upper Centennial	29/31	93.5%	1/3	33.3%	0/31	n/a
Wickenburg	28/31	90.3%	1/2	50%	0/31	n/a
New River/Cave Creek	28/31	90.3%	2/3	66.7%	0/31	n/a
Phoenix North	31/31	100%	1/1	100%	0/31	n/a
Phoenix South	31/31	100%	1/2	50%	0/31	n/a
Scottsdale North	31/31	100%	2/2	100%	0/31	n/a
Scottsdale South	31/31	100%	2/3	66.7%	0/31	n/a
East Valley	31/31	100%	2/3	66.7%	0/31	n/a
Southeast Valley	31/31	100%	3/3	100%	0/31	n/a
Lower Salt River Lakes	28/31	90.3%	3/3	100%	1/31	3.2%
Superstition	29/31	93.5%	3/3	100%	0/31	n/a
All Zones	507/527	96.2%	30/44	68.2%	2/527	0.3%
AUGUST						
Gila Bend	28/31	90.3%	5/6	83.3%	0/31	n/a
Gila River	25/31	80.6%	0/2	0%	0/31	n/a
Palo Verde	28/31	90.3%	0/0	n/a	0/31	n/a
Rainbow Valley	23/31	74.2%	1/2	50%	0/31	n/a
West Valley	24/31	77.4%	0/2	0%	0/31	n/a
Northwest Valley	29/31	93.5%	0/1	0%	0/31	n/a
Upper Centennial	28/31	90.3%	1/2	50%	0/31	n/a

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2019						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
Wickenburg	29/31	93.5%	1/1	100%	0/31	n/a
New River/Cave Creek	26/31	83.9%	2/3	66.7%	0/31	n/a
Phoenix North	24/31	77.4%	0/2	0%	0/31	n/a
Phoenix South	25/31	80.6%	0/2	0%	1/31	3.2%
Scottsdale North	30/31	96.8%	1/1	100%	0/31	n/a
Scottsdale South	27/31	87.1%	0/2	0%	0/31	n/a
East Valley	26/31	83.9%	0/1	0%	1/31	3.2%
Southeast Valley	26/31	83.9%	1/1	100%	1/31	3.2%
Lower Salt River Lakes	27/31	87.1%	1/1	100%	1/31	3.2%
Superstition	27/31	87.1%	1/1	100%	1/31	3.2%
All Zones	452/527	85.8%	14/30	46.7%	5/527	0.9%
SEPTEMBER						
Gila Bend	24/30	80%	6/7	85.7%	0/30	n/a
Gila River	26/30	86.7%	4/4	100%	0/30	n/a
Palo Verde	26/30	86.7%	6/6	100%	0/30	n/a
Rainbow Valley	26/30	86.7%	4/6	66.7%	0/30	n/a
West Valley	22/30	73.3%	4/4	100%	0/30	n/a
Northwest Valley	24/30	80%	3/4	75%	0/30	n/a
Upper Centennial	25/30	83.3%	4/6	66.7%	0/30	n/a
Wickenburg	25/30	83.3%	3/3	100%	0/30	n/a
New River/Cave Creek	23/30	76.7%	4/6	66.7%	1/30	3.2%
Phoenix North	27/30	90%	6/6	100%	0/30	n/a
Phoenix South	26/30	86.7%	3/6	50%	0/30	n/a
Scottsdale North	27/30	90%	6/6	100%	0/30	n/a
Scottsdale South	26/30	86.7%	2/4	50%	0/30	n/a
East Valley	26/30	86.7%	3/3	100%	1/30	3.2%
Southeast Valley	24/30	80%	2/2	100%	1/30	3.2%
Lower Salt River Lakes	22/30	73.3%	5/5	100%	1/30	3.2%
Superstition	24/30	80%	4/4	100%	1/30	3.2%
All Zones	423/510	82.9%	69/82	84.1%	5/510	1%

APPENDIX B: MSP MESSAGES - VERIFICATION TABLES

TABLE B-1: This table shows each of the individual MSP Statements issued during the 2019 Monsoon season including the detailed forecast rainfall information. The table is broken down by date and MSP Message. The columns from left to right are defined as follows:

Statement Details – Message information including date, time issued in local standard time, Forecast Zone, Message type, and issuing forecaster. Data is pulled directly from issued Message.

Forecast Rain – Rain information including forecast rainfall intensity and storm total precipitation where applicable. Data is pulled directly from issued Message. It is important to note that not all issued Messages contain forecast rainfall information (noted by an “N/A” in the table).

