



Downburst over the South Mountains, looking SSE from Sky Harbor Airport, 07-18-2016, Bryan Snider

Flood Control District of Maricopa County

Flood Warning Branch

MSP Verification Report & Season Recap: Monsoon Season 2016



TABLE OF CONTENTS

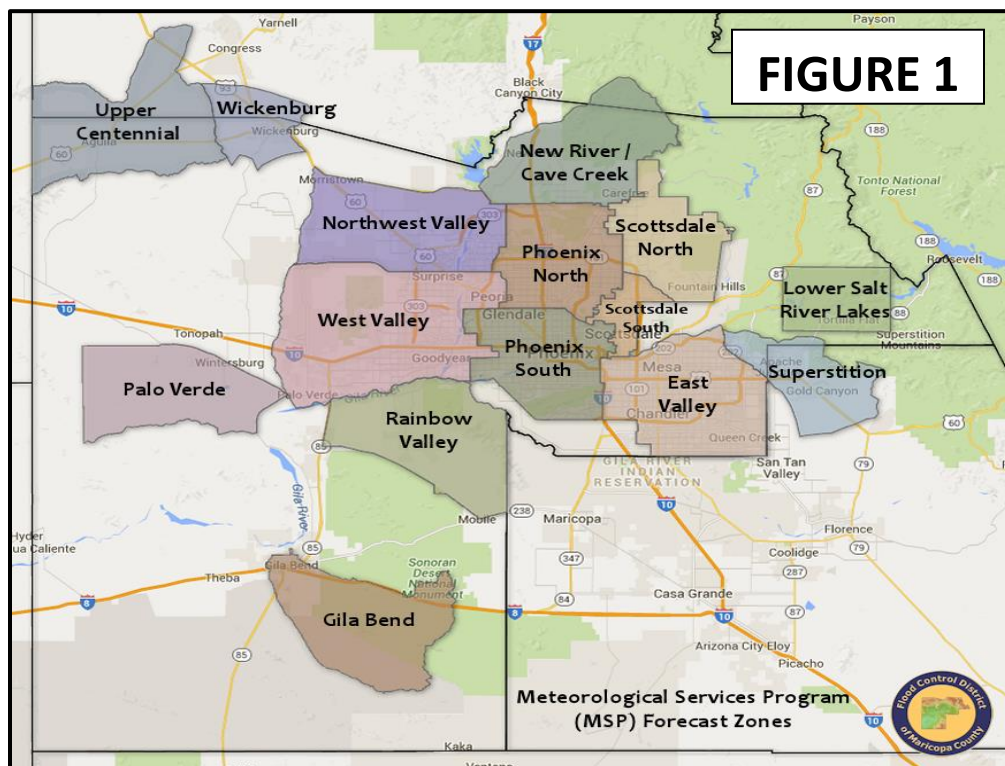
INTRODUCTION	3
MSP PRODUCT DESCRIPTION	4
2016 MONSOON SEASON RECAP.....	6
MSP VERIFICATION METRICS AND CRITERIA	11
OUTLOOK VERIFICATION	15
MESSAGE VERIFICATION	17
LAKE ALERT VERIFICATION	19
QPF PEAK RAINFALL INTENSITY VERIFICATION	20
QPF STORM TOTAL PRECIPITATION VERIFICATION	22
SUMMARY.....	24
APPENDIX A: MSP OUTLOOKS - VERIFICATION TABLES	26
APPENDIX B: MSP MESSAGES - VERIFICATION TABLES	61
APPENDIX C: MSP LAKE ALERTS - VERIFICATION TABLES	76
APPENDIX D: QPF PEAK RAINFALL INTENSITY - VERIFICATION TABLES.....	79
APPENDIX E: QPF STORM TOTAL PRECIPITATION - VERIFICATION TABLES ..	81

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 15 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:

During the summer months, a program exists to aid the Boy Scouts at Camp Geronimo. Though in Gila County, many of the scouts reside within Maricopa County. The Camp exists below a watershed that was recently burned, and NWS Flagstaff declined a request for localized support. A call is made to the officials at the camp when needed, stating the expected flood problem.

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](#)

2016 MONSOON SEASON RECAP

According to the FCDMC ALERT rain gage network, the 2016 monsoon season was characterized as being near normal. When averaged across 277 of the oldest county mesonet rain gages apart, 2.65" of rain fell which was 86% of the mean value of 2.97". An image showing the full 34 year period of record can be viewed [here](#). It's worth noting below average rainfall was recorded at Sky Harbor Airport for the first time since the 2011 season. The official rain total as reported by the NWS Phoenix office was 2.49" which was 0.22" below the period average of 2.71". 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 preliminary FCDMC ALERT rain gage data from around the county. The shaded contours depict precipitation totals from June 15th – September 30th.

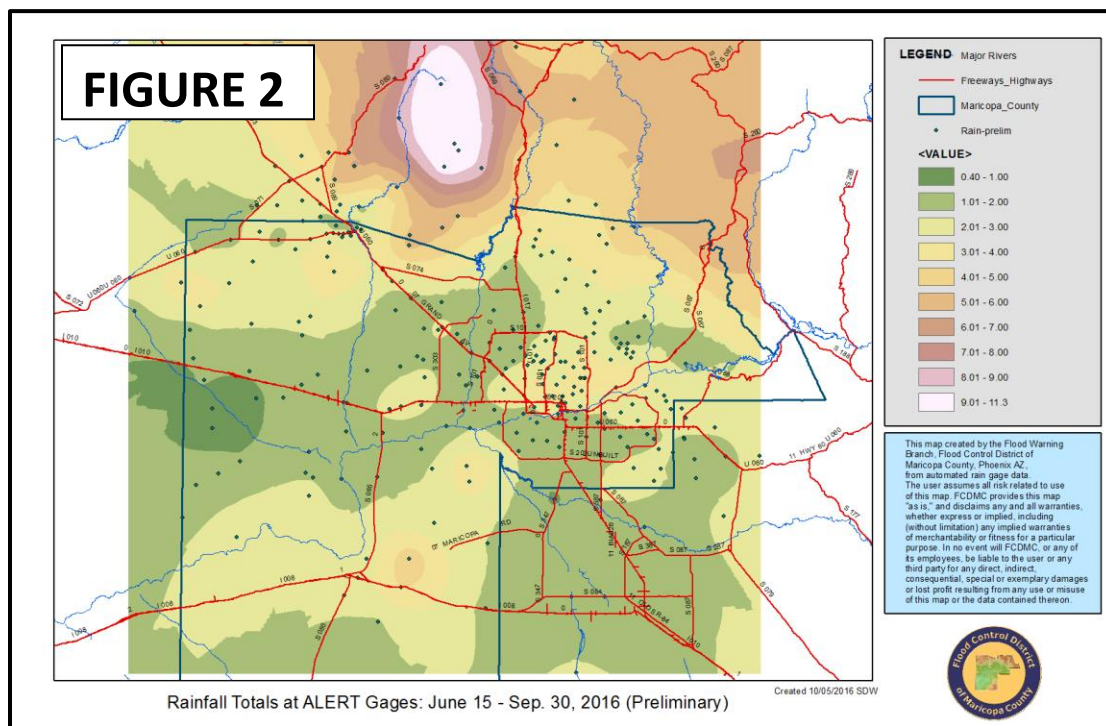
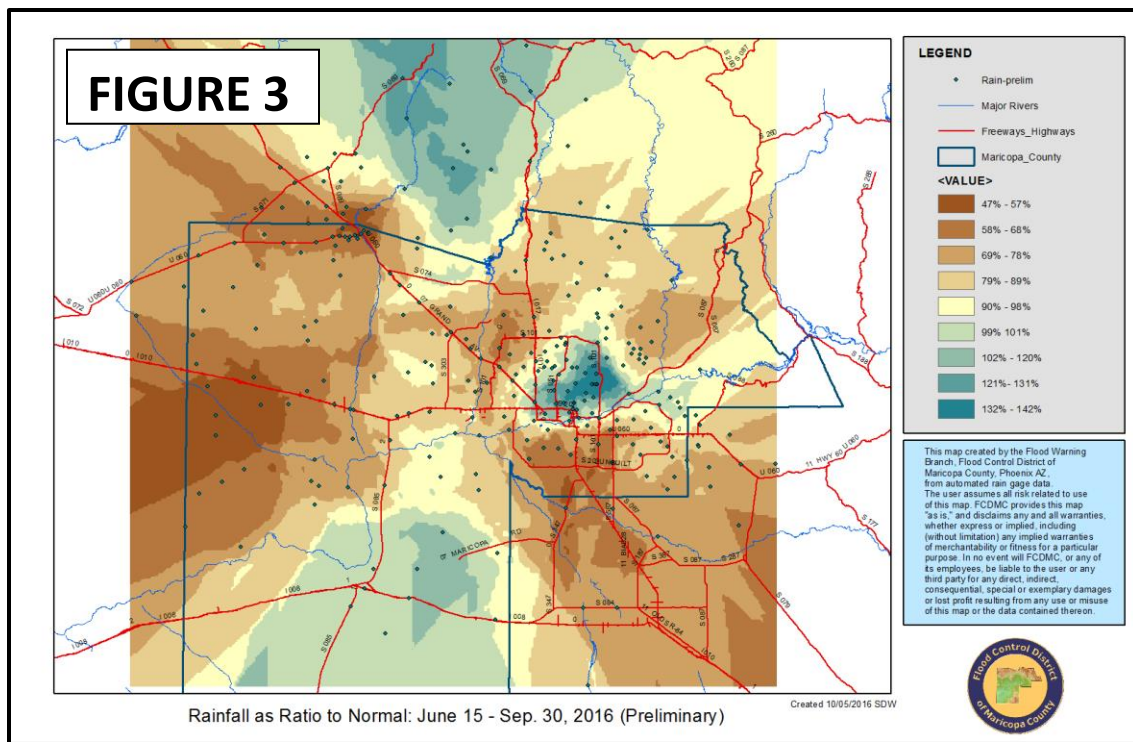
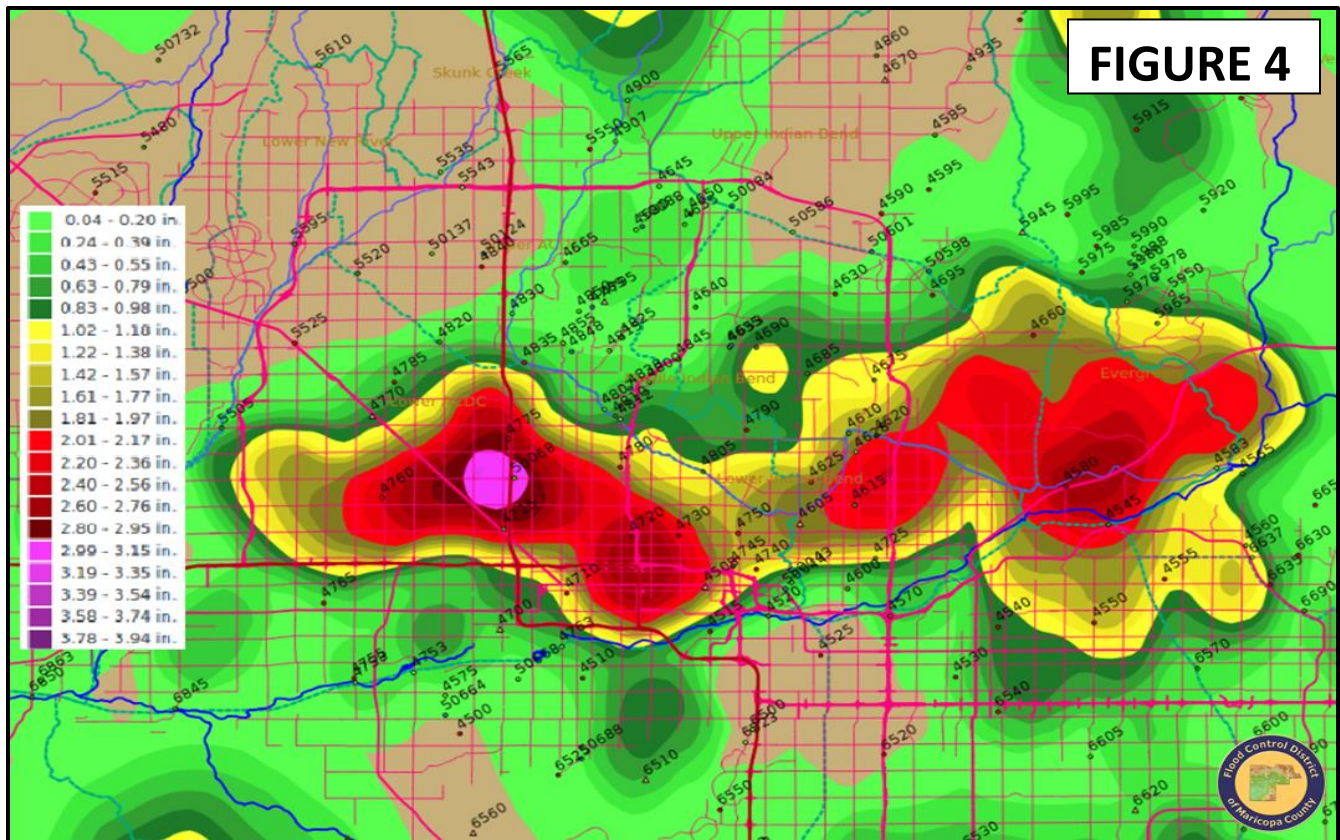


Figure 3, on the next page, shows the ratio of 2016 monsoon precipitation versus average monsoon precipitation. Similar to Figure 2, contours were generated using preliminary FCDMC ALERT rain gage data from around the county. Areas extending west from Wickenburg through Palo Verde saw below to well below average rainfall totals for the season. Similarly southwestern portions of the Valley were equally as dry. Above average rain fell across a large swath of the central Valley including much of metro Phoenix, south/central Scottsdale, and east Mesa. Southwestern portions of the County 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.



The season got off to a hot start (literally) with an abnormally strong monsoon ridge building north across the state during the third week in June. Daily temperatures eclipsed the 110°F mark from June 18th -23rd with new daily record high temperatures of 118°F on June 19th and 116°F on June 20th observed at Sky Harbor Airport. The ridge of high pressure settled across the Four Corners region through the remainder of the month helping the operational season (historical onset July 7th) get off to another early start. The first MSP message statements were issued on the evening of June 29th as localized heavy rain fell across the eastern half of the county with portions of Fountain Hills, East Mesa and Utery Mountain Regional Park getting hit the hardest. A large inverted trough then lifted north out of Mexico and into AZ June 30th - July 1st. Light rain fell across portions of the county on the 30th, before a severe thunderstorm outbreak developed across southwestern portions of the county on July 1st.

The following four weeks of July remained rather quiet as we entered our first extended “break” period to the monsoon during an otherwise historically active period. The only noteworthy event occurred on July 18th as downburst, over the Phoenix South Mountains, dropped localized heavy rain and caused flooding problems for residents in Ahwatukee and South Phoenix. An image of the storm taken from local photographer/storm chaser, Bryan Snider, can be viewed [here](#). Despite a mostly quiet July, activity continued to ramp up during the final week in the month. This period was highlighted by a widespread severe weather event on the evening of July 29th as an organized line of thunderstorms rolled off the higher terrain of eastern AZ into the Valley. Severe wind gusts and heavy rain were observed all across the Valley capped off by torrential rains and flooding over the Maricopa Mountains east of Gila Bend. Two more active days around the County followed as July came to an end.



August picked up where July left off as a very moist and unstable air mass remained in place across southcentral AZ. The County's most notable rain event this summer unfolded on August 2nd where anywhere from 1.00"-3.00" of rain fell across most of the Phoenix urban corridor (Figure 2 above). Portions of I-10, I-17, Loop-202, and many city other streets were shut down for brief stints due to urban flooding. More details on this event can be accessed in the NWS Phoenix WFO storm recap [here](#). This event was quickly followed up by two more heavy rain episodes. The first occurred during the afternoon/evening hours of August 3rd across northcentral portions of the county. The second, more significant event, unfolded during the morning rush hour on August 5th. Two distinct clusters of t-storms developed across metro Phoenix before rapidly intensifying as they moved northeast into central and north Scottsdale. Anywhere from 1.00"-2.00" of rain fell in short duration causing runoff in local washes and streams. A large number of unbridged road crossings had to be shut down along Scottsdale, Tatum, and Pima roads north of the Loop 101 due to flooding.

Following another brief "break" period, a large influx of tropical moisture associated with Tropical Storm Javier brought heavy rains from the Superstition Mountains west through metro Phoenix during the morning of August 9th. Activity continued the following evening from the I-17 corridor west through the White Tank Mountains before one final pulse during the morning of August 11th across the Southeast Valley. When all was said and done, many areas around the county picked up an additional 1.00"-3.00" of rain during the 3-day period before conditions finally dried out.

The third week of the month brought the next active period as a large, nearly stationary, trough developed across the western US sending repeated embedded shortwave disturbances east across the state. Heavy rain fell across western portions of the county during the overnight hours on the 17th, the 18th, and again on the 19th. The active period continued with widespread storms and rain across most of the county on the 20th and then again on the 22nd before the system finally exited the state on the 24th. A fast moving follow-up disturbance brought one more round of storms to the northern half of the county during the morning hours on the 26th. Overall, this period was highlighted by unusually cold temperatures aloft (for mid-August), modest moisture levels, and a pattern more closely resembling late September. Despite several multi-day periods of rain, only localized minor flooding problems occurred around the County. The remainder of August came and went quietly with mainly dry conditions and above average temperatures.

Activity picked back up the first week of September. Localized heavy rain fell across portions of Gila Bend, South Phoenix, and Chandler areas the evening of September 1st. Later that week, tropical system Newton quickly developed off the coast of Mexico before moving north towards Baja Sur and making landfall as a Hurricane near Cabo San Lucas. All attention then turned towards the Desert Southwest as the system continued to track north through the Sea of Cortez and into Arizona as a post-tropical system on the 7th (click [here](#) to see track graphics from National Hurricane Center). Ultimately, the system's center moved northeast across Santa Cruz, eastern Pima, and Cochise counties dropping torrential rainfall before becoming decoupled from its convective bands. In and around the county, heavy rain fell across southwestern locales including Gila Bend, Rainbow Valley, Palo Verde, and Buckeye. These locations picked up anywhere from 0.50"-1.50" which lead to flash flooding in area washes (Sand Tank, Rainbow, etc) during the morning of the 7th. Most locations in and around the Phoenix urban corridor recorded much lower totals mostly below 0.30". Remnant moisture across southcentral AZ led to isolated strong storms the following afternoon south of the Aguila and Wickenburg areas before mainly dry and quiet weather conditions through the middle of the month.

The next period of unsettled weather arrived September 19th-22nd as a cut-off low pressure system across the northern Baja and weak ridging across southern Texas helped draw moisture north from tropical system Paine into Arizona. Widespread light to moderate rain fell across most of the state on the 20th and 21st before a fall disturbance, originating out of the Pacific Northwest, brought a strong cold front across region on Thursday the 22nd. This event was highlighted by strong thunderstorms rolling through the central Valley dropping anywhere from 0.40"-0.75" of rain across Buckeye, metro Phoenix, Scottsdale, and Tempe. Active weather, courtesy of another cut-off system, continued through the last week of the season. The most notable event unfolded on the evening of the 27th as a line of thunderstorms, originating out Tucson, moved north into the County bringing a late season large dust storm to the Southeast Valley and central Phoenix urban corridor. This event was followed up with periods of beneficial rain across portions of the County each day until the official close on the 30th.