TABLE B-1: MSP Statements Issued - Monsoon Season 2019							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
07/22/19	20:45	East Valley	1	Henz	Now-10pm	-	0.50-0.75/1.00
07/22/19	20:45	Scottsdale South	1	Henz	Now-10pm	-	0.50-0.75/1.00
07/30/19	16:13	Superstition	1	Henz	Now-545pm	-	0.50-0.75/1.00-1.25
07/30/19	16:50	East Valley	1	Henz	Now-630pm	-	0.50-0.75/1.00-1.25
08/03/19	20:20	Scottsdale South	1	Henz	Now-945pm	-	0.50-0.75/1.00
08/07/19	15:15	Wickenburg	1	Henz	Now-6pm	-	0.75-1.00/1.50-1.75
08/07/19	15:15	Upper Centennial	1	Henz	Now-6pm	-	0.75-1.00/1.50-1.75
08/28/19	22:10	Phoenix South	1	Waters	Now-11pm	-	-
08/28/19	22:10	Scottsdale South	1	Waters	Now-11pm	-	-
08/28/19	22:10	Scottsdale North	1	Waters	Now-11pm	-	-
08/28/19	22:25	Northwest Valley	1	Waters	Now-11:30pm	-	-
08/28/19	22:35	West Valley	1	Waters	Now-11:30pm	-	0.75-1.00
09/01/19	16:43	Scottsdale North	1	Henz	Now-630pm	-	0.50-0.75/1.00
09/01/19	17:40	Phoenix South	1	Henz	Now-645pm	-	0.50-0.75/1.00
09/01/19	18:05	Gila Bend	1	Henz	Now-730pm	-	0.50-0.75/1.00-1.50
09/01/19	19:37	Palo Verde	1	Henz	Now-9pm	-	0.50-0.75/1.00-1.25
09/03/19	21:45	Southeast Valley	1	Waters	Now-1030pm	-	0.50-0.75/1.00-1.50
09/03/19	21:45	East Valley	1	Waters	Now-1030pm	-	0.50-0.75/1.00-1.50

TABLE B-1: MSP Statements Issued - Monsoon Season 2019

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
09/14/19	15:37	Superstition	1	Henz	Now-515pm	-	0.50-0.75/1.00-1.25
09/14/19	16:32	Scottsdale North	1	Henz	Now-630pm	-	0.50-0.75/1.00
09/16/19	18:58	Rainbow Valley	1	Henz	Now-830pm	-	0.50-0.75/1.00-1.25
09/16/19	19:10	West Valley	1	Henz	Now-8:45pm	-	0.50-0.75/1.00-1.25
09/16/19	20:05	West Valley	3	Henz	Now-1030pm	-	-
09/23/19	3:40	Gila Bend	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Palo Verde	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Rainbow Valley	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Gila River	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	West Valley	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Northwest Valley	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Upper Centennial	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Wickenburg	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	New River/Cave Creek	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Phoenix North	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Phoenix South	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Scottsdale North	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Scottsdale South	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	East Valley	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Southeast Valley	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Superstition	2	Henz	Now-12pm Friday	-	-
09/23/19	3:40	Lower Salt River	2	Henz	Now-12pm Friday	-	-
09/23/19	5:45	Phoenix South	1	Henz	Now-8am	-	0.50-0.75/1.00-2.00
09/23/19	5:45	Scottsdale South	1	Henz	Now-8am	-	0.50-0.75/1.00-2.00
09/23/19	5:45	East Valley	1	Henz	Now-8am	-	0.50-0.75/1.00-2.00
09/23/19	5:57	Lower Salt River Lakes	3	Henz	Now-10am	-	-
09/23/19	6:05	Superstition	3	Henz	Now-10am	-	-
09/23/19	6:53	East Valley	3	Henz	Now-11am	-	-
09/23/19	7:35	Scottsdale North	1	Henz	Now-9am	-	0.75-1.00/1.50-2.00

TABLE B-1: MSP Statements Issued - Monsoon Season 2019

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
09/23/19	8:27	Scottsdale North	3	Henz	Now-12pm	-	-
09/23/19	9:55	Wickenburg	1	Henz/Waters	Now-12pm	-	0.75-1.00/1.50-2.00
09/23/19	11:00	Northwest Valley	1	Henz/Waters	Now-1pm	-	0.50-0.75/1.50-2.50
09/23/19	11:20	Upper Centennial	1	Henz/Waters	Now-1:30pm	-	0.50-0.75/1.25-2.00
09/23/19	11:55	Northwest Valley	3	Henz	Now-3pm	-	-
09/23/19	12:05	New River/Cave Creek	1	Henz	Now-2:30pm	-	0.75-1.00/1.50-2.50
09/23/19	12:20	Wickenburg	3	Henz	Now-3pm	-	-
09/23/19	12:53	New River/Cave Creek	3	Henz	Now-4pm	-	-
09/23/19	13:28	West Valley	1	Henz	Now-3:30pm	-	0.50-0.75/1.00-1.50
09/23/19	13:28	Phoenix North	1	Henz	Now-3:30pm	-	0.50-0.75/1.00-1.50
09/23/19	16:20	Palo Verde	1	Waters	Now-5:30pm	-	0.75-1.00/1.50
09/23/19	16:20	Rainbow Valley	1	Waters	Now-5:30pm	-	0.75-1.00/1.50
09/23/19	16:20	West Valley	1	Waters	Now-5:30pm	-	0.75-1.00/1.50
09/23/19	17:40	Northwest Valley	1	Waters	Now-6:15pm	-	0.50-0.75/1.00
09/23/19	17:40	Phoenix North	1	Waters	Now-6:15pm	-	0.50-0.75/1.00
09/23/19	17:50	Scottsdale North	1	Waters	Now-6:30pm	-	0.50-0.75/1.00
09/23/19	18:30	Phoenix South	1	Waters	Now-7:15pm	-	0.50-0.75/1.00
09/23/19	18:30	Scottsdale South	1	Waters	Now-7:15pm	-	0.50-0.75/1.00
09/23/19	18:55	Scottsdale North	1	Waters	Now-8pm	-	0.50-0.75/1.25
09/23/19	22:35	Palo Verde	3	Henz	Now-1am	-	-
09/23/19	22:45	West Valley	3	Henz	Now-2am	-	-
09/23/19	22:45	Northwest Valley	3	Henz	Now-2am	-	-
09/25/19	20:26	Northwest Valley	1	Henz	Now-10pm	-	0.50-0.75/1.50
09/25/19	20:35	Wickenburg	1	Henz	Now-10pm	-	0.50-0.75/1.25-1.50
09/26/19	16:00	Rainbow Valley	1	Waters	Now-4:45pm	-	0.50-0.75/1.00
09/26/19	16:00	Gila River	1	Waters	Now-4:45pm	-	0.50-0.75/1.00
09/26/19	16:00	East Valley	1	Waters	Now-4:45pm	-	0.50-0.75/1.00
09/26/19	16:00	Phoenix South	1	Waters	Now-4:45pm	-	0.50-0.75/1.00
09/26/19	16:00	West Valley	1	Waters	Now-4:45pm	-	0.50-0.75/1.00

TABLE B-1: MSP Statements Issued - Monsoon Season 2019							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
09/26/19	16:25	Scottsdale North	1	Waters	4:30-5:30pm	-	0.50-0.75
09/26/19	16:25	Scottsdale South	1	Waters	4:30-5:30pm	-	0.50-0.75

TABLE B-2: This table shows the raw verification data of MSP issued Messages for the 2019 Monsoon Season. The valid period for rainfall for each Message can be found in Table B-1. The table is broken down by date and MSP Message. The columns from left to right are defined as follows:

Statement Details – Statement information including date, Forecast Zone, and Message type.

Forecast Rain – Rain information including forecast rainfall intensity and forecast storm total precipitation where applicable. It is important to note that not all issued statements contain forecast rainfall information (noted by an “n/a” in the table).

Rain Observations – Observed rainfall amounts within the forecast zone including ALERT rain gages, gage adjusted radar rainfall totals, and local storm reports submitted to NWS Phoenix WFO.

Alarms – Triggered alarms on ALERT gage sensors. These alarms are broken down by alarm type including rain, stream, and dam.