MSP Issued Products Recap:

A total of 119 forecast zone-specific messages were issued by the MSP spread across nineteen different days during the length of the monsoon season. Table 1, on the next page, shows the monthly break down by forecast zone of messages issued including season totals.

TABLE 1: MSP Messages Issued - 2016 Monsoon Season					
Forecast Zone	June	July	August	September	Total
Gila Bend	0	3	1	1	5
Palo Verde	0	1	1	0	2
Rainbow Valley	0	2	4	0	6
West Valley	0	2	5	0	7
Northwest Valley	0	3	5	0	8
Upper Centennial	0	4	1	0	5
Wickenburg	0	5	5	0	10
New River/Cave Creek	0	5	6	0	11
Phoenix North	0	3	6	0	9
Phoenix South	0	2	6	2	10
Scottsdale North	1	5	7	1	14
Scottsdale South	0	3	5	1	9
Southeast Valley	1	2	4	2	9
Lower Salt River Lakes	0	1	2	2	5
Superstition	1	2	4	2	9
All Zones	3	43	62	11	119

Of the 119 Messages issued, seventy-seven were Message-1 Alerts, thirty were Message-2 Flash Flood Watches, ten were Message-3 Flash Flood Warnings, and two were Message-4 Cancel. Table 2, below, shows the monthly break down by forecast zone of Lake Alerts issued including season totals. Forty-six 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 fully 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 - 2016 Monsoon Season					
Recreational Zone	June	July	August	September	Total
Lake Pleasant	2	3	5	0	10
Horseshoe Lake	0	0	0	0	0
Bartlett Lake	0	3	5	0	8
Saguaro Lake	1	2	3	1	7
Canyon Lake	2	2	5	1	10
Apache Lake	1	3	5	2	11
All Zones	6	13	23	4	46

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 2016 monsoon season. This chapter is broken down into five sections: Outlooks, Messages, Lake Alerts, Peak Intensity, 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:

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

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

Rainfall Intensity: the rate at which rain is falling including an amount in inches over a specific time period i.e. 0.50"/30min.

Storm Total Precipitation (STP): total rainfall from an identified storm or storm complex, given in inches.

Probability of Occurrence: forecast confidence, given 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.

$$\begin{aligned} & \text{Probability} \geq 40\% \text{ and QPF} \geq 0.50'' \text{ AND Observed Rain} < 0.50'' \\ & \text{Probability} = 30\% \text{ and QPF} \geq 1.00'' \text{ AND Observed Rain} < 0.50'' \end{aligned}$$

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 > 30mph, 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](#).

QPF PEAK RAINFALL INTENSITY:

Forecast Accuracy:

Only message statements where QPF peak rainfall intensity was provided were evaluated. Observational data used for this verification included Maricopa County ALERT rain gages and/or local storm reports. Either a hit or a miss was selected for each 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 D](#).

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 84.9%. Forecast accuracy remained above the 75% for each FZ. Wickenburg and Lower Salt River Lakes were the only two FZs to drop below 80%. This was somewhat expected given the forecast challenges associated with predicting storm potential and rainfall output over these mainly high terrain regions. Over-forecasting rain totals was a noticeable reason as to the lower accuracy and was easily visible when comparing with the false alarm rate, discussed below.

TABLE 3: MSP Weather Outlook Verification - SEASON TOTALS, 2016							
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)	TS (%)
Gila Bend	91/108	84.3%	12/16	75%	1	0.9%	78.3%
Palo Verde	91/108	84.3%	7/11	63.6%	1	0.9%	78.3%
Rainbow Valley	91/108	84.3%	9/9	100%	2	1.8%	77.4%
West Valley	95/108	88%	12/15	80%	0	0%	84.1%
Northwest Valley	88/108	81.5%	9/13	69.2%	2	1.8%	73.8%
Upper Centennial	93/108	86.1%	17/24	70.8%	2	1.8%	79.8%
Wickenburg	86/108	79.6%	8/12	66.7%	7	6.5%	67.4%
New River/Cave Creek	87/108	80.6%	11/15	73.3%	4	3.7%	70.9%
Phoenix North	92/108	85.2%	7/8	87.5%	6	5.6%	75.0%
Phoenix South	98/108	90.7%	9/10	90%	1	1.8%	86.7%
Scottsdale North	94/108	87%	10/13	76.9%	3	2.8%	80%
Scottsdale South	98/108	90.7%	8/9	88.9%	1	0.9%	86.7%
Southeast Valley	97/108	89.8%	10/11	90.9%	2	1.8%	84.5%
Lower Salt River Lakes	85/108	78.7%	5/7	71.4%	7	6.5%	66.3%
Superstition	90/108	83.3%	8/9	88.9%	4	3.7%	74.4%
All Zones	1376/1620	84.9%	142/182	78%	43/1620	2.6%	77.5%

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 78%. In general, a POD of over 50% is considered sufficient and over 75% excellent in the forecast community. All of the FZs were above the 50% accuracy threshold with nine 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 2.6% with none of the forecast zones exceeding 7%. The highest FAR was 6.5% at both Wickenburg and Lower Salt River Lakes where forecasters consistently over-predicted rainfall totals.

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 the operational monsoon season began on June 27th and ended on September 30nd. Forecasters also removed fourteen days during the middle of July (2nd -15th) as an extended break period to the monsoon eliminated any chance for rainfall during that period. Overall, forecast skill was 77.5% for all FZs over the length of the active season. Ten of the fifteen FZs met or exceeded the 75% accuracy threshold, while the remaining five FZs remained well above the 50% threshold. Unsurprisingly, Lower Salt River Lakes and Wickenburg had the lowest TSs at 66.3% and 67.4% respectively.

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 112 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 90.2%. Fourteen of the fifteen FZs met or exceeded the 75% accuracy threshold. As stated earlier, 50% accuracy is considered sufficient and 75% or above is considered excellent within the forecast community. Palo Verde had the lowest accuracy coming right in at the 50% threshold.

For the second straight season, three messages were issued in June with another early start to the operational monsoon season and all three verified. Forty messages were issued in July. Messages were spread out across six operationally significant days. Overall, forecast accuracy for the month for all FZs combined was 90%. Three of the four total misses for the month were a result of a Flash Flood Watch being issued for the entire County for July 29th. This day was also the most active day from an operational perspective with twenty-three messages issued across eight FZs.

August was the busiest month with sixty messages spread out across nine operationally significant days. Forecast accuracy for the month across all FZs combined held steady at 90%. Five of the six misses for the month came during a county wide Flash Flood Watch issued on August 8th event. The most significant rain event of the season occurred on August 2nd across the central Phoenix Valley. Fifteen messages were issued across eleven FZs during the afternoon and evening hours.

September saw a sharp decrease in issued messages (9) and operationally significant days (3) which is typical as the season begins to wind down. Overall forecast accuracy remained mostly steady coming in at 88.9%. Seven of the nine qualifying messages were issued as a result to the September 22nd rain event across the central Phoenix urban corridor.

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 and M-3 Flash Flood Warnings combined over the length of the Monsoon season was just under thirty-two minutes. The average lead time for M-2 Flash Flood Watches was just over seven and half hours.

TABLE 4: MSP Issued Statements Verification, broken down by month and Forecast Zone - Monsoon Season 2016

	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	3/3	100%	1/1	100%	1/1	100%	5/5	100%
Palo Verde	0/0	n/a	0/1	0%	1/1	100%	0/0	n/a	1/2	50%
Rainbow Valley	0/0	n/a	2/2	100%	3/3	100%	0/0	n/a	6/6	100%
West Valley	0/0	n/a	1/2	50%	4/4	100%	0/0	n/a	6/7	85.7%
Northwest Valley	0/0	n/a	2/2	100%	5/5	100%	0/0	n/a	8/8	100%
Upper Centennial	0/0	n/a	4/4	100%	0/1	0%	0/0	n/a	4/5	80%
Wickenburg	0/0	n/a	5/5	100%	4/5	80%	0/0	n/a	7/8	87.5%
New River/Cave Creek	0/0	n/a	4/4	100%	5/6	83.3%	0/0	n/a	9/10	90%
Phoenix North	0/0	n/a	3/3	100%	5/6	83.3%	0/0	n/a	8/9	88.9%
Phoenix South	0/0	n/a	3/3	100%	6/6	100%	2/2	100%	11/11	100%
Scottsdale North	1/1	100%	3/4	75%	6/7	85.7%	1/1	100%	12/14	85.7%
Scottsdale South	0/0	n/a	2/2	100%	4/5	80%	1/1	100%	7/8	87.5%
Southeast Valley	1/1	100%	2/2	100%	4/4	100%	2/2	100%	9/9	100%
Lower Salt River Lakes	0/0	n/a	0/1	0%	2/2	100%	1/1	0%	3/4	75%
Superstition	1/1	100%	2/2	100%	4/4	100%	0/1	0%	7/8	87.5%
All Zones	3/3	100%	36/40	90%	54/60	90%	8/9	88.9%	101/112	90.2%

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 forty-six lake alerts issued over the length of the season with half of the events occurring in August. 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 82.6%. Four out of the five zones exceeded the 75% accuracy threshold with the lowest forecast accuracy of 71.4% recorded at Saguaro Lake. 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 16 minutes. Lead time remained steady from last year.

TABLE 5: MSP Lake Alerts Issued - 2016 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	1/2	50%	3/3	100%	4/5	80%	0/0	n/a	5/6	83.3%
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	3/3	100%	5/5	100%	0/0	n/a	8/8	100%
Saguaro Lake	1/1	100%	1/2	50%	2/3	66.7%	1/1	100%	5/7	71.4%
Canyon Lake	2/2	100%	1/2	50%	4/5	80%	1/1	100%	8/10	80%
Apache Lake	1/1	100%	3/3	100%	4/5	80%	1/2	50%	9/11	81.8%
All Zones	5/6	83.3%	11/13	84.6%	19/23	82.6%	3/4	75%	38/46	82.6%

QPF PEAK RAINFALL INTENSITY 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 rainfall intensity that will likely accompany thunderstorms moving through a FZ is intended to help clients make well-informed and proactive decisions.

Figure 5, below, is a scatter plot depicting forecast versus observed rainfall intensity for all qualifying events during the length of the monsoon season. 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. These plots are commonly used within the forecast community to visually inspect how well forecast values correspond to the observed values. There were twenty-three qualifying message events that counted towards the verification of the QPF peak rainfall intensity and fifteen events fell within the error threshold.

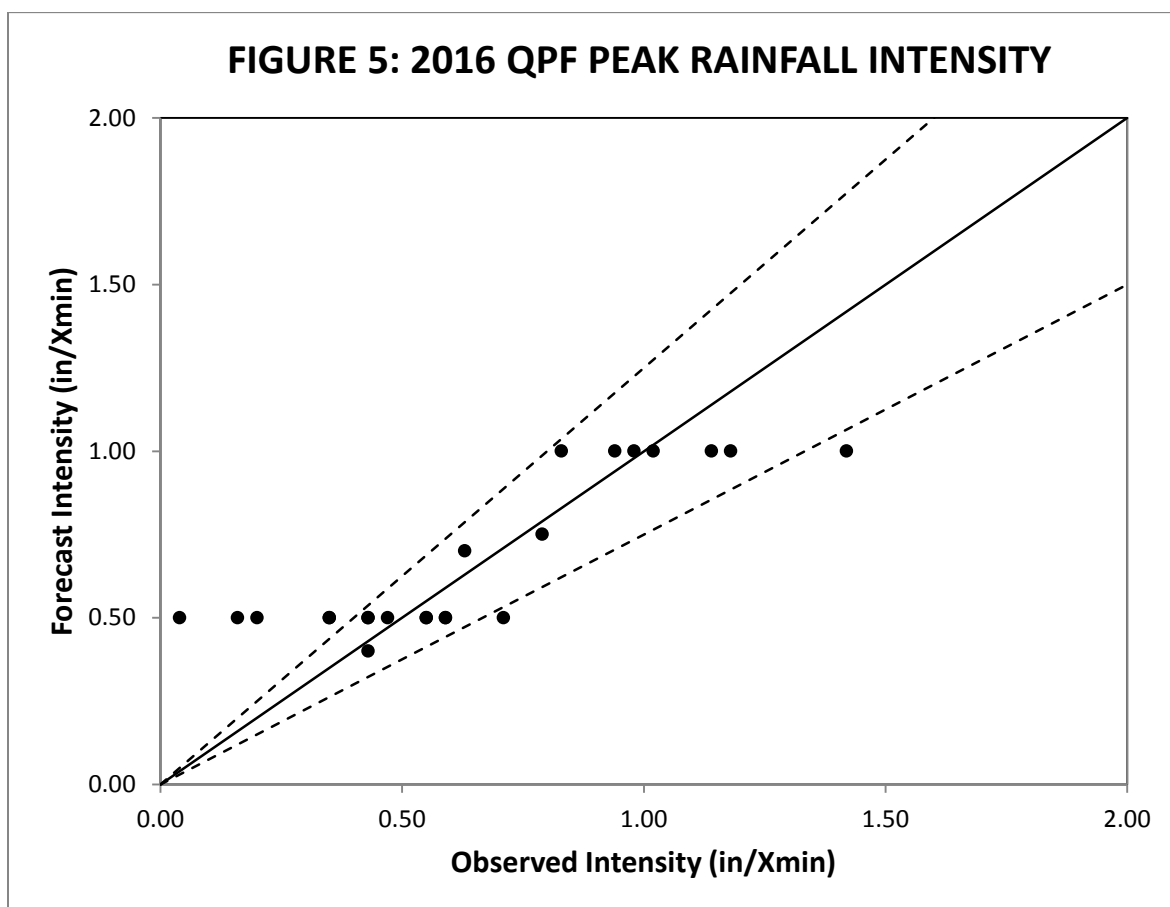


Table 6, below, shows the issued message verification broken down by FZ and month. Complete data tables for each FZ can be viewed in [Appendix D](#): Table D-1. Forecast accuracy for all FZs combined, over the length of the season, was 65.2%. July was the month with the lowest forecast skill and this was directly attributable to the over forecasting of rainfall rates spanning the two main operationally significant days during the month (1st and 31st). Six of the total eight misses came during these two events. Only a handful of qualifying events occurred during the length of the season and the majority of them were during July, therefore a month to month comparison of changing forecast skill is not relevant.

TABLE 6: QPF Peak Rainfall Intensity Verification - Monsoon Season 2016										
	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	1/1	100%	0/0	n/a	0/0	n/a	1/1	100%
Palo Verde	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a
Rainbow Valley	0/0	n/a	1/1	100%	0/0	n/a	0/0	n/a	1/1	100%
West Valley	0/0	n/a	0/1	0%	0/0	n/a	0/0	n/a	0/1	0%
NW Valley	0/0	n/a	0/1	0%	0/0	n/a	0/0	n/a	0/1	0%
Upper Centennial	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a
Wickenburg	0/0	n/a	1/1	100%	0/0	n/a	0/0	n/a	1/1	100%
New River/Cave Creek	0/0	n/a	1/2	50%	0/1	0%	0/0	n/a	1/3	33.3%
Phoenix North	0/0	n/a	0/2	0%	0/0	n/a	0/0	n/a	0/2	0%
Phoenix South	0/0	n/a	0/0	n/a	2/2	100%	0/0	n/a	2/2	100%
Scottsdale North	1/1	100%	1/2	50%	2/2	100%	0/0	n/a	4/5	80%
Scottsdale South	0/0	n/a	0/0	n/a	2/2	100%	0/0	n/a	2/2	100%
Southeast Valley	1/1	100%	0/0	n/a	1/1	100%	0/0	n/a	2/2	100%
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	1/1	100%	0/0	n/a	0/1	0%	0/0	n/a	1/2	50%
All Zones	3/3	100%	5/11	45.5%	7/9	77.8%	0/0	n/a	15/23	65.2%

It is important to remember observed rainfall intensity data is typically gathered from either ALERT rain gages or provided from local storm reports. In either case, accurate measurements of peak rainfall intensity are contingent upon a thunderstorm rain core directly passing over a gage site. Often times the main rain core will move in between or only partially clip a gage site. This can be a noteworthy source of error especially over FZs with greater spatial gaps in between gage sites. Also, gage adjusted radar estimates were used to reconstruct rainfall intensity when/where available.

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 fifty-three qualifying message events that counted towards the verification of the STP forecasts and forty-seven events fell within the error threshold.

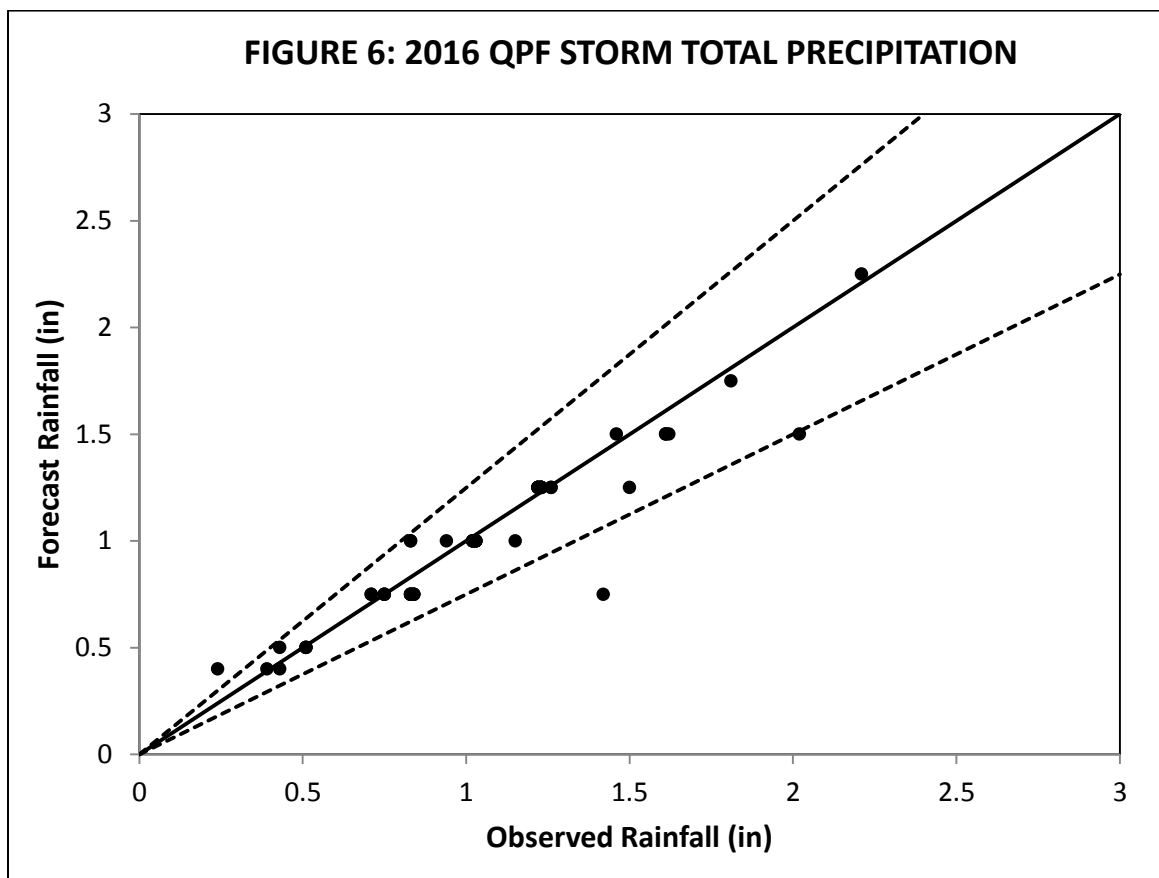


Table 7, on the next page, shows the issued message verification broken down by FZ and month. Complete data tables for each FZ can be viewed in [Appendix E: Table E-1](#). Forecast accuracy for all FZs combined, over the length of the season, was 88.7%. The sole qualifying STP event was correctly forecast in June. Accuracy in July came in at 87.5% with the two

misses occurring on July 1st. Accuracy slightly improved to 88.9% in August which also happened to have the largest number of qualifying STP events at twenty-seven. Forecast accuracy remained steady in September again coming in at 88.9%. Three of the five misses for the month came during the September 13th rain event. No STP forecasts were made for Palo Verde throughout the season. Forecast accuracy for eleven of the remaining fourteen FZs was above the 75% threshold with only Phoenix North, Scottsdale North, and Superstition falling short. Forecast accuracy over the length of the monsoon season for all of the higher terrain FZs (Upper Centennial, Wickenburg, New River/Cave Creek, Sycamore Creek, Lower Salt River Lakes, and Superstition) was exceptional at 92.9% (13/14, correct STP-QPFs).