Verification – The verification was broken down by rain and by alarm. Hits and misses were assigned based on thresholds previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

TABLE B-2: MSP Statements Issued - Monsoon Season 2019											
Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
07/22/19	East Valley	1	-	0.50-0.75/1.00	1.14	1.00-1.25	-	-	-	-	-
07/22/19	Scottsdale South	1	-	0.50-0.75/1.00	0.59	1.00-1.25	-	-	-	-	-
07/30/19	Superstition	1	-	0.50-0.75/1.00-1.25	0.75	1.25-1.50	0.56	-	-	-	-
07/30/19	East Valley	1	-	0.50-0.75/1.00-1.25	0.83	1.00-1.25	0.56	-	-	-	-
08/03/19	Scottsdale South	1	-	0.50-0.75/1.00	0.51	1.00-1.25	-	-	-	-	-
08/07/19	Wickenburg	1	-	0.75-1.00/1.50-1.75	1.30	1.00-1.25	-	X	-	-	-
08/07/19	Upper Centennial	1	-	0.75-1.00/1.50-1.75	1.93	1.25-1.50	-	X	-	-	-
08/28/19	Phoenix South	1	-	-	0.75	0.50-0.75	-	X	-	-	-
08/28/19	Scottsdale South	1	-	-	0.83	0.75-1.00	-	-	X	-	-
08/28/19	Scottsdale North	1	-	-	0.59	0.75-1.00	-	-	-	-	-
08/28/19	Northwest Valley	1	-	-	1.18	1.25-1.50	0.74	X	X	-	-
08/28/19	West Valley	1	-	0.75-1.00	1.02	0.75-1.00	-	-	-	-	-
09/01/19	Scottsdale North	1	-	0.50-0.75/1.00	0.16	1.25-1.50	-	-	-	-	-

TABLE B-2: MSP Statements Issued - Monsoon Season 2019

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
09/01/19	Phoenix South	1	-	0.50-0.75/1.00	0.16	0.75-1.00	-	-	-	-	-
09/01/19	Gila Bend	1	-	0.50-0.75/1.00-1.50	1.22	1.50-2.00	-	-	X	-	-
09/01/19	Palo Verde	1	-	0.50-0.75/1.00-1.25	0.87	1.50-2.00	-	X	X	-	-
09/03/19	Southeast Valley	1	-	0.50-0.75/1.00-1.50	0.00	N/A	-	-	-	-	Y
09/03/19	East Valley	1	-	0.50-0.75/1.00-1.50	0.04	N/A	-	-	-	-	Y
09/14/19	Superstition	1	-	0.50-0.75/1.00-1.25	1.10	1.50-2.00	-	X	-	-	-
09/14/19	Scottsdale North	1	-	0.50-0.75/1.00	0.24	0.75-1.00	-	-	-	-	-
09/16/19	Rainbow Valley	1	-	0.50-0.75/1.00-1.25	0.59	0.75-1.00	-	-	-	-	-
09/16/19	West Valley	1	-	0.50-0.75/1.00-1.25	2.44	1.00-1.25	-	X	-	-	-
09/16/19	West Valley	3	-	-	2.44	1.00-1.25	-	X	-	-	-
09/23/19	Gila Bend	2	-	-	-	-	-	-	-	-	Y
09/23/19	Palo Verde	2	-	-	-	-	-	X	X	X	-
09/23/19	Rainbow Valley	2	-	-	-	-	-	-	-	-	-
09/23/19	Gila River	2	-	-	-	-	-	-	-	-	Y
09/23/19	West Valley	2	-	-	-	-	-	-	X	-	-
09/23/19	Northwest Valley	2	-	-	-	-	-	X	X	X	-
09/23/19	Upper Centennial	2	-	-	-	-	-	X	-	-	-
09/23/19	Wickenburg	2	-	-	-	-	-	X	X	-	-
09/23/19	New River/Cave Creek	2	-	-	-	-	-	X	X	-	-
09/23/19	Phoenix North	2	-	-	-	-	-	-	X	X	-
09/23/19	Phoenix South	2	-	-	-	-	-	X	X	-	-
09/23/19	Scottsdale North	2	-	-	-	-	-	X	-	X	-
09/23/19	Scottsdale South	2	-	-	-	-	-	X	X	X	-
09/23/19	East Valley	2	-	-	-	-	-	X	X	X	-
09/23/19	Southeast Valley	2	-	-	-	-	-	-	X	-	-
09/23/19	Superstition	2	-	-	-	-	-	X	X	X	-
09/23/19	Lower Salt River	2	-	-	-	-	-	X	-	-	-
09/23/19	Phoenix South	1	-	0.50-0.75/1.00-2.00	0.94	1.25-1.50	-	X	X	-	-
09/23/19	Scottsdale South	1	-	0.50-0.75/1.00-2.00	1.18	1.00-1.25	-	-	X	-	-

TABLE B-2: MSP Statements Issued - Monsoon Season 2019

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
09/23/19	East Valley	1	-	0.50-0.75/1.00-2.00	2.01	2.00-2.50	-	X	X	X	-
09/23/19	Lower Salt River Lakes	3	-	-	2.83	4.00-5.00	-	X	-	-	-
09/23/19	Superstition	3	-	-	3.35	3.00-4.00	-	X	X	X	-
09/23/19	East Valley	3	-	-	2.20	3.00-4.00	-	X	X	X	-
09/23/19	Scottsdale North	1	-	0.75-1.00/1.50-2.00	2.72	3.00-4.00	-	X	-	X	-
09/23/19	Scottsdale North	3	-	-	2.72	3.00-4.00	-	X	-	X	-
09/23/19	Wickenburg	1	-	0.75-1.00/1.50-2.00	0.35	1.50-2.00	-	X	X	-	-
09/23/19	Northwest Valley	1	-	0.50-0.75/1.50-2.50	2.13	3.00-4.00	1.74	X	-	-	-
09/23/19	Upper Centennial	1	-	0.50-0.75/1.25-2.00	0.94	2.00-2.50	-	-	-	-	-
09/23/19	Northwest Valley	3	-	-	2.83	3.00-4.00	-	X	X	-	-
09/23/19	New River/Cave Creek	1	-	0.75-1.00/1.50-2.50	2.17	3.00-4.00	-	X	X	-	-
09/23/19	Wickenburg	3	-	-	1.50	1.50-2.00	-	X	X	-	-
09/23/19	New River/Cave Creek	3	-	-	2.36	3.00-4.00	-	X	X	-	-
09/23/19	West Valley	1	-	0.50-0.75/1.00-1.50	0.35	3.00-4.00	-	-	-	-	-
09/23/19	Phoenix North	1	-	0.50-0.75/1.00-1.50	1.14	1.50-2.00	-	-	X	-	-
09/23/19	Palo Verde	1	-	0.75-1.00/1.50	1.69	8.00-10.00	-	X	X	-	-
09/23/19	Rainbow Valley	1	-	0.75-1.00/1.50	0.04	1.25-1.50	-	-	-	-	-
09/23/19	West Valley	1	-	0.75-1.00/1.50	0.35	3.00-4.00	-	-	-	-	-
09/23/19	Northwest Valley	1	-	0.50-0.75/1.00	0.12	3.00-4.00	-	-	-	X	-
09/23/19	Phoenix North	1	-	0.50-0.75/1.00	1.26	1.25-1.50	-	-	X	X	-
09/23/19	Scottsdale North	1	-	0.50-0.75/1.00	1.02	3.00-4.00	-	X	-	-	-
09/23/19	Phoenix South	1	-	0.50-0.75/1.00	1.38	2.50-3.00	-	X	-	X	-
09/23/19	Scottsdale South	1	-	0.50-0.75/1.00	1.14	2.50-3.00	-	X	X	X	-
09/23/19	Scottsdale North	1	-	0.50-0.75/1.25	0.67	3.00-4.00	-	X	-	-	-
09/23/19	Palo Verde	3	-	-	0.71	8.00-10.00	-	X	-	X	-
09/23/19	West Valley	3	-	-	0.87	3.00-4.00	-	-	X	-	-
09/23/19	Northwest Valley	3	-	-	0.39	3.00-4.00	-	-	X	-	-
09/25/19	Northwest Valley	1	-	0.50-0.75/1.50	0.87	1.50-2.00	-	-	X	-	-
09/25/19	Wickenburg	1	-	0.50-0.75/1.25-1.50	0.98	1.50-2.00	-	X	X	-	-

TABLE B-2: MSP Statements Issued - Monsoon Season 2019

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
09/26/19	Rainbow Valley	1	-	0.50-0.75/1.00	0.20	0.75-1.00	-	-	-	-	-
09/26/19	Gila River	1	-	0.50-0.75/1.00	0.28	3.00-4.00	-	-	-	-	-
09/26/19	East Valley	1	-	0.50-0.75/1.00	0.55	0.25-0.50	-	-	-	-	-
09/26/19	Phoenix South	1	-	0.50-0.75/1.00	0.43	0.75-1.00	-	-	-	-	-
09/26/19	West Valley	1	-	0.50-0.75/1.00	0.28	1.00-1.25	-	-	-	-	-
09/26/19	Scottsdale North	1	-	0.50-0.75	0.16	0.10-0.25	-	-	-	-	Y
09/26/19	Scottsdale South	1	-	0.50-0.75	0.24	0.25-0.50	-	-	-	-	Y

TABLE B-3: This table shows the lead time data of MSP issued Messages for the 2019 Monsoon Season. The table is broken down by Statement details and lead time. The columns from left to right are defined as follows:

Statement Details – Statement information including date, issue time, forecast zone, message type, forecaster, and valid time.