The end of the previous section covered possible sources of error in peak rainfall intensity due to spatial gaps in reporting gages within certain FZs. In this case, observed storm total precipitation data was gathered from ALERT rain gages, local storm reports, and gage adjusted radar rainfall estimation (e.g. GAQPE). Radar rainfall estimates were able to fill in the gaps that would otherwise be missed in the aforementioned FZs.

TABLE 7: QPF Storm Total Precipitation Verification - Monsoon Season 2016

	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	2/2	100%	0/0	n/a	1/1	100%	3/3	100%
Palo Verde	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a
Rainbow Valley	0/0	n/a	1/1	100%	2/2	100%	0/0	n/a	3/3	100%
West Valley	0/0	n/a	1/1	100%	3/3	100%	0/0	n/a	4/4	100%
NW Valley	0/0	n/a	0/0	n/a	4/4	100%	0/0	n/a	4/4	100%
Upper Centennial	0/0	n/a	1/1	100%	0/0	n/a	0/0	n/a	1/1	100%
Wickenburg	0/0	n/a	1/1	100%	2/2	100%	0/0	n/a	3/3	100%
New River/Cave Creek	0/0	n/a	2/2	100%	3/3	100%	0/0	n/a	5/5	100%
Phoenix North	0/0	n/a	0/1	0%	3/4	75%	0/0	n/a	3/5	60%
Phoenix South	0/0	n/a	2/2	100%	1/2	50%	2/2	100%	5/6	83.3%
Scottsdale North	0/0	n/a	1/2	50%	1/2	50%	1/1	100%	3/5	60%
Scottsdale South	0/0	n/a	1/1	100%	1/1	100%	1/1	100%	3/3	100%
Southeast Valley	1/1	100%	1/1	100%	2/2	100%	2/2	100%	6/6	100%
Lower Salt River Lakes	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%	2/2	100%
Superstition	0/0	n/a	1/1	100%	1/1	100%	0/1	0%	2/3	66.7%
All Zones	1/1	100%	14/16	87.5%	24/27	88.9%	8/9	88.9%	47/53	88.7%

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 2016 monsoon season. Outlooks, Messages, Lake Alerts, QPF Peak Intensity, and QPF Storm Total Precipitation were the five 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 77.5%, probability of detection was 78%, the false alarm rate was 2.6%, and the Threat Score was 77.5%. Each metric fell into the "excellent" category when equating these results with accepted values within the forecast community. The largest errors in each of the metrics and resulting lowest skill were observed at Wickenburg and Lower Salt River Lakes due to over-forecasting rain totals.

Verification of messages was conducted using forecast accuracy. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 90.2%. Any value of over 75% is considered "excellent" within the forecast community. Forecast skill was consistent across each of the months during the length of the season. A large portion of the missed statements during July and August was a direct result of null events in FZs during Flash Flood Watches during these months. The average lead time for all M-1 Alerts and M-3 Flash Flood Warnings combined over the length of the Monsoon season was just under thirty-two minutes. The average lead time for M-2 Flash Flood Watches was just over seven and half hours.

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 82.6% forty-six events. Any value over 75% is considered "excellent" within the forecast community. 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 sixteen minutes.

Verification of QPF peak rainfall intensity 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 65.2%.

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 88.7%. 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 Intensity		QPF STP	
Year	AOF	POD	FAR	TS	Events	AOF	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	n/a	n/a
2013	79.8%	78.7%	6.2%	n/a	137	88.0%	56	89.3%	69	58.0%	54	72.2%
2014	77.7%	76.9%	7.1%	67.4%	263	80.2%	57	84.2%	118	57.6%	76	72.4%
2015	74.8%	60.3%	2.8%	67.9%	118	75.4%	40	95%	16	68.8%	56	82.1%
2016	84.9%	78%	2.6%	77.5%	112	90.2%	46	82.6%	23	65.2%	53	88.7%

Table 8, above, was included to add more historical perspective in the verification process. Verification metrics for Outlooks, Messages, Lake Alerts, and QPF products were included for all previous years. Outlook forecast accuracy showed a dramatic rise in 2016 and was over 5% higher than the previous benchmark set in 2013. Probability of detection was also the highest since 2012, showing a dramatic rise from 2014 and 2015. False alarm rate remained nearly the same as 2015, also coming in below any previous year. The final metric, threat score, improved by roughly 10% from 2014 and 2015.

After seeing a large drop in forecast skill for issued messages in 2015, forecast accuracy jumped 15% in 2016 and was higher than any previous year. Lead time (not shown) for M-1 Alerts and M-3 Flash Flood Warnings remained nearly constant from 2015 at roughly thirty-two minutes. M-2 Flash Flood Watch lead time dropped significantly from 2015, but remained well above the critical six hour requirement at seven and half hours. Forecast accuracy for Lake Alerts dropped significantly from 2015 and skill was the lowest of any previous year. Lead time (not shown) remained nearly unchanged from 2015 at sixteen minutes. QPF intensity skill dropped slightly from 2015, but remained well above 2013 and 2014. STP skill was higher than any previous year and this was directly attributable to continued improvements to the District's QPF program, which supplies hourly and sub-hourly rainfall information to forecasters.

When all was said and done, the 2016 monsoon season ended up being near normal when viewed across the county as a whole and was considered a nice "bounce back" season after a rather dry 2015 season. 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 2016 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 2016														
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							PALO VERDE						
06/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/16	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 2016														
	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
06/27/16	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.25-0.43	h	-	-
06/28/16	10	0.10	0.00	0.25-0.43	h	-	-	10	0.10	0.00	0.04-0.24	h	-	-
06/29/16	30	0.75	0.04	1.03-1.22	h	h	-	20	0.50	0.04	0.04-0.24	h	-	-
06/30/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.10	0.08	0.04-0.24	h	-	-
16 days					16/16	1/1	0					16/16	0/0	0
07/01/16	30	0.50	0.87	1.62-1.81	h	h	-	30	0.50	0.55	1.03-1.22	h	h	-
07/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	h	-	-
07/17/16	20	0.25	0.00	0.04-0.24	h	-	-	20	0.25	0.04	0.64-0.83	m	-	-
07/18/16	10	0.10	0.00	0.44-0.63	m	-	-	10	0.10	0.00	0.25-0.43	m	-	-
07/19/16	20	0.20	0.00	1.03-1.22	m	-	-	10	0.10	0.00	0.04-0.24	h	-	-
07/20/16	10	0.25	0.00	0.25-0.43	h	-	-	10	0.10	0.00	0.00	h	-	-
07/21/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.10	0.00	0.00	h	-	-
07/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/16	10	0.25	0.00	0.04-0.24	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016

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
07/25/16	10	0.20	0.00	0.00	h	-	-	10	0.20	0.04	0.04-0.24	h	-	-
07/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.10	0.00	0.00	h	-	-
07/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/16	30	0.50	1.26	1.23-1.61	m	h	-	30	1.00	0.51	0.64-0.83	h	h	-
07/30/16	10	0.50	0.00	0.04-0.24	h	-	-	10	0.50	0.00	0.00	h	-	-
07/31/16	20	0.75	0.00	0.25-0.43	h	-	-	20	0.75	0.24	0.04-0.24	m	-	-
31 days					28/31	2/2	0					28/31	2/2	0
08/01/16	10	0.30	0.00	0.04-0.24	h	-	-	10	0.30	0.00	0.04-0.24	h	-	-
08/02/16	10	0.50	0.00	0.64-0.83	h	h	-	10	0.50	0.31	0.64-0.83	h	h	-
08/03/16	10	0.50	0.12	1.23-1.61	h	h	-	10	0.50	0.08	1.03-1.22	h	h	-
08/04/16	0	0.00	0.04	0.84-1.02	m	m	-	0	0.00	0.24	0.64-0.83	m	m	-
08/05/16	50	0.75	0.00	0.84-1.02	h	h	-	30	0.75	0.00	0.00	m	-	-
08/06/16	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/16	50	2.50	0.00	0.84-1.02	m	h	-	50	2.00	0.39	2.21-2.40	h	h	-
08/10/16	30	0.75	0.28	1.03-1.22	h	h	-	30	0.75	0.00	0.25-0.43	h	-	-
08/11/16	10	0.25	0.00	0.04-0.24	h	-	-	10	0.25	0.00	0.00	h	-	-
08/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	h	-	-
08/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/16	20	0.30	0.00	1.23-1.61	m	m	-	20	0.30	0.04	0.25-0.43	h	-	-
08/17/16	20	0.30	0.08	0.25-0.43	h	-	-	20	0.30	0.35	1.03-1.22	m	m	-
08/18/16	30	0.50	0.08	0.25-0.43	h	-	-	20	0.40	0.28	0.64-0.73	h	m	-
08/19/16	30	0.50	0.00	0.04-0.24	m	-	-	30	0.50	0.08	0.44-0.63	h	h	-
08/20/16	30	0.50	0.24	1.23-1.61	m	h	-	30	0.30	0.67	0.84-1.02	m	m	-
08/21/16	20	0.30	0.00	0.25-0.43	h	-	-	20	0.30	0.00	0.00	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
	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
08/22/16	20	0.60	0.16	1.23-1.61	m	h	-	20	0.30	0.20	0.44-0.63	h	-	-
08/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	h	-	-
08/25/16	10	0.10	0.00	1.23-1.61	m	m	-	10	0.10	0.00	0.04-0.24	h	-	-
08/26/16	30	0.50	0.00	0.04-0.24	h	-	-	30	0.50	0.16	0.25-0.43	h	-	-
08/27/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/16	10	0.15	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/16	10	0.50	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.04-0.24	m	-	-
31 days					23/31	7/10	0					25/31	4/8	0
09/01/16	30	1.50	0.20	1.03-1.22	h	h	-	20	1.25	0.04	0.25-0.43	m	-	-
09/02/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
09/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/16	50	1.50	1.30	1.82-2.01	h	h	-	40	0.50	1.34	1.03-1.22	h	h	-
09/07/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.10	0.04	0.04-0.24	h	-	-
09/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/12/16	20	0.50	0.00	0.00	m	-	-	20	0.30	0.00	0.00	m	-	-
09/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/16	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 2016

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
09/19/16	50	0.60	0.00	0.04-0.24	m	-	x	50	0.50	0.00	0.04-0.24	m	-	x
09/20/16	30	0.10	0.00	0.00	m	-	-	30	0.20	0.00	0.04-0.24	h	-	-
09/21/16	30	0.30	0.39	0.44-0.63	h	-	-	30	0.50	0.08	0.04-0.24	m	-	-
09/22/16	30	0.30	0.04	0.04-0.24	h	-	-	30	0.40	0.04	0.44-0.63	h	-	-
09/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/16	10	0.15	0.00	0.04-0.24	h	-	-	10	0.05	0.00	0.00	h	-	-
09/27/16	30	0.40	0.00	0.25-0.43	h	-	-	30	0.25	0.00	0.00	m	-	-
09/28/16	10	0.10	0.00	0.44-0.63	m	-	-	10	0.10	0.00	0.00	h	-	-
09/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/30/16	0	0.00	0.00	0.64-0.83	m	m	-	0	0.00	0.00	0.25-0.43	m	-	-
30 days					24/30	2/3	1					22/30	1/1	1
	Rainbow Valley							West Valley						
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/16	10	0.10	0.00	0.00	h	-	-	10	0.10	0.12	0.04-0.24	h	-	-
06/28/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.20	0.00	0.04-0.24	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
06/29/16	20	0.40	0.00	0.00	m	-	-	20	0.40	0.04	0.44-0.63	h	-	-
06/30/16	10	0.25	0.00	0.04-0.24	h	-	-	20	0.25	0.00	0.00	m	-	-
16 days					15/16	0/0	0					15/16	0/0	0
07/01/16	30	0.75	0.47	1.23-1.61	h	h	-	30	0.75	0.35	1.03-1.22	h	h	-
07/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/16	20	0.25	0.00	0.04-0.24	h	-	-	20	0.25	0.04	0.04-0.24	h	-	-
07/18/16	30	0.40	0.00	1.23-1.61	m	-	-	20	0.25	0.20	0.25-0.43	h	-	-
07/19/16	30	0.50	0.00	0.25-0.43	h	-	-	30	0.40	0.08	0.25-0.43	h	-	-
07/20/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.04	1.82-2.01	m	m	-
07/21/16	10	0.20	0.00	0.00	h	-	-	10	0.20	0.00	0.00	h	-	-
07/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
07/25/16	10	0.10	0.00	0.00	h	-	-	20	0.10	0.00	0.04-0.24	h	-	-
07/26/16	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 2016														
	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
07/27/16	20	0.20	0.00	0.00	m	-	-	20	0.20	0.00	0.00	m	-	-
07/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
07/29/16	30	1.00	0.98	1.23-1.61	h	h	-	40	1.00	0.63	0.84-1.02	h	h	-
07/30/16	20	0.50	0.00	0.00	m	-	-	20	0.75	0.00	0.00	m	-	-
07/31/16	30	0.75	0.00	0.00	m	-	-	30	1.00	0.00	0.44-0.63	h	h	-
31 days					27/31	2/2	0					26/31	3/4	0
08/01/16	20	0.75	0.00	0.04-0.24	m	-	-	20	1.00	0.20	0.04-0.24	m	-	-
08/02/16	20	1.00	1.46	1.23-1.61	h	h	-	20	1.00	0.51	0.84-1.02	h	h	-
08/03/16	20	1.00	0.31	0.44-0.63	h	h	-	20	1.00	0.08	0.64-0.83	h	h	-
08/04/16	0	0.00	0.12	0.44-0.63	m	-	-	10	0.50	0.55	1.23-1.61	h	h	-
08/05/16	50	0.75	0.00	0.00	m	-	x	30	0.75	0.00	0.00	m	-	-
08/06/16	10	0.10	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/16	50	1.50	0.47	0.44-0.63	m	h	-	50	1.25	0.47	0.64-0.83	h	h	-
08/10/16	40	1.25	0.87	1.23-1.61	h	h	-	40	1.00	1.73	1.82-2.01	h	h	-
08/11/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.25-0.43	m	-	-
08/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/16	20	0.30	0.12	0.25-0.43	h	-	-	10	0.10	0.16	0.44-0.63	m	-	-
08/17/16	20	0.30	0.00	0.04-0.24	h	-	-	20	0.20	0.35	0.44-0.63	h	-	-
08/18/16	20	0.30	0.04	0.04-0.24	h	-	-	20	0.30	0.28	0.64-0.83	h	m	-
08/19/16	20	0.50	0.00	0.04-0.24	m	-	-	20	0.50	0.04	0.25-0.43	h	-	-
08/20/16	30	0.50	0.04	0.84-1.02	h	h	-	30	0.50	0.28	0.84-1.02	h	h	-
08/21/16	10	0.30	0.00	0.00	h	-	-	10	0.30	0.00	0.00	h	-	-
08/22/16	20	0.50	0.24	0.25-0.43	h	-	-	20	0.30	0.55	0.84-1.02	m	m	-
08/23/16	0	0.00	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
	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
08/24/16	0	0.00	0.00	0.04-0.24	h	-	-	10	0.10	0.35	0.44-0.63	m	-	-
08/25/16	20	0.20	0.08	0.04-0.24	h	-	-	20	0.20	0.24	0.04-0.24	h	-	-
08/26/16	20	0.50	0.00	0.04-0.24	h	-	-	20	0.50	0.16	0.04-0.24	h	-	-
08/27/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/16	0	0.00	0.00	0.04-0.24	m	-	-	10	0.30	0.00	0.04-0.24	h	-	-
31 days					25/31	5/5	1					25/31	6/8	0
09/01/16	20	0.75	0.00	0.04-0.24	m	-	-	20	0.75	0.00	0.84-1.02	h	h	-
09/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/16	30	0.50	1.14	1.03-1.22	h	h	-	40	0.50	0.71	0.84-1.02	h	h	-
09/07/16	10	0.10	0.00	0.04-0.24	h	-	-	20	0.50	0.16	0.04-0.24	h	-	-
09/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
09/12/16	20	0.50	0.00	0.00	m	-	-	20	0.40	0.28	0.04-0.24	h	-	-
09/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/16	40	0.50	0.00	0.04-0.24	m	-	x	40	0.40	0.00	0.04-0.24	h	-	-
09/20/16	30	0.10	0.00	0.00	m	-	-	30	0.20	0.12	0.04-0.24	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016