Statement Lead time – The first column denotes the time when the first ALERT Alarm (rain, stream, or impoundment) was triggered if any. The second column depicts the calculated lead time based on beginning statement valid time and when the first alarm was triggered.

TABLE B-3: MSP Statement Lead Time - Monsoon Season 2019							
Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
08/07/19	15:15	Wickenburg	1	Henz	Now-6pm	15:10	0
08/07/19	15:15	Upper Centennial	1	Henz	Now-6pm	15:10	0
08/28/19	22:10	Phoenix South	1	Waters	Now-11pm	22:24	14
08/28/19	22:10	Scottsdale South	1	Waters	Now-11pm	21:40	0
08/28/19	22:25	Northwest Valley	1	Waters	Now-11:30pm	22:09	0
09/01/19	18:05	Gila Bend	1	Henz	Now-730pm	21:32	207
09/01/19	19:37	Palo Verde	1	Henz	Now-9pm	19:26	0
09/14/19	15:37	Superstition	1	Henz	Now-515pm	16:04	27
09/16/19	19:10	West Valley	1	Henz	Now-8:45pm	19:54	44
09/23/19	3:40	Palo Verde	2	Henz	Now-12pm Friday	16:20	760
09/23/19	3:40	West Valley	2	Henz	Now-12pm Friday	16:20	760
09/23/19	3:40	Northwest Valley	2	Henz	Now-12pm Friday	11:55	495
09/23/19	3:40	Upper Centennial	2	Henz	Now-12pm Friday	11:20	460
09/23/19	3:40	Wickenburg	2	Henz	Now-12pm Friday	9:55	375
09/23/19	3:40	New River/Cave Creek	2	Henz	Now-12pm Friday	12:05	575
09/23/19	3:40	Phoenix North	2	Henz	Now-12pm Friday	13:28	588
09/23/19	3:40	Phoenix South	2	Henz	Now-12pm Friday	5:45	125
09/23/19	3:40	Scottsdale North	2	Henz	Now-12pm Friday	7:35	235
09/23/19	3:40	Scottsdale South	2	Henz	Now-12pm Friday	5:45	125
09/23/19	3:40	East Valley	2	Henz	Now-12pm Friday	5:45	125

TABLE B-3: MSP Statement Lead Time - Monsoon Season 2019

Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
09/23/19	3:40	Southeast Valley	2	Henz	Now-12pm Friday	13:20	580
09/23/19	3:40	Superstition	2	Henz	Now-12pm Friday	6:05	145
09/23/19	3:40	Lower Salt River	2	Henz	Now-12pm Friday	5:57	137
09/23/19	5:45	Phoenix South	1	Henz	Now-8am	5:20	0
09/23/19	5:45	Scottsdale South	1	Henz	Now-8am	5:38	0
09/23/19	5:45	East Valley	1	Henz	Now-8am	6:01	16
09/23/19	7:35	Scottsdale North	1	Henz	Now-9am	7:53	18
09/23/19	9:55	Wickenburg	1	Henz/Waters	Now-12pm	11:50	115
09/23/19	11:00	Northwest Valley	1	Henz/Waters	Now-1pm	11:40	40
09/23/19	12:05	New River/Cave Creek	1	Henz	Now-2:30pm	11:58	0
09/23/19	16:20	Palo Verde	1	Waters	Now-5:30pm	16:57	37
09/23/19	17:40	Northwest Valley	1	Waters	Now-6:15pm	19:43	123
09/23/19	17:40	Phoenix North	1	Waters	Now-6:15pm	17:32	0
09/23/19	18:30	Scottsdale South	1	Waters	Now-7:15pm	18:48	18
09/23/19	18:55	Scottsdale North	1	Waters	Now-8pm	19:15	20
09/25/19	20:26	Northwest Valley	1	Henz	Now-10pm	20:49	23
09/25/19	20:35	Wickenburg	1	Henz	Now-10pm	21:17	42

APPENDIX C: MSP LAKE ALERTS - VERIFICATION TABLES

TABLE C-1: This table shows each of the individual MSP Lake Alerts issued during the 2019 Monsoon season. The table is broken down by statement Details, observations, and verification. The columns from left to right are defined as follows:

Statement Details – Message information including date, time issued in local standard time, lake, issuing forecaster, and valid time. Data is pulled directly from issued Message.

Observations – Rain information including forecast rainfall intensity and storm total precipitation where applicable. Data is pulled directly from issued Message. It is important to note that not all issued Messages contain forecast rainfall information (noted by an “N/A” in the table).

Lead Time – amount of lead time in minutes from when Lake Alert was issued to when first observation occurred.

Verification – Hits and misses were assigned based on thresholds previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2019									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
07/30/19	15:37	Canyon	Henz	Now-445pm	-	-	-	-	Miss
08/03/19	19:57	Saguaro	Henz	Now-9pm	-	-	X	0	Hit
08/03/19	19:57	Canyon	Henz	Now-9pm	-	-	-	-	Miss
08/05/19	15:42	Bartlett	Henz	Now-5pm	-	X	-	0	Hit
08/05/19	16:25	Pleasant	Henz	Now-6pm	-	X	X	20	Hit
08/29/19	17:40	Bartlett	Henz	Now-7pm	-	-	-	-	Miss
08/29/19	18:40	Pleasant	Henz	Now-8pm	-	X	-	35	Hit
09/01/19	16:00	Apache	Henz	Now-6pm	X	-	X	8	Hit
09/01/19	16:00	Canyon	Henz	Now-6pm	X	-	X	30	Hit
09/01/19	16:00	Saguaro	Henz	Now-6pm	X	-	X	37	Hit
09/01/19	16:30	Bartlett	Henz	Now-530pm	X	-	-	28	Hit
09/03/19	16:48	Bartlett	Henz	Now-6pm	X	-	-	0	Hit
09/03/19	16:55	Saguaro	Henz	Now-615pm	X	-	-	15	Hit

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2019									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
09/03/19	16:55	Canyon	Henz	Now-615pm	X	-	-	27	Hit
09/14/19	15:21	Bartlett	Henz	Now-430pm	X	X	X	25	Hit
09/14/19	16:10	Apache	Henz	Now-530pm	-	X	-	9	Hit
09/14/19	16:10	Canyon	Henz	Now-530pm	-	X	-	9	Hit
09/14/19	16:10	Saguaro	Henz	Now-530pm	X	-	-	60	Hit

APPENDIX E: QPF STORM TOTAL PRECIPITATION - VERIFICATION TABLES

TABLE E-1: This table shows each of the individual MSP Lake Alerts issued during the 2019 Monsoon season including the detailed forecast rainfall information. The table is broken down by statement Details, observations, and verification. The columns from left to right are defined as follows:

Statement Details – Message information including date and forecast zone. Data is pulled directly from issued Message.

Peak Storm Total Precipitation – Rain information including forecast (QPF), observed (ALERT), radar estimated (GAQPE), and local storm report total (LSR). Data is pulled directly from issued Message. Observations are gathered the ALERT database, WDT Inc radar products, and NWS local storm reports.

Error – Percent error was calculated based on Equation 4 previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

Verification – Hits and misses were assigned based on thresholds previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2019											
Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
07/22/19	East Valley	1.00	1.14	1.00	1.25	-	-12.28	0.00	-20.00	-	Hit
07/22/19	Scottsdale South	1.00	0.59	1.00	1.25	-	69.49	0.00	-20.00	-	Hit
07/30/19	Superstition	0.75	0.75	1.25	1.50	0.56	0.00	-40.00	-50.00	33.93	Hit
07/30/19	East Valley	1.00	0.83	1.00	1.25	0.56	20.48	0.00	-20.00	78.57	Hit
08/03/19	Scottsdale South	1.00	0.51	1.00	1.25	-	96.08	0.00	-20.00	-	Hit
08/07/19	Wickenburg	1.50	1.30	1.00	1.25	-	15.38	50.00	20.00	-	Hit
08/07/19	Upper Centennial	1.75	1.93	1.25	1.50	-	-9.33	40.00	16.67	-	hit
08/28/19	West Valley	1.00	1.02	0.75	1.00	-	-1.96	33.33	0.00	-	Hit
09/01/19	Scottsdale North	1.00	0.16	1.25	1.50	-	525.00	-20.00	-33.33	-	Hit
09/01/19	Phoenix South	0.75	0.16	0.75	1.00	-	368.75	0.00	-25.00	-	Hit
09/01/19	Gila Bend	1.50	1.22	1.50	2.00	-	22.95	0.00	-25.00	-	Hit
09/01/19	Palo Verde	1.00	0.87	1.50	2.00	-	14.94	-33.33	-50.00	-	Hit