	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
09/21/16	10	0.20	0.08	0.04-0.24	h	-	-	10	0.20	0.35	0.25-0.43	h	-	-
09/22/16	40	0.50	0.55	0.44-0.63	h	h	-	40	0.60	0.43	0.44-0.63	h	h	-
09/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/16	10	0.05	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/16	20	0.25	0.00	0.00	m	-	-	10	0.10	0.00	0.04-0.24	h	-	-
09/28/16	10	0.10	0.08	0.25-0.43	h	-	-	10	0.10	0.20	0.04-0.24	h	-	-
09/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.04	0.25-0.43	m	-	-
30 days					24/30	2/2	1					29/30	3/3	0
	Northwest Valley							Upper Centennial						
06/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/16	20	0.20	0.04	0.04-0.24	h	-	-	20	0.20	0.47	1.23-1.61	m	m	-
06/28/16	20	0.20	0.00	0.25-0.43	h	-	-	20	0.20	0.00	0.04-0.24	h	-	-
06/29/16	30	0.50	0.08	0.04-0.24	m	-	-	30	0.50	0.00	0.25-0.43	h	-	-
06/30/16	20	0.25	0.00	0.00	m	-	-	10	0.25	0.12	0.25-0.43	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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					14/16	0/0	0					15/16	0/1	0
07/01/16	30	0.40	0.00	0.84-1.02	m	m	-	30	0.50	0.00	0.64-0.83	h	h	-
07/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/16	20	0.25	0.04	0.04-0.24	h	-	-	20	0.33	0.00	0.04-0.24	h	-	-
07/18/16	20	0.25	0.00	0.25-0.43	h	-	-	10	0.10	0.00	0.04-0.24	h	-	-
07/19/16	20	0.30	0.00	0.25-0.43	h	-	-	20	0.20	0.08	0.84-1.02	m	-	-
07/20/16	20	0.25	0.08	0.25-0.43	h	-	-	20	0.50	0.55	1.03-1.22	h	h	-
07/21/16	20	0.20	0.00	0.00	m	-	-	20	0.40	0.00	0.00	m	-	-
07/22/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
07/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/16	30	0.40	0.12	0.25-0.43	h	-	-	30	0.50	0.04	0.25-0.43	h	-	-
07/26/16	10	0.10	0.00	0.00	h	-	-	10	0.20	0.04	1.03-1.22	m	m	-
07/27/16	10	0.10	0.00	0.00	h	-	-	20	0.10	0.12	0.44-0.63	m	-	-
07/28/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.25	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
	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
07/29/16	40	0.75	0.08	0.04-0.24	m	-	x	30	0.50	1.06	1.03-1.22	h	h	-
07/30/16	20	0.75	0.00	0.00	m	-	-	30	1.00	0.00	0.00	m	-	x
07/31/16	30	1.00	0.55	1.03-1.22	h	h	-	30	1.00	1.65	1.62-1.81	h	h	-
31 days					26/31	1/2	1					26/31	4/5	1
08/01/16	30	1.00	0.00	0.00	m	-	x	40	1.00	1.06	1.23-1.61	h	h	-
08/02/16	30	1.00	0.59	1.23-1.61	h	h	-	30	1.50	0.35	1.23-1.61	h	h	-
08/03/16	30	1.00	0.35	0.64-0.83	h	h	-	30	1.50	0.47	2.21-2.40	h	h	-
08/04/16	10	0.50	0.91	1.23-1.61	h	h	-	0	0.00	1.22	2.61-2.80	m	m	-
08/05/16	30	0.75	0.00	0.00	m	-	-	40	1.00	0.00	1.03-1.22	h	h	-
08/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/16	50	1.50	0.04	0.64-0.83	h	h	-	50	1.50	0.31	1.23-1.61	h	h	-
08/10/16	40	1.50	0.75	0.84-1.02	h	h	-	40	1.25	0.04	0.64-0.83	h	h	-
08/11/16	20	0.50	0.00	0.04-0.24	h	-	-	20	0.50	0.00	0.44-0.63	h	-	-
08/12/16	0	0.00	0.28	0.64-0.83	m	-	-	10	0.25	0.08	0.84-1.02	m	m	-
08/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/16	10	0.10	0.00	0.00	h	-	-	10	0.25	0.00	0.04-0.24	h	-	-
08/16/16	10	0.10	0.04	0.44-0.63	m	-	-	20	0.30	0.00	0.04-0.24	h	-	-
08/17/16	20	0.20	0.35	0.84-1.02	m	m	-	30	0.30	2.20	2.02-2.20	m	m	-
08/18/16	20	0.30	0.16	0.44-0.63	h	-	-	30	0.50	0.20	0.44-0.63	h	-	-
08/19/16	20	0.50	0.00	0.04-0.24	m	-	-	30	0.50	0.00	0.04-0.24	m	-	-
08/20/16	40	0.60	0.39	0.64-0.83	h	h	-	30	0.50	0.16	0.64-0.83	h	h	-
08/21/16	20	0.20	0.00	0.00	m	-	-	30	0.30	0.04	0.25-0.43	h	-	-
08/22/16	20	0.30	0.98	1.03-1.22	m	m	-	30	0.50	1.34	1.23-1.61	m	h	-
08/23/16	20	0.25	0.00	0.00	m	-	-	10	0.25	0.00	0.00	h	-	-
08/24/16	10	0.25	0.35	1.03-1.22	m	-	-	10	0.25	0.00	0.00	h	-	-
08/25/16	20	0.30	0.12	0.04-0.24	h	-	-	10	0.20	0.00	0.25-0.43	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016

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
08/26/16	30	0.50	0.20	0.64-0.83	h	h	-	30	0.50	0.24	0.64-0.83	h	h	-
08/27/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/16	10	0.20	0.00	0.00	h	-	-	10	0.20	0.00	0.00	h	-	-
31 days					21/31	7/9	1					26/31	9/12	0
09/01/16	30	0.75	0.04	0.04-0.24	m	-	-	30	1.00	0.00	0.64-0.83	h	h	-
09/02/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
09/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/16	20	0.30	0.28	0.04-0.24	h	-	-	10	0.10	0.00	0.25-0.43	h	-	-
09/07/16	30	0.25	0.08	0.04-0.24	h	-	-	20	0.50	0.20	0.64-0.83	h	h	-
09/08/16	10	0.50	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/16	10	0.30	0.00	0.04-0.24	h	-	-	10	0.30	0.00	0.00	h	-	-
09/13/16	10	0.10	0.00	0.00	h	-	-	10	0.25	0.16	0.04-0.24	h	-	-
09/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/16	40	0.30	0.00	0.04-0.24	h	-	-	40	0.40	0.63	0.64-0.83	h	m	-
09/20/16	30	0.40	0.00	0.04-0.24	h	-	-	30	1.50	0.12	0.04-0.24	m	-	x
09/21/16	10	0.20	0.24	0.04-0.24	h	-	-	30	0.75	0.71	0.64-0.83	h	h	-
09/22/16	50	0.75	0.04	0.44-0.63	h	h	-	50	0.75	0.28	0.84-1.02	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016

	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
09/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/27/16	10	0.10	0.08	0.04-0.24	h	-	-	10	0.15	0.00	0.00	h	-	-
09/28/16	10	0.10	0.20	0.64-0.83	m	m	-	10	0.15	0.00	0.04-0.24	h	-	-
09/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/30/16	0	0.00	0.08	0.25-0.43	m	-	-	10	0.25	0.16	0.84-1.02	m	m	-
30 days					27/30	1/2	0					26/30	4/6	1
	Wickenburg							New River Cave Creek						
06/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/16	20	0.20	0.47	0.64-0.83	m	m	-	30	0.20	0.04	0.44-0.63	h	-	-
06/28/16	20	0.20	0.00	0.04-0.24	h	-	-	30	0.40	0.08	0.44-0.43	h	-	-
06/29/16	30	0.50	0.43	0.64-0.83	h	h	-	30	0.50	0.47	0.44-0.63	h	h	-
06/30/16	10	0.25	0.00	0.04-0.24	h	-	-	30	0.75	0.24	0.04-0.24	m	-	-
16 days					15/16	1/2	0					15/16	1/1	0
07/01/16	30	0.40	0.08	0.25-0.43	h	-	-	30	0.40	0.71	1.62-1.81	m	m	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016

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
07/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/16	20	0.33	0.00	0.00	m	-	-	20	0.33	0.04	0.04-0.24	h	-	-
07/18/16	10	0.10	0.00	0.04-0.24	h	-	-	30	0.50	0.59	0.84-1.02	h	h	-
07/19/16	20	0.20	0.08	0.84-1.02	m	-	-	30	0.50	0.04	0.04-0.24	m	-	-
07/20/16	20	0.50	0.28	0.25-0.43	h	-	-	20	0.50	0.00	0.04-0.24	m	-	-
07/21/16	20	0.40	0.00	0.00	m	-	-	10	0.20	0.00	0.00	h	-	-
07/22/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.16	0.44-0.63	m	-	-
07/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/16	0	0.00	0.00	0.00	h	-	-	20	0.25	0.00	0.00	m	-	-
07/25/16	30	0.50	0.47	0.64-0.83	h	-	-	30	0.50	0.00	0.04-0.24	m	-	-
07/26/16	10	0.20	0.00	0.00	h	-	-	10	0.20	0.00	0.04-0.24	h	-	-
07/27/16	20	0.10	0.04	0.25-0.43	h	-	-	20	0.30	0.00	0.00	m	-	-
07/28/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/29/16	40	0.75	1.06	1.03-1.22	h	h	-	40	1.25	0.59	0.64-0.83	h	h	-
07/30/16	30	1.00	0.00	0.00	m	-	x	20	0.75	0.00	0.00	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
07/31/16	30	1.00	2.01	1.62-1.81	h	h	-	30	1.25	0.94	2.41-2.60	h	h	-
31 days					26/31	2/2	1					23/31	3/4	0
08/01/16	40	1.00	0.20	0.25-0.43	m	-	x	30	1.00	0.83	1.23-1.61	h	h	-
08/02/16	30	1.50	0.75	1.62-1.81	h	h	-	30	1.50	1.26	1.23-1.61	h	h	-
08/03/16	30	1.50	0.24	0.44-0.63	m	-	x	40	1.50	0.83	1.03-1.22	h	h	-
08/04/16	0	0.00	0.91	1.03-1.22	m	m	-	20	1.00	1.14	1.03-1.22	h	h	-
08/05/16	40	1.00	0.00	0.00	m	-	x	30	1.00	0.04	0.04-0.24	m	-	x
08/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
08/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/16	50	1.50	0.04	0.04-0.24	m	-	x	50	1.50	0.24	0.44-0.63	m	-	x
08/10/16	40	1.00	0.04	0.25-0.43	m	-	x	40	1.50	0.04	0.25-0.43	m	-	x
08/11/16	20	0.50	0.04	0.00	m	-	-	20	0.50	0.00	0.25-0.43	h	-	-
08/12/16	10	0.25	0.00	0.44-0.63	h	-	-	10	0.25	0.24	0.25-0.43	h	-	-
08/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/16/16	20	0.30	0.04	0.44-0.63	h	-	-	20	0.30	0.28	0.84-1.02	m	m	-
08/17/16	20	0.30	0.51	1.03-1.22	m	m	-	20	0.30	0.04	0.04-0.24	h	-	-
08/18/16	30	0.50	0.08	0.44-0.63	h	-	-	20	0.30	0.04	0.25-0.43	h	-	-
08/19/16	30	0.50	0.00	0.00	m	-	-	20	0.50	0.20	0.44-0.63	h	-	-
08/20/16	30	0.50	0.75	2.02-2.20	m	h	-	40	0.60	0.39	0.84-1.02	h	h	-
08/21/16	30	0.30	0.00	0.25-0.43	h	-	-	20	0.30	0.00	0.00	m	-	-
08/22/16	30	0.50	0.83	1.23-1.61	h	h	-	10	0.40	0.59	0.64-0.83	h	m	-
08/23/16	10	0.25	0.00	0.00	h	-	-	20	0.25	0.00	0.00	m	-	-
08/24/16	10	0.25	0.04	0.04-0.24	h	-	-	20	0.40	0.16	0.44-0.63	h	-	-
08/25/16	10	0.20	0.00	0.00	h	-	-	20	0.30	0.16	0.25-0.43	h	-	-
08/26/16	30	0.50	0.28	0.44-0.63	h	h	-	20	0.50	0.55	0.64-0.83	h	h	-
08/27/16	10	0.25	0.00	0.00	h	-	-	10	0.33	0.04	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
08/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/16	0	0.00	0.00	0.00	h	-	-	10	0.15	0.16	0.04-0.24	h	-	-
08/31/16	10	0.20	0.00	0.04-0.24	h	-	-	20	0.50	0.00	0.04-0.24	h	-	-
31 days					21/31	4/6	5					24/31	6/8	3
09/01/16	30	1.00	0.00	0.00	m	-	x	30	1.00	0.00	0.04-0.24	m	-	x
09/02/16	10	0.25	0.00	0.00	h	-	-	10	0.33	0.00	0.00	h	-	-
09/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/16	10	0.10	0.00	0.04-0.24	h	-	-	30	0.30	0.04	0.04-0.24	h	-	-
09/07/16	20	0.50	0.43	0.44-0.63	h	h	-	30	0.25	0.04	0.00	m	-	-
09/08/16	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
09/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.28	0.25-0.43	m	-	-
09/12/16	10	0.30	0.00	0.00	h	-	-	20	0.40	0.00	0.04-0.24	h	-	-
09/13/16	10	0.25	0.00	0.04-0.24	h	-	-	10	0.25	0.00	0.00	h	-	-
09/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/16	40	0.30	0.04	0.04-0.24	h	-	-	40	0.30	0.12	0.04-0.24	h	-	-
09/20/16	30	0.75	0.04	0.04-0.24	m	-	-	30	0.30	0.04	0.04-0.24	h	-	-
09/21/16	30	0.75	0.24	0.04-0.24	m	-	-	10	0.20	0.24	0.04-0.24	h	-	-
09/22/16	50	0.75	0.00	0.04-0.24	m	-	x	40	0.60	0.55	0.64-0.83	h	h	-
09/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/16	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 2016

	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
09/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/16	10	0.15	0.20	0.04-0.24	h	-	-	10	0.20	0.08	0.04-0.24	h	-	-
09/28/16	10	0.15	0.00	0.04-0.24	h	-	-	20	0.25	0.43	0.44-0.63	h	-	-
09/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.12	0.25-0.43	m	-	-
09/30/16	10	0.25	0.28	0.84-1.02	m	m	-	20	0.33	0.47	0.84-1.02	m	m	-
30 days					24/30	1/2	1					25/30	1/2	1
	Phoenix North							Phoenix South						
06/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/16	10	0.10	0.04	0.04-0.24	h	-	-	10	0.10	0.04	0.04-0.24	h	-	-
06/28/16	20	0.30	0.08	0.04-0.24	h	-	-	20	0.20	0.12	0.04-0.24	h	-	-
06/29/16	30	0.50	0.51	0.64-0.83	h	h	-	30	0.50	0.47	0.64-0.83	h	h	-
06/30/16	30	0.75	0.04	0.04-0.24	m	-	-	30	0.75	0.04	0.04-0.24	m	-	-
16 days					15/16	1/1	0					15/16	1/1	0
07/01/16	30	0.50	0.28	0.64-0.83	h	h	-	30	0.75	0.28	0.04-0.24	m	-	-
07/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/16	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 2016

Date	Forecast Zone Data				Verification			Date	Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA		Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/04/16	0	0.00	0.00	0.00	h	-	-	07/04/16	0	0.00	0.00	0.00	h	-	-
07/05/16	0	0.00	0.00	0.00	h	-	-	07/05/16	0	0.00	0.00	0.00	h	-	-
07/06/16	0	0.00	0.00	0.00	h	-	-	07/06/16	0	0.00	0.00	0.00	h	-	-
07/07/16	0	0.00	0.00	0.00	h	-	-	07/07/16	0	0.00	0.00	0.00	h	-	-
07/08/16	0	0.00	0.00	0.00	h	-	-	07/08/16	0	0.00	0.00	0.00	h	-	-
07/09/16	0	0.00	0.00	0.00	h	-	-	07/09/16	0	0.00	0.00	0.00	h	-	-
07/10/16	0	0.00	0.00	0.00	h	-	-	07/10/16	0	0.00	0.00	0.00	h	-	-
07/11/16	0	0.00	0.00	0.00	h	-	-	07/11/16	0	0.00	0.00	0.00	h	-	-
07/12/16	0	0.00	0.00	0.00	h	-	-	07/12/16	0	0.00	0.00	0.00	h	-	-
07/13/16	0	0.00	0.00	0.00	h	-	-	07/13/16	0	0.00	0.00	0.00	h	-	-
07/14/16	0	0.00	0.00	0.00	h	-	-	07/14/16	0	0.00	0.00	0.00	h	-	-
07/15/16	0	0.00	0.00	0.00	h	-	-	07/15/16	0	0.00	0.00	0.00	h	-	-
07/16/16	0	0.00	0.00	0.00	h	-	-	07/16/16	0	0.00	0.00	0.00	h	-	-
07/17/16	20	0.25	0.04	0.04-0.24	h	-	-	07/17/16	20	0.25	0.04	0.04-0.24	h	-	-
07/18/16	30	0.50	0.00	0.04-0.24	m	-	-	07/18/16	30	0.40	0.67	1.03-1.22	h	m	-
07/19/16	30	0.50	0.12	0.25-0.43	h	-	-	07/19/16	30	0.50	0.31	0.25-0.43	h	-	-
07/20/16	10	0.25	0.00	0.00	h	-	-	07/20/16	10	0.25	0.00	0.00	h	-	-
07/21/16	10	0.10	0.00	0.00	h	-	-	07/21/16	10	0.10	0.00	0.00	h	-	-
07/22/16	0	0.00	0.00	0.00	h	-	-	07/22/16	0	0.00	0.00	0.00	h	-	-
07/23/16	0	0.00	0.00	0.00	h	-	-	07/23/16	0	0.00	0.00	0.00	h	-	-
07/24/16	10	0.25	0.00	0.00	h	-	-	07/24/16	10	0.10	0.00	0.00	h	-	-
07/25/16	20	0.30	0.00	0.00	m	-	-	07/25/16	10	0.20	0.04	0.00	h	-	-
07/26/16	0	0.00	0.00	0.00	h	-	-	07/26/16	0	0.00	0.00	0.00	h	-	-
07/27/16	20	0.30	0.00	0.00	m	-	-	07/27/16	20	0.30	0.00	0.00	m	-	-
07/28/16	10	0.10	0.20	0.04-0.24	h	-	-	07/28/16	0	0.00	0.00	0.00	h	-	-
07/29/16	40	1.25	0.12	0.25-0.43	m	-	x	07/29/16	40	1.00	0.67	0.84-1.02	h	h	-
07/30/16	20	0.75	0.12	0.25-0.43	h	-	-	07/30/16	10	0.50	0.00	0.04-0.24	m	-	-
07/31/16	30	1.25	0.43	0.64-0.83	h	h	-	07/31/16	30	0.75	0.00	0.00	m	-	-
31 days					27/31	2/2	1						27/31	1/2	0

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
08/01/16	30	1.00	0.00	0.00	m	-	x	20	0.75	0.00	0.00	m	-	-
08/02/16	30	1.25	1.26	1.23-1.61	h	h	-	20	1.00	2.91	2.02-2.20	h	h	-
08/03/16	30	1.50	0.59	1.03-1.22	h	h	-	30	1.00	0.12	0.25-0.43	m	-	x
08/04/16	20	0.75	1.61	1.62-1.81	h	h	-	20	0.50	1.26	0.84-1.02	h	h	-
08/05/16	30	1.00	0.04	0.04-0.24	m	-	x	20	0.50	0.51	0.04-0.24	h	h	-
08/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/16	50	1.00	0.08	0.25-0.43	m	-	x	50	1.00	0.67	0.64-0.83	h	h	-
08/10/16	40	1.25	0.47	0.25-0.43	m	-	x	40	1.00	0.43	0.84-1.02	h	h	-
08/11/16	20	0.40	0.04	0.00	m	-	-	10	0.25	0.04	0.00	h	-	-
08/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/16	10	0.20	0.12	0.04-0.24	h	-	-	10	0.10	0.12	0.25-0.43	h	-	-
08/17/16	10	0.20	0.04	0.04-0.24	h	-	-	10	0.10	0.04	0.25-0.43	h	-	-
08/18/16	10	0.20	0.12	0.25-0.43	h	-	-	10	0.10	0.12	0.25-0.43	h	-	-
08/19/16	10	0.40	0.00	0.04-0.24	h	-	-	10	0.33	0.00	0.00	h	-	-
08/20/16	30	0.50	0.20	0.64-0.83	h	h	-	30	0.40	0.20	0.44-0.63	h	-	-
08/21/16	20	0.20	0.04	0.00	h	-	-	10	0.10	0.00	0.04-0.024	h	-	-
08/22/16	10	0.30	1.22	1.03-1.22	m	m	-	10	0.30	0.35	0.44-0.63	h	-	-
08/23/16	20	0.10	0.00	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
08/24/16	10	0.25	0.39	1.03-1.22	m	-	-	10	0.10	0.16	0.04-0.24	h	-	-
08/25/16	20	0.30	0.24	0.04-0.24	h	-	-	20	0.20	0.24	0.25-0.43	h	-	-
08/26/16	20	0.40	0.20	0.64-0.83	h	-	-	20	0.33	0.08	0.04-0.24	h	-	-
08/27/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/16	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 2016														
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
08/30/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/16	10	0.30	0.00	0.00	h	-	-	10	0.30	0.04	0.04-0.24	h	-	-
31 days					23/31	4/5	4					29/31	5/5	1
09/01/16	20	0.75	0.00	0.00	m	-	-	20	0.75	0.51	0.44-0.63	h	h	-
09/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/16	30	0.30	0.20	0.25-0.43	h	-	-	40	0.25	0.24	0.04-0.24	h	-	-
09/07/16	30	0.25	0.04	0.04-0.24	h	-	-	40	0.25	0.00	0.04-0.24	h	-	-
09/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
09/12/16	20	0.30	0.00	0.04-0.24	h	-	-	20	0.30	0.00	0.00	m	-	-
09/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/16	30	0.30	0.00	0.04-0.24	h	-	-	30	0.30	0.00	0.04-0.24	h	-	-
09/20/16	30	0.20	0.00	0.04-0.24	h	-	-	30	0.10	0.00	0.00	m	-	-
09/21/16	10	0.10	0.20	0.04-0.24	h	-	-	10	0.10	0.08	0.04-0.24	h	-	-
09/22/16	40	0.50	0.24	0.25-0.43	m	-	x	40	0.50	0.71	0.44-0.63	h	h	-
09/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/16	10	0.05	0.00	0.00	h	-	-	10	0.05	0.00	0.04-0.24	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
	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
09/27/16	10	0.20	0.08	0.04-0.24	h	-	-	20	0.15	0.00	0.04-0.24	h	-	-
09/28/16	20	0.10	0.04	0.04-0.24	h	-	-	10	0.10	0.04	0.04-0.24	h	-	-
09/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/16	10	0.25	0.00	0.04-0.24	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
30 days					27/30	0	1					27/30	2/2	0
	Scottsdale North							Scottsdale South						
06/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/16	10	0.20	0.08	0.04-0.24	h	-	-	10	0.10	0.08	0.04-0.24	h	-	-
06/28/16	20	0.30	0.00	0.04-0.24	h	-	-	20	0.20	0.08	0.04-0.24	h	-	-
06/29/16	30	0.50	0.67	1.23-1.61	h	h	-	30	0.50	0.51	1.23-1.61	h	h	-
06/30/16	30	0.75	0.24	0.04-0.24	m	-	-	30	0.75	0.08	0.04-0.24	m	-	-
16 days					15/16	1/1	0					15/16	1/1	0
07/01/16	30	0.40	0.04	0.64-0.83	h	h	-	30	0.60	0.00	0.04-0.24	m	-	-
07/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/16	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 2016

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
07/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/16	20	0.25	0.04	0.04-0.24	h	-	-	10	0.10	0.08	0.04-0.24	h	-	-
07/18/16	30	0.50	0.00	0.04-0.24	m	-	-	30	0.50	0.20	0.25-0.43	h	-	-
07/19/16	30	0.50	0.16	0.25-0.43	h	-	-	30	0.50	0.31	0.25-0.43	h	-	-
07/20/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/21/16	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
07/22/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
07/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/16	10	0.25	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
07/25/16	20	0.30	0.04	0.04-0.24	h	-	-	10	0.20	0.04	0.04-0.24	h	-	-
07/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/16	20	0.30	0.00	0.00	m	-	-	20	0.30	0.00	0.00	m	-	-
07/28/16	10	0.25	0.00	0.25-0.43	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/16	40	1.25	0.28	0.25-0.43	m	-	x	40	1.00	1.02	1.03-1.22	h	h	-
07/30/16	20	0.75	0.51	0.64-0.83	h	h	-	10	0.50	0.35	0.64-0.83	h	h	-
07/31/16	30	1.00	0.47	0.44-0.63	h	h	-	30	0.75	0.00	0.00	m	-	-
31 days					27/31	3/3	1					28/31	2/2	0
08/01/16	20	1.00	0.98	0.25-0.43	h	h	-	20	0.75	0.04	0.04-0.24	m	-	-
08/02/16	20	1.25	1.26	1.23-1.61	h	h	-	20	1.00	1.61	1.62-1.81	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016

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
08/03/16	40	1.50	0.43	0.84-1.02	h	h	-		30	1.00	0.12	0.25-0.43	m	-	x
08/04/16	20	0.75	2.72	2.41-2.60	m	m	-		20	0.50	1.50	1.23-1.61	m	m	-
08/05/16	30	0.75	0.04	0.00	m	-	-		20	0.50	0.51	0.04-0.24	h	h	-
08/06/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/07/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/08/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/09/16	50	1.50	1.46	1.03-1.22	h	h	-		50	1.00	0.35	0.64-0.83	h	h	-
08/10/16	40	1.50	0.35	0.44-0.63	m	-	x		40	1.00	0.75	0.64-0.83	h	h	-
08/11/16	20	0.50	0.00	0.00	m	-	-		10	0.25	0.04	0.00	h	-	-
08/12/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/13/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/14/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/15/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/16/16	10	0.20	0.00	0.04-0.24	h	-	-		10	0.10	0.04	0.00	h	-	-
08/17/16	10	0.20	0.00	0.04-0.24	h	-	-		10	0.10	0.00	0.04-0.24	h	-	-
08/18/16	10	0.20	0.00	0.04-0.24	h	-	-		10	0.10	0.08	0.04-0.24	h	-	-
08/19/16	10	0.40	0.00	0.04-0.24	h	-	-		10	0.33	0.00	0.04-0.24	h	-	-
08/20/16	40	0.50	0.47	0.64-0.83	h	h	-		30	0.40	0.20	0.44-0.63	h	-	-
08/21/16	20	0.20	0.00	0.00	m	-	-		10	0.10	0.39	0.44-0.63	m	-	-
08/22/16	10	0.40	0.55	0.64-0.83	h	m	-		10	0.30	0.28	0.25-0.43	h	-	-
08/23/16	20	0.10	0.04	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/24/16	20	0.33	0.00	0.04-0.24	h	-	-		10	0.10	0.04	0.04-0.24	h	-	-
08/25/16	20	0.30	0.20	0.04-0.24	h	-	-		20	0.20	0.20	0.04-0.24	h	-	-
08/26/16	20	0.40	0.75	0.44-0.63	h	m	-		20	0.33	0.00	0.04-0.24	h	-	-
08/27/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/28/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/29/16	0	0.00	0.00	0.00	h	-	-		0	0.00	0.00	0.00	h	-	-
08/30/16	10	0.15	0.00	0.25-0.43	h	-	-		0	0.00	0.00	0.04-0.24	h	-	-
08/31/16	20	0.50	0.08	0.04-0.24	h	-	-		10	0.30	0.04	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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					26/31	5/8	1					27/31	4/5	1
09/01/16	30	1.00	0.00	0.00	m	-	x	20	0.75	0.00	0.25-0.43	h	-	-
09/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/16	40	0.25	0.04	0.04-0.24	h	-	-	40	0.25	0.04	0.04-0.24	h	-	-
09/07/16	40	0.25	0.00	0.00	m	-	-	40	0.25	0.00	0.00	m	-	-
09/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/16	0	0.00	0.20	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
09/12/16	30	0.40	0.00	0.00	m	-	-	20	0.30	0.00	0.00	m	-	-
09/13/16	10	0.10	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/16	30	0.30	0.00	0.04-0.24	h	-	-	30	0.30	0.00	0.04-0.24	h	-	-
09/20/16	30	0.20	0.08	0.04-0.24	h	-	-	30	0.10	0.08	0.04-0.24	h	-	-
09/21/16	10	0.20	0.16	0.04-0.24	h	-	-	10	0.10	0.04	0.00	h	-	-
09/22/16	40	0.50	0.39	0.44-0.63	h	h	-	40	0.50	0.71	0.25-0.43	h	h	-
09/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/16	10	0.05	0.00	0.04-0.24	h	-	-	10	0.05	0.04	0.04-0.24	h	-	-
09/27/16	20	0.25	0.12	0.04-0.24	h	-	-	20	0.25	0.00	0.04-0.24	h	-	-
09/28/16	20	0.25	0.04	0.04-0.24	h	-	-	10	0.10	0.04	0.04-0.24	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
09/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/16	10	0.25	0.00	0.04-0.24	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					26/30	1/1	1					28/30	1/1	0
	Southeast Valley							Lower Salt River Lakes						
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/16	10	0.20	0.04	0.04-0.24	h	-	-	30	0.20	0.00	0.00	m	-	-
06/28/16	20	0.30	0.08	0.04-0.24	h	-	-	30	0.40	0.00	0.44-0.63	h	-	-
06/29/16	30	0.75	0.67	1.23-1.61	h	h	-	40	0.75	0.28	0.64-0.83	h	h	-
06/30/16	40	1.00	0.28	0.25-0.43	m	-	x	40	1.00	0.00	0.04-0.24	m	-	x
16 days					15/16	1/1	1					14/16	1/1	1
07/01/16	30	0.75	0.00	0.00	m	-	-	30	0.75	0.00	0.04-0.24	m	-	-
07/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/16	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 2016

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
07/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/16	10	0.10	0.16	0.04-0.24	h	-	-	10	0.10	0.00	0.04-0.24	h	-	-
07/18/16	40	0.50	0.55	0.44-0.63	h	h	-	40	0.50	0.00	0.00	m	-	x
07/19/16	40	0.50	0.46	0.44-0.63	h	-	-	40	0.50	0.00	0.04-0.24	m	-	x
07/20/16	20	0.25	0.00	0.00	m	-	-	30	0.50	0.00	0.04-0.24	m	-	-
07/21/16	10	0.10	0.00	0.00	h	-	-	20	0.20	0.00	0.00	m	-	-
07/22/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/16	10	0.25	0.00	0.04-0.24	h	-	-	20	0.25	0.00	0.00	m	-	-
07/25/16	20	0.30	0.00	0.00	m	-	-	10	0.20	0.00	0.00	h	-	-
07/26/16	0	0.00	0.00	0.00	h	-	-	10	0.20	0.00	0.00	h	-	-
07/27/16	20	0.30	0.00	0.00	m	-	-	30	0.30	0.00	0.00	m	-	-
07/28/16	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.25-0.43	h	-	-
07/29/16	40	1.00	0.87	0.84-1.02	h	h	-	30	0.50	0.31	0.64-0.83	h	h	-
07/30/16	10	0.50	0.04	0.04-0.24	m	-	-	20	0.50	0.00	0.04-0.24	m	-	-
07/31/16	30	1.00	0.08	0.04-0.24	m	-	x	20	0.50	0.04	0.04-0.24	m	-	-
31 days					25/31	2/2	1					22/31	1/1	2
08/01/16	20	1.00	0.51	0.04-0.24	h	h	-	20	0.50	0.20	0.04-0.24	m	-	-
08/02/16	30	1.00	1.85	2.21-2.40	h	h	-	30	1.50	0.00	0.04-0.24	m	-	x
08/03/16	30	1.25	0.24	0.64-0.83	h	h	-	40	1.50	0.00	1.23-1.61	h	h	-
08/04/16	20	0.50	0.43	0.25-0.43	h	-	-	30	0.75	0.09	0.25-0.43	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
08/05/16	20	0.50	0.00	0.00	m	-	-	20	0.75	0.00	0.00	m	-	-
08/06/16	10	0.10	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/07/16	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
08/08/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/16	50	1.50	0.59	1.82-2.01	h	h	-	50	1.50	0.04	0.84-1.02	h	h	-
08/10/16	40	1.00	1.65	1.23-1.61	h	h	-	40	1.25	0.00	0.04-0.24	m	-	x
08/11/16	10	0.25	0.00	0.04-0.24	h	-	-	20	0.50	0.00	0.00	m	-	-
08/12/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.12	0.84-1.02	m	m	-
08/13/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/16	10	0.20	0.04	0.04-0.24	h	-	-	10	0.20	0.00	0.64-0.83	m	m	-
08/17/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.10	0.04	0.04-0.24	h	-	-
08/18/16	10	0.10	0.16	0.04-0.24	h	-	-	10	0.10	0.04	0.04-0.24	h	-	-
08/19/16	10	0.33	0.04	0.00	h	-	-	10	0.33	0.00	0.00	h	-	-
08/20/16	30	0.50	0.20	0.25-0.43	h	-	-	20	0.30	0.00	0.04-0.24	h	-	-
08/21/16	10	0.30	0.59	0.64-0.83	m	m	-	10	0.30	0.00	0.00	h	-	-
08/22/16	10	0.30	0.20	0.04-0.24	h	-	-	10	0.10	0.12	0.25-0.43	h	-	-
08/23/16	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
08/24/16	10	0.10	0.08	0.04-0.24	h	-	-	20	0.25	0.00	0.04-0.24	h	-	-
08/25/16	20	0.20	0.12	0.04-0.24	h	-	-	10	0.20	0.00	0.44-0.63	h	-	-
08/26/16	20	0.33	0.31	0.64-0.83	h	-	-	20	0.33	0.12	0.25-0.43	h	-	-
08/27/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/16	10	0.15	0.24	0.25-0.43	h	-	-	10	0.15	0.08	0.25-0.43	h	-	-
08/31/16	20	0.50	0.31	0.25-0.43	h	-	-	20	0.50	0.00	0.00	h	-	-
31 days					29/31	5/6	0					24/31	2/4	2
09/01/16	30	1.00	0.51	0.44-0.63	h	h	-	30	1.00	0.00	0.44-0.63	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
09/02/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/16	50	0.75	0.35	0.25-0.43	h	-	-	40	1.00	0.00	0.04-0.24	m	-	x
09/07/16	10	0.50	0.04	0.00	h	-	-	10	0.75	0.00	0.00	h	-	-
09/08/16	10	0.50	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
09/09/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/16	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.04	0.04-0.24	m	-	-
09/12/16	30	0.50	0.28	0.25-0.43	h	-	-	30	0.50	0.00	0.00	m	-	-
09/13/16	10	0.10	0.00	0.00	h	-	-	20	0.25	0.00	0.04-0.24	h	-	-
09/14/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/16	30	0.30	0.00	0.04-0.24	h	-	-	30	0.30	0.00	0.00	m	-	-
09/20/16	30	0.10	0.16	0.04-0.24	h	-	-	30	0.10	0.00	0.04-0.24	h	-	-
09/21/16	10	0.20	0.00	0.04-0.24	h	-	-	10	0.20	0.00	0.00	h	-	-
09/22/16	50	0.50	0.51	0.25-0.43	h	h	-	50	0.50	0.00	0.25-0.43	m	-	x
09/23/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/16	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/16	10	0.10	0.00	0.04-0.24	h	-	-	10	0.15	0.04	0.04-0.24	h	-	-
09/27/16	30	0.25	0.00	0.00	m	-	-	30	0.25	0.00	0.04-0.24	h	-	-
09/28/16	20	0.10	0.04	0.04-0.24	h	-	-	20	0.25	0.00	0.25-0.43	h	-	-
09/29/16	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
09/30/16	10	0.25	0.04	0.04-0.24	h	-	-	10	0.25	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
	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					28/30	2/2	0					25/30	1/1	2
	Superstition													
06/15/16	0	0.00	0.00	0.00	h	-	-							
06/16/16	0	0.00	0.00	0.00	h	-	-							
06/17/16	0	0.00	0.00	0.00	h	-	-							
06/18/16	0	0.00	0.00	0.00	h	-	-							
06/19/16	0	0.00	0.00	0.00	h	-	-							
06/20/16	0	0.00	0.00	0.00	h	-	-							
06/21/16	0	0.00	0.00	0.00	h	-	-							
06/22/16	0	0.00	0.00	0.00	h	-	-							
06/23/16	0	0.00	0.00	0.00	h	-	-							
06/24/16	0	0.00	0.00	0.00	h	-	-							
06/25/16	0	0.00	0.00	0.00	h	-	-							
06/26/16	0	0.00	0.00	0.00	h	-	-							
06/27/16	30	0.20	0.20	0.25-0.43	h	-	-							
06/28/16	30	0.40	0.08	0.04-0.24	h	-	-							
06/29/16	40	0.75	1.57	1.62-1.81	h	h	-							
06/30/16	40	1.00	0.71	0.44-0.63	h	h	-							
16 days					16/16	2/2	0							
07/01/16	30	0.40	0.00	0.04-0.24	h	-	-							
07/02/16	0	0.00	0.00	0.00	h	-	-							
07/03/16	0	0.00	0.00	0.00	h	-	-							
07/04/16	0	0.00	0.00	0.00	h	-	-							
07/05/16	0	0.00	0.00	0.00	h	-	-							
07/06/16	0	0.00	0.00	0.00	h	-	-							
07/07/16	0	0.00	0.00	0.00	h	-	-							
07/08/16	0	0.00	0.00	0.00	h	-	-							
07/09/16	0	0.00	0.00	0.00	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016