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2019

Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
09/03/19	Southeast Valley	0.50	0.00	N/A	N/A	-	-	-	-	-	Miss
09/03/19	East Valley	0.50	0.04	N/A	N/A	-	1150.00	-	-	-	Miss
09/14/19	Superstition	1.25	1.10	1.50	2.00	-	13.64	-16.67	-37.50	-	Hit
09/14/19	Scottsdale North	0.75	0.24	0.75	1.00	-	212.50	0.00	-25.00	-	Hit
09/16/19	Rainbow Valley	0.75	0.59	0.75	1.00	-	27.12	0.00	-25.00	-	Hit
09/16/19	West Valley	1.25	2.44	1.00	1.25	-	-48.77	25.00	0.00	-	Hit
09/23/19	Phoenix South	1.00	0.94	1.25	1.50	-	6.38	-20.00	-33.33	-	Hit
09/23/19	Scottsdale South	1.00	1.18	1.00	1.25	-	-15.25	0.00	-20.00	-	Hit
09/23/19	East Valley	2.00	2.01	2.00	2.50	-	-0.50	0.00	-20.00	-	Hit
09/23/19	Scottsdale North	2.00	2.72	3.00	4.00	-	-26.47	-33.33	-50.00	-	Miss
09/23/19	Wickenburg	1.50	0.35	1.50	2.00	-	328.57	0.00	-25.00	-	Hit
09/23/19	Northwest Valley	2.50	2.13	3.00	4.00	1.74	17.37	-16.67	-37.50	43.68	Hit
09/23/19	Upper Centennial	2.00	0.94	2.00	2.50	-	112.77	0.00	-20.00	-	Hit
09/23/19	New River/Cave Creek	2.50	2.17	3.00	4.00	-	15.21	-16.67	-37.50	-	Hit
09/23/19	West Valley	1.50	0.35	3.00	4.00	-	328.57	-50.00	-62.50	-	Miss
09/23/19	Phoenix North	1.25	1.14	1.50	2.00	-	9.65	-16.67	-37.50	-	Hit
09/23/19	Palo Verde	1.50	1.69	8.00	10.00	-	-11.24	-81.25	-85.00	-	Hit
09/23/19	Rainbow Valley	1.50	0.04	1.25	1.50	-	3650.00	20.00	0.00	-	Hit
09/23/19	West Valley	1.50	0.35	3.00	4.00	-	328.57	-50.00	-62.50	-	Miss
09/23/19	Northwest Valley	1.00	0.12	3.00	4.00	-	733.33	-66.67	-75.00	-	Miss
09/23/19	Phoenix North	1.00	1.26	1.25	1.50	-	-20.63	-20.00	-33.33	-	Hit
09/23/19	Scottsdale North	1.00	1.02	3.00	4.00	-	-1.96	-66.67	-75.00	-	Hit
09/23/19	Phoenix South	1.00	1.38	2.50	3.00	-	-27.54	-60.00	-66.67	-	Miss
09/23/19	Scottsdale South	1.00	1.14	2.50	3.00	-	-12.28	-60.00	-66.67	-	Hit
09/23/19	Scottsdale North	0.75	0.67	3.00	4.00	-	11.94	-75.00	-81.25	-	Hit
09/25/19	Northwest Valley	1.50	0.87	1.50	2.00	-	72.41	0.00	-25.00	-	Hit
09/25/19	Wickenburg	1.25	0.98	1.50	2.00	-	27.55	-16.67	-37.50	-	Hit
09/26/19	Rainbow Valley	0.75	0.20	0.75	1.00	-	275.00	0.00	-25.00	-	Hit
09/26/19	Gila River	1.00	0.28	3.00	4.00	-	257.14	-66.67	-75.00	-	Miss

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2019

Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
09/26/19	East Valley	0.50	0.55	0.25	0.50	-	-9.09	100.00	0.00	-	Hit
09/26/19	Phoenix South	0.50	0.43	0.75	1.00	-	16.28	-33.33	-50.00	-	Hit
09/26/19	West Valley	1.00	0.28	1.00	1.25	-	257.14	0.00	-20.00	-	Hit
09/26/19	Scottsdale North	0.50	0.16	0.10	0.25	-	212.50	400.00	100.00	-	Miss
09/26/19	Scottsdale South	0.50	0.24	0.25	0.50	-	108.33	100.00	0.00	-	Hit
* GAQPE (Radar) estimated data given in ranges: (LT) Lower Total and (UT) Upper Total											