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
07/10/16	0	0.00	0.00	0.00	h	-	-							
07/11/16	0	0.00	0.00	0.00	h	-	-							
07/12/16	0	0.00	0.00	0.00	h	-	-							
07/13/16	0	0.00	0.00	0.00	h	-	-							
07/14/16	0	0.00	0.00	0.00	h	-	-							
07/15/16	0	0.00	0.00	0.00	h	-	-							
07/16/16	0	0.00	0.00	0.00	h	-	-							
07/17/16	10	0.10	0.00	0.00	h	-	-							
07/18/16	40	0.50	0.16	0.25-0.43	h	-	-							
07/19/16	40	0.50	0.24	0.25-0.43	h	-	-							
07/20/16	30	0.50	0.00	0.04-0.24	m	-	-							
07/21/16	20	0.20	0.00	0.00	m	-	-							
07/22/16	0	0.00	0.00	0.00	h	-	-							
07/23/16	0	0.00	0.00	0.00	h	-	-							
07/24/16	20	0.25	0.00	0.00	m	-	-							
07/25/16	10	0.20	0.00	0.00	h	-	-							
07/26/16	10	0.10	0.00	0.00	h	-	-							
07/27/16	30	0.30	0.00	0.00	m	-	-							
07/28/16	0	0.00	0.00	0.04-0.24	m	-	-							
07/29/16	30	0.50	0.79	0.64-0.83	h	h	-							
07/30/16	20	0.50	0.08	0.04-0.24	m	-	-							
07/31/16	20	0.50	0.24	0.04-0.24	h	-	-							
31 days					25/31	1/1	0							
08/01/16	20	0.50	0.51	0.44-0.63	h	h	-							
08/02/16	30	1.50	0.59	1.03-1.22	h	h	-							
08/03/16	40	1.50	0.55	0.04-0.24	m	-	x							
08/04/16	30	0.75	0.08	0.25-0.43	h	-	-							
08/05/16	20	0.75	0.00	0.04-0.24	m	-	-							
08/06/16	10	0.25	0.00	0.00	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
08/07/16	10	0.10	0.00	0.00	h	-	-							
08/08/16	0	0.00	0.00	0.00	h	-	-							
08/09/16	50	1.50	2.13	1.23-1.61	h	h	-							
08/10/16	40	1.50	0.71	0.84-1.02	h	h	-							
08/11/16	20	0.50	0.00	0.00	m	-	-							
08/12/16	0	0.00	0.00	0.00	h	-	-							
08/13/16	0	0.00	0.00	0.00	h	-	-							
08/14/16	0	0.00	0.00	0.00	h	-	-							
08/15/16	0	0.00	0.00	0.00	h	-	-							
08/16/16	10	0.20	0.00	0.04-0.24	h	-	-							
08/17/16	10	0.10	0.04	0.04-0.24	h	-	-							
08/18/16	10	0.10	0.16	0.04-0.24	h	-	-							
08/19/16	10	0.33	0.04	0.04-0.24	h	-	-							
08/20/16	20	0.30	0.00	0.04-0.24	h	-	-							
08/21/16	10	0.30	0.00	0.00	h	-	-							
08/22/16	10	0.10	0.43	0.25-0.43	m	-	-							
08/23/16	10	0.10	0.00	0.00	h	-	-							
08/24/16	20	0.25	0.00	0.00	m	-	-							
08/25/16	10	0.20	0.16	0.04-0.24	h	-	-							
08/26/16	20	0.33	0.04	0.04-0.24	h	-	-							
08/27/16	0	0.00	0.00	0.00	h	-	-							
08/28/16	0	0.00	0.00	0.00	h	-	-							
08/29/16	0	0.00	0.00	0.00	h	-	-							
08/30/16	10	0.15	0.55	1.03-1.22	m	m	-							
08/31/16	20	0.50	0.55	1.23-1.61	h	h	-							
31 days					25/31	5/6	1							
09/01/16	30	1.00	0.00	0.00	m	-	x							
09/02/16	0	0.00	0.00	0.00	h	-	-							
09/03/16	0	0.00	0.00	0.00	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2016														
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
09/04/16	0	0.00	0.00	0.00	h	-	-							
09/05/16	0	0.00	0.00	0.00	h	-	-							
09/06/16	40	1.00	0.04	0.04-0.24	m	-	x							
09/07/16	10	0.75	0.00	0.00	h	-	-							
09/08/16	10	0.50	0.00	0.00	h	-	-							
09/09/16	0	0.00	0.00	0.00	h	-	-							
09/10/16	0	0.00	0.00	0.00	h	-	-							
09/11/16	0	0.00	0.00	0.04-0.24	m	-	-							
09/12/16	30	0.50	0.16	0.04-0.24	m	-	-							
09/13/16	20	0.25	0.00	0.25-0.43	h	-	-							
09/14/16	0	0.00	0.00	0.00	h	-	-							
09/15/16	0	0.00	0.00	0.00	h	-	-							
09/16/16	0	0.00	0.00	0.00	h	-	-							
09/17/16	0	0.00	0.00	0.00	h	-	-							
09/18/16	0	0.00	0.00	0.00	h	-	-							
09/19/16	30	0.30	0.00	0.00	m	-	-							
09/20/16	30	0.10	0.08	0.04-0.24	h	-	-							
09/21/16	10	0.20	0.00	0.00	h	-	-							
09/22/16	50	0.50	0.08	0.04-0.24	m	-	x							
09/23/16	0	0.00	0.00	0.00	h	-	-							
09/24/16	0	0.00	0.00	0.00	h	-	-							
09/25/16	0	0.00	0.00	0.00	h	-	-							
09/26/16	10	0.15	0.00	0.04-0.24	h	-	-							
09/27/16	20	0.25	0.00	0.04-0.24	h	-	-							
09/28/16	20	0.25	0.08	0.04-0.24	h	-	-							
09/29/16	10	0.25	0.00	0.00	h	-	-							
09/30/16	10	0.25	0.04	0.04-0.24	h	-	-							
30 days					24/30	0	3							

TABLE A-2: This table shows the verification data of MSP issued precipitation forecasts contained in the daily Outlooks for the 2016 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 2016						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
JUNE						
Gila Bend	16/16	100%	1/1	100%	0	0%
Palo Verde	16/16	100%	0/0	n/a	0	0%
Rainbow Valley	15/16	93.8%	0/0	n/a	0	0%
West Valley	15/16	93.8%	0/0	n/a	0	0%
Northwest Valley	14/16	87.5%	0/0	n/a	0	0%
Upper Centennial	15/16	93.8%	0/1	0%	0	0%
Wickenburg	15/16	93.8%	1/2	50%	0	0%
New River/Cave Creek	15/16	93.8%	1/1	100%	0	0%
Phoenix North	15/16	93.8%	1/1	100%	0	0%
Phoenix South	15/16	93.8%	1/1	100%	0	0%
Scottsdale North	15/16	93.8%	1/1	100%	0	0%
Scottsdale South	15/16	93.8%	1/1	100%	0	0%
Southeast Valley	15/16	93.8%	1/1	100%	1	6.3%
Lower Salt River Lakes	14/16	87.5%	1/1	100%	1	6.3%
Superstition	16/16	100%	2/2	100%	0	0%
All Zones	226/240	94.2%	11/13	84.6%	2/240	0.8%

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2016						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
JULY						
Gila Bend	28/31	90.3%	2/2	100%	0	0%
Palo Verde	28/31	90.3%	2/2	100%	0	0%
Rainbow Valley	27/31	87.1%	2/2	100%	0	0%
West Valley	26/31	83.9%	3/4	75%	0	0%
Northwest Valley	26/31	83.9%	1/2	50%	1	3.2%
Upper Centennial	26/31	83.9%	4/5	80%	1	3.2%
Wickenburg	26/31	83.9%	2/2	100%	1	3.2%
New River/Cave Creek	23/31	74.2%	3/4	75%	0	0%
Phoenix North	27/31	87.1%	2/2	100%	1	3.2%
Phoenix South	27/31	87.1%	1/2	50%	0	0%
Scottsdale North	27/31	87.1%	3/3	100%	1	3.2%
Scottsdale South	28/31	90.3%	2/2	100%	0	0%
Southeast Valley	25/31	80.6%	2/2	100%	1	3.2%
Lower Salt River Lakes	22/31	71%	1/1	100%	2	6.5%
Superstition	25/31	80.6%	1/1	100%	0	0%
All Zones	391/465	84.1%	31/36	86.1%	8/465	1.7%
AUGUST						
Gila Bend	23/31	74.2%	7/10	70%	0	0%
Palo Verde	25/31	80.6%	4/8	50%	0	0%
Rainbow Valley	25/31	80.6%	5/5	100%	1	3.2%
West Valley	25/31	80.6%	6/8	75%	0	0%
Northwest Valley	21/31	67.7%	7/9	77.8%	1	3.2%
Upper Centennial	26/31	83.9%	9/12	75%	0	0%
Wickenburg	21/31	67.7%	4/6	66.7%	5	16.1%
New River/Cave Creek	24/31	77.4%	6/8	75%	3	9.7%
Phoenix North	23/31	74.2%	4/5	80%	4	12.9%
Phoenix South	29/31	93.5%	5/5	100%	1	3.2%
Scottsdale North	26/31	83.9%	5/8	62.5%	1	3.2%

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2016						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
Scottsdale South	27/31	87.1%	4/5	80%	1	3.2%
Southeast Valley	29/31	93.5%	5/6	83.3%	0	0%
Lower Salt River Lakes	24/31	77.4%	2/4	50%	2	6.5%
Superstition	25/31	80.6%	5/6	83.3%	1	3.2%
All Zones	373/465	80.2%	78/105	74.3%	20/465	4.3%
SEPTEMBER						
Gila Bend	24/30	80%	2/3	66.7%	1	3.3%
Palo Verde	22/30	73.3%	1/1	100%	1	3.3%
Rainbow Valley	24/30	80%	2/2	100%	1	3.3%
West Valley	29/30	96.7%	3/3	100%	0	0%
Northwest Valley	27/30	90%	1/2	50%	0	0%
Upper Centennial	26/30	86.7%	4/6	66.7%	1	3.3%
Wickenburg	24/30	80%	1/2	50%	1	3.3%
New River/Cave Creek	25/30	83.3%	1/2	50%	1	3.3%
Phoenix North	27/30	90%	0/0	n/a	1	3.3%
Phoenix South	27/30	90%	2/2	100%	0	0%
Scottsdale North	26/30	86.7%	1/1	100%	1	3.3%
Scottsdale South	28/30	93.3%	1/1	100%	0	0%
Southeast Valley	28/30	93.3%	2/2	100%	0	0%
Lower Salt River Lakes	25/30	83.3%	1/1	100%	2	6.6%
Superstition	24/30	80%	0/0	n/a	3	10%
All Zones	386/450	85.8%	22/28	78.6%	13/450	2.9%

APPENDIX B: MSP MESSAGES - VERIFICATION TABLES

TABLE B-1: This table shows each of the individual MSP Statements issued during the 2016 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 2016							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
06/29/16	20:25	Superstition	1	Henz	Now-10pm	0.40-0.70/20-30min	-
06/29/16	20:41	Scottsdale North	1	Henz	Now-10pm	0.40-0.70/20-30min	-
06/29/16	21:13	Southeast Valley	1	Henz	Now-1030pm	0.50-0.75/20-30min	1.25
07/01/16	16:10	New River/Cave Creek	1	Henz	Now-530pm	0.50-0.75/20-30min	1.00-1.50
07/01/16	16:45	West Valley	1	Henz	Now-6pm	0.50-0.75/20-30min	1.00-1.50
07/01/16	17:12	Phoenix North	1	Henz	Now-630pm	0.50-0.75/20-30min	1.00-1.50
07/01/16	17:12	Scottsdale North	1	Henz	Now-630pm	0.50-0.75/20-30min	1.00-1.50
07/01/16	18:11	Rainbow Valley	1	Henz	Now-715pm	0.50-0.75/20-30min	1.25
07/01/16	19:30	Gila Bend	1	Henz	Now-830pm	0.50-0.75/20-30min	1.25
07/18/16	17:38	Phoenix South	1	Henz	Now-7pm	-	1.00
07/20/16	15:45	Upper Centennial	1	Henz	Now-515pm	-	1.00
07/27/16	16:50	Wickenburg	1	Henz	Now-615pm	-	0.50-0.75
07/27/16	16:50	Upper Centennial	1	Henz	Now-615pm	-	0.50-0.75
07/29/16	13:00	Gila Bend	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Palo Verde	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Rainbow Valley	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	West Valley	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Northwest Valley	2	Waters	7pm 7/29-11pm 8/3	-	-

TABLE B-1: MSP Statements Issued - Monsoon Season 2016

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
07/29/16	13:00	Upper Centennial	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Wickenburg	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	New River/Cave Creek	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Phoenix North	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Phoenix South	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Scottsdale North	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Scottsdale South	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Southeast Valley	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Lower Salt River Lakes	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Superstition	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	18:45	New River/Cave Creek	1	Henz	Now-815pm	-	0.50-0.75
07/29/16	20:00	Superstition	1	Henz	Now-930pm	-	0.50-0.75
07/29/16	20:00	Southeast Valley	1	Henz	Now-930pm	-	0.50-0.75
07/29/16	20:15	Phoenix South	1	Henz	Now-930pm	-	0.50-0.75
07/29/16	20:22	Scottsdale North	1	Henz	Now-930pm	-	0.50-0.75
07/29/16	20:22	Scottsdale South	1	Henz	Now-930pm	-	1.25-1.50
07/29/16	21:25	Wickenburg	1	Henz	Now-11pm	-	1.25-1.50
07/29/16	21:35	Gila Bend	1	Henz	Now-11pm	-	0.75-1.00
07/31/16	17:20	New River/Cave Creek	1	Waters	Now-630pm	0.50-1.00/20-30min	-
07/31/16	17:20	Scottsdale North	1	Waters	Now-630pm	0.50-1.00/20-30min	-
07/31/16	17:20	New River/Cave Creek	1U	Waters	Now-730pm	-	-
07/31/16	17:20	Scottsdale North	1U	Waters	Now-730pm	-	-
07/31/16	18:55	Phoenix North	1	Waters	Now-745pm	0.50-1.00/20-30min	-
07/31/16	18:55	Northwest Valley	1	Waters	Now-745pm	0.50-1.00/20-30min	-
07/31/16	20:00	Northwest Valley	1U	Waters	Now-830pm	-	-
07/31/16	20:15	Wickenburg	1	Waters	Now-9pm	0.50-1.00/20-30min	-
07/31/16	20:40	Wickenburg	3	Waters	Now-10pm	-	-
07/31/16	21:15	Upper Centennial	1	Waters	Now-10pm	-	-
08/02/16	13:27	New River/Cave Creek	1	Henz	Now-230pm	-	0.75-1.25

TABLE B-1: MSP Statements Issued - Monsoon Season 2016

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
08/02/16	13:45	Wickenburg	1	Henz	Now-330pm	-	1.50-2.00
08/02/16	14:50	Wickenburg	3	Henz	Now-430pm	-	-
08/02/16	15:15	Northwest Valley	1	Henz	Now-445pm	-	1.25-1.75
08/02/16	15:38	New River/Cave Creek	1	Henz	Now-515pm	-	0.75-1.25
08/02/16	16:10	Phoenix North	1	Henz	Now-530pm	-	0.75-1.25
08/02/16	16:24	New River/Cave Creek	3	Henz	Now-630pm	-	-
08/02/16	16:36	Phoenix South	1	Henz	Now-6pm	-	1.50
08/02/16	16:43	Rainbow Valley	1	Henz	Now-615pm	-	1.50
08/02/16	17:07	Scottsdale North	1	Henz	Now-645pm	-	1.50
08/02/16	17:25	Phoenix South	3	Henz	Now-7pm	-	-
08/02/16	17:35	Scottsdale South	1	Henz	Now-7pm	-	1.75-2.25
08/02/16	18:15	Superstition	1	Henz	Now-8pm	-	0.75-1.25
08/02/16	18:15	Southeast Valley	1	Henz	Now-8pm	-	1.75-2.25
08/02/16	18:40	Scottsdale South	3	Henz	Now-845pm	-	-
08/03/16	12:56	New River/Cave Creek	1	Henz	Now-230pm	-	0.75-1.25
08/03/16	13:52	Scottsdale North	1	Henz	Now-315pm	-	0.75-1.25
08/03/16	14:03	Phoenix North	1	Henz	Now-330pm	-	0.75-1.25
08/03/16	14:03	Northwest Valley	1	Henz	Now-330pm	-	0.75-1.25
08/05/16	8:00	Phoenix North	1	Waters	Now-9am	-	0.50-0.75
08/05/16	8:15	Scottsdale North	1	Waters	Now-9am	0.50-1.00/20-30min	-
08/05/16	8:15	New River/Cave Creek	1	Waters	Now-9am	0.50-1.00/20-30min	-
08/05/16	8:40	Phoenix South	1	Waters	Now-915am	0.50-1.00/20-30min	-
08/05/16	8:40	Scottsdale South	1	Waters	Now-915am	0.50-1.00/20-30min	-
08/05/16	9:10	Phoenix North	3	Waters	Now-12pm	-	-
08/05/16	9:10	Scottsdale North	3	Waters	Now-12pm	-	-
08/08/16	13:00	Gila Bend	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Palo Verde	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Rainbow Valley	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	West Valley	2	Henz	12pm 8/9-12pm 8/11	-	-

TABLE B-1: MSP Statements Issued - Monsoon Season 2016

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
08/08/16	13:00	Northwest Valley	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Upper Centennial	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Wickenburg	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	New River/Cave Creek	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Phoenix North	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Phoenix South	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Scottsdale North	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Scottsdale South	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Southeast Valley	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Lower Salt River Lakes	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Superstition	2	Henz	12pm 8/9-12pm 8/11	-	-
08/09/16	11:15	Phoenix South	1	Waters	Now-530pm	0.50-1.00/20-30min	-
08/09/16	11:15	Southeast Valley	1	Waters	Now-530pm	0.50-1.00/20-30min	-
08/09/16	11:15	Superstition	1	Waters	Now-530pm	0.50-1.00/20-30min	-
08/09/16	12:00	Scottsdale South	1	Waters	Now-530pm	0.50-1.00/20-30min	-
08/09/16	12:00	Scottsdale North	1	Waters	Now-530pm	0.50-1.00/20-30min	-
08/09/16	12:07	West Valley	1	Henz	Now-2pm	-	0.75-1.25
08/09/16	12:15	Lower Salt River Lakes	1	Henz	Now-2pm	-	0.75-1.25
08/09/16	12:45	Scottsdale North	3	Henz	Now-230pm	-	-
08/09/16	12:55	Superstition	3	Henz	Now-3pm	-	-
08/10/16	19:24	West Valley	1	Henz	Now-9pm	-	0.75-1.25
08/10/16	19:24	Rainbow Valley	1	Henz	Now-9pm	-	0.75-1.25
08/10/16	19:51	Phoenix South	1	Henz	Now-10pm	-	0.75-1.25
08/10/16	20:50	West Valley	1U	Henz	Now-1030pm	-	-
08/10/16	20:50	Rainbow Valley	1U	Henz	Now-1030pm	-	-
08/10/16	21:12	Northwest Valley	1	Henz	Now-1030pm	-	0.50-0.75
08/11/16	7:30	Southeast Valley	1	Henz	Now-9am	-	1.00-1.50
08/20/16	17:58	Wickenburg	1	Henz	Now-730pm	-	0.50-0.75
08/20/16	18:52	Northwest Valley	1	Henz	Now-830pm	-	0.50-0.75

TABLE B-1: MSP Statements Issued - Monsoon Season 2016							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
08/20/16	19:04	Wickenburg	3	Henz	Now-9pm	-	-
08/22/16	15:35	West Valley	1	Henz	Now-5pm	-	0.50-1.00
08/22/16	15:35	Phoenix North	1	Henz	Now-5pm	-	0.50-1.00
09/01/16	17:22	Phoenix South	1	Henz	Now-645pm	-	0.50/0.75-1.25
09/01/16	17:22	Southeast Valley	1	Henz	Now-645pm	-	0.50/0.75-1.25
09/07/16	4:45	Gila Bend	1	Henz	Now-615am	-	0.50-1.00/1.50
09/22/16	15:12	Phoenix South	1	Henz	Now-430pm	-	0.40-0.75/1.00-1.50
09/22/16	15:45	Scottsdale North	1	Henz	Now-515pm	-	0.40-0.75/1.00-1.50
09/22/16	15:45	Scottsdale South	1	Henz	Now-515pm	-	0.40-0.75/1.00-1.50
09/22/16	15:51	Southeast Valley	1	Henz	Now-515pm	-	0.40-0.75/1.00-1.50
09/22/16	16:12	Lower Salt River Lakes	1	Henz	Now-545pm	-	0.40-0.75/1.00-1.50
09/22/16	16:12	Superstition	1	Henz	Now-545pm	-	0.40-0.75/1.00-1.50
09/22/16	16:45	Lower Salt River Lakes	4	Henz	-	-	-
09/22/16	16:45	Superstition	4	Henz	-	-	-

TABLE B-2: This table shows the raw verification data of MSP issued Messages for the 2016 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 2016											
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
06/29/16	Superstition	1	0.40-0.70/20-30min	-	1.50	1.23-1.61	-	X	X	-	Hit
06/29/16	Scottsdale North	1	0.40-0.70/20-30min	-	0.63	1.23-1.61	-	-	-	-	Hit
06/29/16	Southeast Valley	1	0.50-0.75/20-30min	1.25	0.63	1.23-1.61	-	-	-	-	Hit
07/01/16	New River/Cave Creek	1	0.50-0.75/20-30min	1.00-1.50	0.71	1.23-1.61	-	-	-	-	Hit
07/01/16	West Valley	1	0.50-0.75/20-30min	1.00-1.50	0.35	1.03-1.22	-	-	-	-	Hit
07/01/16	Phoenix North	1	0.50-0.75/20-30min	1.00-1.50	0.12	0.64-0.83	-	-	-	-	Hit
07/01/16	Scottsdale North	1	0.50-0.75/20-30min	1.00-1.50	0.04	0.64-0.83	-	-	-	-	Hit
07/01/16	Rainbow Valley	1	0.50-0.75/20-30min	1.25	0.47	1.23-1.61	-	-	X	-	Hit
07/01/16	Gila Bend	1	0.50-0.75/20-30min	1.25	1.50	1.62-1.81	-	X	-	-	Hit
07/18/16	Phoenix South	1	-	1.00	0.67	1.02-1.18	-	-	-	-	Hit
07/20/16	Upper Centennial	1	-	1.00	0.55	1.03-1.22	-	-	-	-	Hit
07/27/16	Wickenburg	1	-	0.50-0.75	0.31	0.25-0.43	-	-	-	-	Hit
07/27/16	Upper Centennial	1	-	0.50-0.75	0.12	0.44-0.63	-	-	-	-	Hit

TABLE B-2: MSP Statements Issued - Monsoon Season 2016

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
07/29/16	Gila Bend	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Palo Verde	2	-	-	-	-	-	-	-	-	Miss
07/29/16	Rainbow Valley	2	-	-	-	-	-	-	-	-	Hit
07/29/16	West Valley	2	-	-	-	-	-	-	-	-	Miss
07/29/16	Northwest Valley	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Upper Centennial	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Wickenburg	2	-	-	-	-	-	-	-	-	Hit
07/29/16	New River/Cave Creek	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Phoenix North	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Phoenix South	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Scottsdale North	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Scottsdale South	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Southeast Valley	2	-	-	-	-	-	-	-	-	Hit
07/29/16	Lower Salt River Lakes	2	-	-	-	-	-	-	-	-	Miss
07/29/16	Superstition	2	-	-	-	-	-	-	-	-	Hit
07/29/16	New River/Cave Creek	1	-	0.50-0.75	0.59	0.64-0.83	-	-	-	-	Hit
07/29/16	Superstition	1	-	0.50-0.75	0.75	0.64-0.83	-	-	-	-	Hit
07/29/16	Southeast Valley	1	-	0.50-0.75	0.87	0.84-1.02	-	-	-	-	Hit
07/29/16	Phoenix South	1	-	0.50-0.75	0.63	1.03-1.22	-	X	-	-	Hit
07/29/16	Scottsdale North	1	-	0.50-0.75	0.28	0.25-0.43	-	-	-	-	Miss
07/29/16	Scottsdale South	1	-	1.25-1.50	1.02	1.03-1.22	-	X	X	-	Hit
07/29/16	Wickenburg	1	-	1.25-1.50	1.06	1.03-1.22	-	X	X	-	Hit
07/29/16	Gila Bend	1	-	0.75-1.00	1.06	1.03-1.22	-	X	X	-	Hit
07/31/16	New River/Cave Creek	1	0.50-1.00/20-30min	-	0.94	2.61-2.80	0.81/3	-	-	-	Hit
07/31/16	Scottsdale North	1	0.50-1.00/20-30min	-	0.47	0.44-0.63	-	-	-	-	Hit
07/31/16	New River/Cave Creek	1U	-	-	-	-	-	-	-	-	-
07/31/16	Scottsdale North	1U	-	-	-	-	-	-	-	-	-
07/31/16	Phoenix North	1	0.50-1.00/20-30min	-	0.43	0.64-0.83	-	-	-	-	Hit
07/31/16	Northwest Valley	1	0.50-1.00/20-30min	-	0.43	0.64-0.83	-	X	-	-	Hit

TABLE B-2: MSP Statements Issued - Monsoon Season 2016

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
07/31/16	Northwest Valley	1U	-	-	-	-	-	-	-	-	-
07/31/16	Wickenburg	1	0.50-1.00/20-30min	-	1.81	1.62-1.81	-	X	X	-	Hit
07/31/16	Wickenburg	3	-	-	1.81	1.62-1.81	-	X	X	-	Hit
07/31/16	Upper Centennial	1	-	-	1.06	1.62-1.81	-	-	-	-	Hit
08/02/16	New River/Cave Creek	1	-	0.75-1.25	0.39	1.23-1.61	-	-	-	-	Hit
08/02/16	Wickenburg	1	-	1.50-2.00	0.75	1.62-1.81	-	X	X	-	Hit
08/02/16	Wickenburg	3	-	-	0.75	1.62-1.81	-	X	X	-	Hit
08/02/16	Northwest Valley	1	-	1.25-1.75	0.83	1.23-1.61		-	-	-	Hit
08/02/16	New River/Cave Creek	1	-	0.75-1.25	1.26	1.23-1.61	1.00	X	-	-	Hit
08/02/16	Phoenix North	1	-	0.75-1.25	1.26	1.23-1.61	-	-	X	-	Hit
08/02/16	New River/Cave Creek	3	-	-	1.26	1.23-1.61	-	-	-	-	Hit
08/02/16	Phoenix South	1	-	1.50	2.83	2.02-2.20	3.62	X	-	-	Hit
08/02/16	Rainbow Valley	1	-	1.50	1.46	1.23-1.61	-	X	X	-	Hit
08/02/16	Scottsdale North	1	-	1.50	1.26	1.23-1.61	-	X	-	-	Hit
08/02/16	Phoenix South	3	-	-	2.83	2.02-2.20	-	X	X	-	Hit
08/02/16	Scottsdale South	1	-	1.75-2.25	1.57	1.62-1.81	-	X	X	-	Hit
08/02/16	Superstition	1	-	0.75-1.25	0.59	1.03-1.22	-	-	-	-	Hit
08/02/16	Southeast Valley	1	-	1.75-2.25	1.81	2.21-2.40	-	X	-	-	Hit
08/02/16	Scottsdale South	3	-	-	1.57	1.62-1.81	-	X	X	-	Hit
08/03/16	New River/Cave Creek	1	-	0.75-1.25	0.75	1.23-1.61	-	-	-	-	Hit
08/03/16	Scottsdale North	1	-	0.75-1.25	0.39	0.64-0.83	-	-	-	-	Miss
08/03/16	Phoenix North	1	-	0.75-1.25	0.55	1.03-1.22	-	-	-	-	Hit
08/03/16	Northwest Valley	1	-	0.75-1.25	0.35	0.84-1.02	-	-	-	-	Hit
08/05/16	Phoenix North	1	-	0.50-0.75	1.42	1.61-1.81	-	X	X	X	Hit
08/05/16	Scottsdale North	1	0.50-1.00/20-30min	-	1.81	2.41-2.60	-	X	X	-	Hit
08/05/16	New River/Cave Creek	1	0.50-1.00/20-30min	-	0.98	1.03-1.22	-	-	-	-	Hit
08/05/16	Phoenix South	1	0.50-1.00/20-30min	-	0.98	0.84-1.02	0.64/1	X	X	-	Hit
08/05/16	Scottsdale South	1	0.50-1.00/20-30min	-	1.38	1.23-1.61	0.50/2	X	X	-	Hit
08/05/16	Phoenix North	3	-	-	1.42	1.61-1.81	-	-	-	X	Hit

TABLE B-2: MSP Statements Issued - Monsoon Season 2016

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
08/05/16	Scottsdale North	3	-	-	1.81	2.41-2.60	-	X	X	-	Hit
08/08/16	Gila Bend	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Palo Verde	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Rainbow Valley	2	-	-	-	-	-	-	-	-	Hit
08/08/16	West Valley	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Northwest Valley	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Upper Centennial	2	-	-	-	-	-	-	-	-	Miss
08/08/16	Wickenburg	2	-	-	-	-	-	-	-	-	Miss
08/08/16	New River/Cave Creek	2	-	-	-	-	-	-	-	-	Miss
08/08/16	Phoenix North	2	-	-	-	-	-	-	-	-	Miss
08/08/16	Phoenix South	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Scottsdale North	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Scottsdale South	2	-	-	-	-	-	-	-	-	Miss
08/08/16	Southeast Valley	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Lower Salt River Lakes	2	-	-	-	-	-	-	-	-	Hit
08/08/16	Superstition	2	-	-	-	-	-	-	-	-	Hit
08/09/16	Phoenix South	1	0.50-1.00/20-30min	-	0.67	0.64-0.83	-	X	-	-	Hit
08/09/16	Southeast Valley	1	0.50-1.00/20-30min	-	1.06	1.82-2.01	-	X	-	-	Hit
08/09/16	Superstition	1	0.50-1.00/20-30min	-	2.05	1.23-1.61	1.57	X	X	X	Hit
08/09/16	Scottsdale South	1	0.50-1.00/20-30min	-	0.35	0.64-0.83	-	-	X	-	Hit
08/09/16	Scottsdale North	1	0.50-1.00/20-30min	-	1.46	1.03-1.22	1.10/2	X	-	-	Hit
08/09/16	West Valley	1	-	0.75-1.25	0.35	0.64-0.83	0.50/1	-	-	-	Hit
08/09/16	Lower Salt River Lakes	1	-	0.75-1.25	0.04	0.84-1.02	-	-	-	-	Hit
08/09/16	Scottsdale North	3	-	-	1.46	1.03-1.22	-	X	-	-	Hit
08/09/16	Superstition	3	-	-	2.05	1.23-1.61	-	X	X	X	Hit
08/10/16	West Valley	1	-	0.75-1.25	1.73	1.82-2.01	1.02	X	-	-	Hit
08/10/16	Rainbow Valley	1	-	0.75-1.25	0.94	1.23-1.61	-	-	-	-	Hit
08/10/16	Phoenix South	1	-	0.75-1.25	0.94	0.84-1.02	-	-	-	-	Hit
08/10/16	West Valley	1U	-	-	-	-	-	-	-	-	-

TABLE B-2: MSP Statements Issued - Monsoon Season 2016

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
08/10/16	Rainbow Valley	1U	-	-	-	-	-	-	-	-	-
08/10/16	Northwest Valley	1	-	0.50-0.75	0.75	0.84-1.02	1.02	-	-	-	Hit
08/11/16	Southeast Valley	1	-	1.00-1.50	0.94	1.23-1.61	0.55/3	X	X	-	Hit
08/20/16	Wickenburg	1	-	0.50-0.75	0.75	2.02-2.20	-	-	X	-	Hit
08/20/16	Northwest Valley	1	-	0.50-0.75	0.43	0.64-0.83	-	-	X	-	Hit
08/20/16	Wickenburg	3	-	-	0.75	2.02-2.20	-	-	X	-	Hit
08/22/16	West Valley	1	-	0.50-1.00	0.43	0.84-1.02	0.97	-	-	-	Hit
08/22/16	Phoenix North	1	-	0.50-1.00	0.91	1.03-1.22	0.60	-	-	X	Hit
09/01/16	Phoenix South	1	-	0.50/0.75-1.25	0.51	0.44-0.63	-	-	-	-	Hit
09/01/16	Southeast Valley	1	-	0.50/0.75-1.25	0.51	0.44-0.93	-	-	-	-	Hit
09/07/16	Gila Bend	1	-	0.50-1.00/1.50	1.14	1.82-2.01	-	-	X	-	Hit
09/22/16	Phoenix South	1	-	0.40-0.75/1.00-1.50	0.71	0.44-0.63	-	-	-	-	Hit
09/22/16	Scottsdale North	1	-	0.40-0.75/1.00-1.50	0.39	0.44-0.63	-	-	-	-	Hit
09/22/16	Scottsdale South	1	-	0.40-0.75/1.00-1.50	0.71	0.25-0.43	-	-	X	-	Hit
09/22/16	Southeast Valley	1	-	0.40-0.75/1.00-1.50	0.51	0.25-0.43	-	-	-	-	Hit
09/22/16	Lower Salt River Lakes	1	-	0.40-0.75/1.00-1.50	0.08	0.25-0.43	-	-	-	-	Hit
09/22/16	Superstition	1	-	0.40-0.75/1.00-1.50	0.00	0.04-0.24	-	-	-	-	Miss
09/22/16	Lower Salt River Lakes	4	-	-	-	-	-	-	-	-	-
09/22/16	Superstition	4	-	-	-	-	-	-	-	-	-

TABLE B-3: This table shows the lead time data of MSP issued Messages for the 2016 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 2016							
Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
06/29/16	20:25	Superstition	1	Henz	Now-10pm	21:13	48
06/29/16	20:41	Scottsdale North	1	Henz	Now-10pm	-	-
06/29/16	21:13	Southeast Valley	1	Henz	Now-1030pm	-	-
07/01/16	16:10	New River/Cave Creek	1	Henz	Now-530pm	-	-
07/01/16	16:45	West Valley	1	Henz	Now-6pm	-	-
07/01/16	17:12	Phoenix North	1	Henz	Now-630pm	-	-
07/01/16	17:12	Scottsdale North	1	Henz	Now-630pm	-	-
07/01/16	18:11	Rainbow Valley	1	Henz	Now-715pm	19:06	63
07/01/16	19:30	Gila Bend	1	Henz	Now-830pm	19:16	0
07/18/16	17:38	Phoenix South	1	Henz	Now-7pm	-	-
07/20/16	15:45	Upper Centennial	1	Henz	Now-515pm	-	-
07/27/16	16:50	Wickenburg	1	Henz	Now-615pm	-	-
07/27/16	16:50	Upper Centennial	1	Henz	Now-615pm	-	-
07/29/16	13:00	Gila Bend	2	Waters	7pm 7/29-11pm 8/3	21:35	515
07/29/16	13:00	Palo Verde	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Rainbow Valley	2	Waters	7pm 7/29-11pm 8/3	8/2 16:43	529
07/29/16	13:00	West Valley	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Northwest Valley	2	Waters	7pm 7/29-11pm 8/3	7/31 18:55	419
07/29/16	13:00	Upper Centennial	2	Waters	7pm 7/29-11pm 8/3	7/31 21:15	559
07/29/16	13:00	Wickenburg	2	Waters	7pm 7/29-11pm 8/3	21:25	505

TABLE B-3: MSP Statement Lead Time - Monsoon Season 2016							
Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
07/29/16	13:00	New River/Cave Creek	2	Waters	7pm 7/29-11pm 8/3	18:45	345
07/29/16	13:00	Phoenix North	2	Waters	7pm 7/29-11pm 8/3	7/31 18:55	419
07/29/16	13:00	Phoenix South	2	Waters	7pm 7/29-11pm 8/3	20:15	435
07/29/16	13:00	Scottsdale North	2	Waters	7pm 7/29-11pm 8/3	20:22	442
07/29/16	13:00	Scottsdale South	2	Waters	7pm 7/29-11pm 8/3	20:22	442
07/29/16	13:00	Southeast Valley	2	Waters	7pm 7/29-11pm 8/3	20:00	420
07/29/16	13:00	Lower Salt River Lakes	2	Waters	7pm 7/29-11pm 8/3	-	-
07/29/16	13:00	Superstition	2	Waters	7pm 7/29-11pm 8/3	8/2 18:15	621
07/29/16	18:45	New River/Cave Creek	1	Henz	Now-815pm	-	-
07/29/16	20:00	Superstition	1	Henz	Now-930pm	-	-
07/29/16	20:00	Southeast Valley	1	Henz	Now-930pm	-	-
07/29/16	20:15	Phoenix South	1	Henz	Now-930pm	20:41	26
07/29/16	20:22	Scottsdale North	1	Henz	Now-930pm	-	-
07/29/16	20:22	Scottsdale South	1	Henz	Now-930pm	20:16	0
07/29/16	21:25	Wickenburg	1	Henz	Now-11pm	21:18	0
07/29/16	21:35	Gila Bend	1	Henz	Now-11pm	23:22	107
07/31/16	17:20	New River/Cave Creek	1	Waters	Now-630pm	-	-
07/31/16	17:20	Scottsdale North	1	Waters	Now-630pm	-	-
07/31/16	17:20	New River/Cave Creek	1U	Waters	Now-730pm	-	-
07/31/16	17:20	Scottsdale North	1U	Waters	Now-730pm	-	-
07/31/16	18:55	Phoenix North	1	Waters	Now-745pm	-	-
07/31/16	18:55	Northwest Valley	1	Waters	Now-745pm	21:04	129
07/31/16	20:00	Northwest Valley	1U	Waters	Now-830pm	-	-
07/31/16	20:15	Wickenburg	1	Waters	Now-9pm	20:36	21
07/31/16	20:40	Wickenburg	3	Waters	Now-10pm	20:55	15
07/31/16	21:15	Upper Centennial	1	Waters	Now-10pm	-	-
08/02/16	13:27	New River/Cave Creek	1	Henz	Now-230pm	-	-
08/02/16	13:45	Wickenburg	1	Henz	Now-330pm	13:23	0
08/02/16	14:50	Wickenburg	3	Henz	Now-430pm	14:36	0

TABLE B-3: MSP Statement Lead Time - Monsoon Season 2016							
Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
08/02/16	15:15	Northwest Valley	1	Henz	Now-445pm	-	-
08/02/16	15:38	New River/Cave Creek	1	Henz	Now-515pm	16:09	31
08/02/16	16:10	Phoenix North	1	Henz	Now-530pm	16:48	38
08/02/16	16:24	New River/Cave Creek	3	Henz	Now-630pm	-	-
08/02/16	16:36	Phoenix South	1	Henz	Now-6pm	17:18	42
08/02/16	16:43	Rainbow Valley	1	Henz	Now-615pm	17:11	28
08/02/16	17:07	Scottsdale North	1	Henz	Now-645pm	16:52	0
08/02/16	17:25	Phoenix South	3	Henz	Now-7pm	17:53	28
08/02/16	17:35	Scottsdale South	1	Henz	Now-7pm	18:06	31
08/02/16	18:15	Superstition	1	Henz	Now-8pm	-	-
08/02/16	18:15	Southeast Valley	1	Henz	Now-8pm	19:06	51
08/02/16	18:40	Scottsdale South	3	Henz	Now-845pm	18:26	0
08/03/16	12:56	New River/Cave Creek	1	Henz	Now-230pm	-	-
08/03/16	13:52	Scottsdale North	1	Henz	Now-315pm	-	-
08/03/16	14:03	Phoenix North	1	Henz	Now-330pm	-	-
08/03/16	14:03	Northwest Valley	1	Henz	Now-330pm	-	-
08/05/16	8:00	Phoenix North	1	Waters	Now-9am	7:46	0
08/05/16	8:15	Scottsdale North	1	Waters	Now-9am	8:34	19
08/05/16	8:15	New River/Cave Creek	1	Waters	Now-9am	-	-
08/05/16	8:40	Phoenix South	1	Waters	Now-915am	10:32	112
08/05/16	8:40	Scottsdale South	1	Waters	Now-915am	9:16	36
08/05/16	9:10	Phoenix North	3	Waters	Now-12pm	8:58	0
08/05/16	9:10	Scottsdale North	3	Waters	Now-12pm	9:24	14
08/08/16	13:00	Gila Bend	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Palo Verde	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Rainbow Valley	2	Henz	12pm 8/9-12pm 8/11	8/10 19:24	1884
08/08/16	13:00	West Valley	2	Henz	12pm 8/9-12pm 8/11	12:07	7
08/08/16	13:00	Northwest Valley	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Upper Centennial	2	Henz	12pm 8/9-12pm 8/11	8/10 21:12	1992

TABLE B-3: MSP Statement Lead Time - Monsoon Season 2016

Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
08/08/16	13:00	Wickenburg	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	New River/Cave Creek	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Phoenix North	2	Henz	12pm 8/9-12pm 8/11	-	-
08/08/16	13:00	Phoenix South	2	Henz	12pm 8/9-12pm 8/11	11:15	0
08/08/16	13:00	Scottsdale North	2	Henz	12pm 8/9-12pm 8/11	12:00	0
08/08/16	13:00	Scottsdale South	2	Henz	12pm 8/9-12pm 8/11	12:00	0
08/08/16	13:00	Southeast Valley	2	Henz	12pm 8/9-12pm 8/11	11:15	0
08/08/16	13:00	Lower Salt River Lakes	2	Henz	12pm 8/9-12pm 8/11	12:15	0
08/08/16	13:00	Superstition	2	Henz	12pm 8/9-12pm 8/11	11:15	0
08/09/16	11:15	Phoenix South	1	Waters	Now-530pm	11:33	18
08/09/16	11:15	Southeast Valley	1	Waters	Now-530pm	11:12	0
08/09/16	11:15	Superstition	1	Waters	Now-530pm	11:36	21
08/09/16	12:00	Scottsdale South	1	Waters	Now-530pm	13:54	114
08/09/16	12:00	Scottsdale North	1	Waters	Now-530pm	12:34	34
08/09/16	12:07	West Valley	1	Henz	Now-2pm	-	-
08/09/16	12:15	Lower Salt River Lakes	1	Henz	Now-2pm	-	-
08/09/16	12:45	Scottsdale North	3	Henz	Now-230pm	12:34	0
08/09/16	12:55	Superstition	3	Henz	Now-3pm	12:30	0
08/10/16	19:24	West Valley	1	Henz	Now-9pm	21:26	122
08/10/16	19:24	Rainbow Valley	1	Henz	Now-9pm	-	-
08/10/16	19:51	Phoenix South	1	Henz	Now-10pm	-	-
08/10/16	20:50	West Valley	1U	Henz	Now-1030pm	-	-
08/10/16	20:50	Rainbow Valley	1U	Henz	Now-1030pm	-	-
08/10/16	21:12	Northwest Valley	1	Henz	Now-1030pm	-	-
08/11/16	7:30	Southeast Valley	1	Henz	Now-9am	8:09	39
08/20/16	17:58	Wickenburg	1	Henz	Now-730pm	18:58	60
08/20/16	18:52	Northwest Valley	1	Henz	Now-830pm	18:45	0
08/20/16	19:04	Wickenburg	3	Henz	Now-9pm	-	-
08/22/16	15:35	West Valley	1	Henz	Now-5pm	-	-

TABLE B-3: MSP Statement Lead Time - Monsoon Season 2016							
Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
08/22/16	15:35	Phoenix North	1	Henz	Now-5pm	16:08	33
09/01/16	17:22	Phoenix South	1	Henz	Now-645pm	-	-
09/01/16	17:22	Southeast Valley	1	Henz	Now-645pm	-	-
09/07/16	4:45	Gila Bend	1	Henz	Now-615am	4:41	0
09/22/16	15:12	Phoenix South	1	Henz	Now-430pm	-	-
09/22/16	15:45	Scottsdale North	1	Henz	Now-515pm	-	-
09/22/16	15:45	Scottsdale South	1	Henz	Now-515pm	16:03	18
09/22/16	15:51	Southeast Valley	1	Henz	Now-515pm	-	-
09/22/16	16:12	Lower Salt River Lakes	1	Henz	Now-545pm	-	-
09/22/16	16:12	Superstition	1	Henz	Now-545pm	-	-

APPENDIX C: MSP LAKE ALERTS - VERIFICATION TABLES

TABLE C-1: This table shows each of the individual MSP Lake Alerts issued during the 2016 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 2016									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
06/27/16	16:30	Lake Pleasant	Henz	Now-530pm	-	X	-	15	Hit
06/28/16	19:39	Apache Lake	Henz	Now-845pm	X	-	-	0	Hit
06/28/16	19:39	Canyon Lake	Henz	Now-845pm	X	-	-	30	Hit
06/29/16	19:00	Lake Pleasant	Henz	Now-8pm	-	-	-	-	Miss
06/29/16	19:47	Saguaro Lake	Henz	Now-845pm	X	-	-	11	Hit
06/29/16	19:47	Canyon Lake	Henz	Now-845pm	X	-	-	0	Hit
07/01/16	16:35	Apache Lake	Henz	Now-530pm	X	-	-	5	Hit
07/20/16	17:15	Apache Lake	Henz	Now-615pm	X	-	X	0	Hit
07/22/16	17:30	Lake Pleasant	Waters	Now-615pm	X	-	-	18	Hit
07/28/16	17:35	Canyon Lake	Waters	Now-610pm	-	-	-	-	Miss
07/28/16	17:35	Saguaro Lake	Waters	Now-610pm	-	-	-	-	Miss
07/28/16	17:45	Bartlett Lake	Waters	Now-7pm	X	-	-	5	Hit
07/29/16	19:10	Bartlett Lake	Henz	Now-8pm	X	X	-	0	Hit

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2016									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
07/29/16	19:15	Lake Pleasant	Henz	Now-8pm	-	X	-	0	Hit
07/29/16	19:24	Apache Lake	Henz	Now-830pm	-	X	-	36	Hit
07/29/16	19:24	Canyon Lake	Henz	Now-830pm	-	X	-	36	Hit
07/29/16	19:24	Saguaro Lake	Henz	Now-830pm	-	X	-	36	Hit
07/31/16	17:00	Bartlett Lake	Waters	Now-545pm	-	X	-	0	Hit
07/31/16	18:15	Lake Pleasant	Waters	Now-645pm	-	X	-	60	Hit
08/02/16	14:55	Lake Pleasant	Henz	Now-430pm	X	-	-	20	Hit
08/03/16	12:52	Lake Pleasant	Henz	Now-2pm	X	X	-	38	Hit
08/03/16	14:26	Apache Lake	Henz	Now-345pm	X	-	-	0	Hit
08/03/16	14:26	Canyon Lake	Henz	Now-345pm	X	-	-	0	Hit
08/05/16	9:55	Bartlett Lake	Waters	Now-12pm	X	X	-	0	Hit
08/09/16	12:10	Apache Lake	Waters	Now-130pm	X	-	-	-	Hit
08/09/16	12:10	Canyon Lake	Waters	Now-130pm	X	-	-	-	Hit
08/09/16	12:10	Saguaro Lake	Waters	Now-130pm	X	-	-	-	Hit
08/09/16	12:30	Bartlett Lake	Henz	Now-130pm	X	X	-	0	Hit
08/12/16	17:00	Apache Lake	Waters	Now-6pm	-	-	-	-	Miss
08/12/16	17:00	Canyon Lake	Waters	Now-6pm	-	-	-	-	Miss
08/12/16	17:00	Saguaro Lake	Waters	Now-6pm	-	-	-	-	Miss
08/16/16	15:56	Bartlett Lake	Henz	Now-6pm	X	-	-	18	Hit
08/16/16	16:55	Apache Lake	Henz	Now-630pm	X	-	-	60	Hit
08/16/16	16:55	Canyon Lake	Henz	Now-630pm	X	-	-	60	Hit
08/16/16	17:55	Lake Pleasant	Henz	Now-7pm	-	-	-	-	Miss
08/20/16	17:02	Bartlett Lake	Henz	Now-630pm	X	X	X	13	Hit
08/20/16	17:15	Apache Lake	Henz	Now-630pm	X	X	-	26	Hit
08/20/16	17:34	Canyon Lake	Henz	Now-7pm	-	X	-	5	Hit
08/20/16	17:34	Saguaro Lake	Henz	Now-7pm	-	X	-	10	Hit
08/20/16	17:41	Lake Pleasant	Henz	Now-7pm	-	X	X	0	Hit
08/25/16	16:26	Bartlett Lake	Henz	Now-545pm	X	X	X	15	Hit
08/25/16	17:55	Lake Pleasant	Henz	Now-615pm	X	X	-	0	Hit

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2016									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
09/01/16	14:01	Apache Lake	Waters	Now-245pm	X	X	X	0	Hit
09/22/16	16:18	Saguaro Lake	Henz	430pm-545pm	-	X	X	13	Hit
09/22/16	16:18	Canyon Lake	Henz	430pm-545pm	-	X	X	43	Hit
09/22/16	16:18	Apache Lake	Henz	430pm-545pm	-	-	-	-	Miss

APPENDIX D: QPF PEAK RAINFALL INTENSITY - VERIFICATION TABLES

TABLE D-1: This table shows each of the individual qualifying MSP Messages issued during the 2016 Monsoon season including the detailed forecast rainfall information. The table is broken down by statement details, peak rainfall intensity, 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 Rainfall Intensity – Rain information including forecast and observed rainfall intensity. Observed rainfall intensities include rain gage type and number (if ALERT data). Data is pulled directly from issued Message. Observations are gathered the ALERT database and local storm reports.

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

TABLE D-1: MSP QPF Peak Intensity Verification - Monsoon Season 2016						
Statement Details		Peak Rainfall Intensity			Verification	
Date	MSP Forecast Zone	QPF (in/min)	Observed (in/min) *	Gage Type	(%) Error	Hit/Miss
06/29/16	Superstition	0.40-0.70/20min	0.63	4565, 6650	11.11	hit
06/29/16	Scottsdale North	0.40-0.70/30min	0.43	4590	-6.98	hit
06/29/16	Southeast Valley	0.50-0.75/30min	0.59	6570	-15.25	hit
07/01/16	New River/Cave Creek	0.50-0.75/30min	0.59	5580	-15.25	hit
07/01/16	West Valley	0.50-0.75/30min	0.35	5415	42.86	miss
07/01/16	Phoenix North	0.50-0.75/30min	0.20	4900	150.00	miss
07/01/16	Scottsdale North	0.50-0.75/30min	0.04	4910	1150.00	miss
07/01/16	Rainbow Valley	0.50-0.75/30min	0.47	6950	6.38	hit
07/01/16	Gila Bend	0.50-0.75/30min	0.79	6910	-5.06	hit
07/31/16	New River/Cave Creek	0.50-1.00/30min	0.71	4920	-29.58	miss
07/31/16	Scottsdale North	0.50-1.00/30min	0.43	5940	16.28	hit
07/31/16	Phoenix North	0.50-1.00/30min	0.35	5610	42.86	miss
07/31/16	Northwest Valley	0.50-1.00/30min	0.16	5475	212.50	miss

TABLE D-1: MSP QPF Peak Intensity Verification - Monsoon Season 2016						
Statement Details		Peak Rainfall Intensity			Verification	
Date	MSP Forecast Zone	QPF (in/min)	Observed (in/min) *	Gage Type	(%) Error	Hit/Miss
07/31/16	Wickenburg	0.50-1.00/30min	1.18	7050	-15.25	hit
08/05/16	Scottsdale North	0.50-1.00/30min	1.02	4860	-1.96	hit
08/05/16	New River/Cave Creek	0.50-1.00/30min	0.83	4920	20.48	miss
08/05/16	Phoenix South	0.50-1.00/30min	0.55	4780	-9.08	hit
08/05/16	Scottsdale South	0.50-1.00/20min	1.14	4685	-12.28	hit
08/09/16	Phoenix South	0.50-1.00/20min	0.55	6560	-9.09	hit
08/09/16	Southeast Valley	0.50-1.00/30min	0.98	6575	2.04	hit
08/09/16	Superstition	0.50-1.00/20min	1.42	6675	-29.58	miss
08/09/16	Scottsdale South	0.50-1.00/20min	0.43	4660	16.28	hit
08/09/16	Scottsdale North	0.50-1.00/20min	0.94	5970	6.38	hit
<i>* Data in the Observed column was fit to match QPF Intensity time scale.</i>						

APPENDIX E: QPF STORM TOTAL PRECIPITATION - VERIFICATION TABLES

TABLE E-1: This table shows each of the individual MSP Lake Alerts issued during the 2016 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 2016											
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
06/29/16	Southeast Valley	1.25	0.63	1.23	1.61	-	98.41	1.63	-22.36	-	Hit
07/01/16	New River/Cave Creek	1.50	0.71	1.23	1.61	-	111.27	21.95	-6.83	-	Hit
07/01/16	West Valley	1.00	0.35	1.03	1.22	-	185.71	-2.91	-18.03	-	Hit
07/01/16	Phoenix North	1.00	0.12	0.64	0.83	-	733.33	56.25	20.48		Miss
07/01/16	Scottsdale North	1.00	0.04	0.64	0.83	-	2400.00	56.25	20.48		Miss
07/01/16	Rainbow Valley	1.25	0.47	1.23	1.61	-	165.96	1.63	-22.36	-	Hit
07/01/16	Gila Bend	1.25	1.50	1.62	1.81	-	-16.67	-22.84	-30.94	-	Hit
07/18/16	Phoenix South	1.00	0.67	1.02	1.18	-	49.25	-1.96	-15.25	-	Hit
07/20/16	Upper Centennial	1.00	0.55	1.03	1.22	-	81.82	-2.91	-18.03	-	Hit
07/29/16	New River/Cave Creek	0.75	0.59	0.64	0.83	-	27.12	17.19	-9.64	-	Hit
07/29/16	Superstition	0.75	0.75	0.64	0.83	-	0.00	17.19	-9.64	-	Hit
07/29/16	Southeast Valley	0.75	0.87	0.84	1.02	-	-13.79	-10.71	-26.47	-	Hit

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2016

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
07/29/16	Phoenix South	1.25	0.63	1.03	1.22	-	98.41	21.36	2.46	-	Hit
07/29/16	Scottsdale North	0.50	0.28	0.25	0.43	-	78.57	100.00	16.28	-	Hit
07/29/16	Scottsdale South	1.25	1.02	1.03	1.22	-	22.55	21.36	2.46	-	Hit
07/29/16	Wickenburg	1.25	1.06	1.03	1.22	-	17.92	21.36	2.46	-	Hit
07/29/16	Gila Bend	1.00	1.06	1.03	1.22	-	-5.66	-2.91	-18.03	-	Hit
08/02/16	New River/Cave Creek	1.25	0.39	1.23	1.61	-	220.51	1.63	-22.36	-	Hit
08/02/16	Wickenburg	1.50	0.75	1.62	1.81	-	100.00	-7.41	-17.13	-	Hit
08/02/16	Northwest Valley	1.25	0.83	1.23	1.61	-	50.60	1.63	-22.36	-	Hit
08/02/16	New River/Cave Creek	1.25	1.26	1.23	1.61	1.00	-0.79	1.63	-22.36	25.00	Hit
08/02/16	Phoenix North	1.25	1.26	1.23	1.61	-	-0.79	1.63	-22.36	-	Hit
08/02/16	Phoenix South	1.50	2.83	2.02	2.20	3.62	-47.00	-25.74	-31.82	-58.56	Miss
08/02/16	Rainbow Valley	1.50	1.46	1.23	1.61	-	2.74	21.95	-6.83	-	Hit
08/02/16	Scottsdale North	1.50	1.26	1.23	1.61	-	19.05	21.95	-6.83	-	Hit
08/02/16	Scottsdale South	1.75	1.57	1.62	1.81	-	11.46	8.02	-3.31	-	Hit
08/02/16	Superstition	1.25	0.59	1.03	1.22	-	111.86	21.36	2.46	-	Hit
08/02/16	Southeast Valley	2.25	1.81	2.21	2.40	-	24.31	1.81	-6.25	-	Hit
08/03/16	New River/Cave Creek	1.25	0.75	1.23	1.61	-	66.67	1.63	-22.36	-	Hit
08/03/16	Scottsdale North	0.75	0.39	0.64	0.83	-	92.31	17.19	-9.64	-	Miss
08/03/16	Phoenix North	1.25	0.55	1.03	1.22	-	127.27	21.36	2.46	-	Hit
08/03/16	Northwest Valley	0.75	0.35	0.84	1.02	-	114.29	-10.71	-26.47	-	Hit
08/05/16	Phoenix North	0.75	1.42	1.61	1.81	-	-47.18	-53.42	-58.56	-	Miss
08/09/16	West Valley	0.75	0.35	0.64	0.83	0.50	114.29	17.19	-9.64	50.00	Hit
08/09/16	Lower Salt River Lakes	0.75	0.04	0.84	1.02	-	1775.00	-10.71	-26.47	-	Hit
08/10/16	West Valley	1.00	1.73	1.82	2.01	1.02	-42.20	-45.05	-50.25	-1.96	Hit
08/10/16	Rainbow Valley	1.25	0.94	1.23	1.61	-	32.98	1.63	-22.36	-	Hit
08/10/16	Phoenix South	1.00	0.94	0.84	1.02	-	6.38	19.05	-1.96	-	Hit
08/10/16	Northwest Valley	0.75	0.75	0.84	1.02	1.02	0.00	-10.71	-26.47	-26.47	Hit
08/11/16	Southeast Valley	1.00	0.94	1.23	1.61	-	6.38	-18.70	-37.89	-	Hit
08/20/16	Wickenburg	0.75	0.75	2.02	2.20	-	0.00	-62.87	-65.91	-	Hit

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2016

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
08/20/16	Northwest Valley	0.75	0.43	0.64	0.83	-	74.42	17.19	-9.64	-	Hit
08/22/16	West Valley	1.00	0.43	0.84	1.02	0.97	132.56	19.05	-1.96	3.09	Hit
08/22/16	Phoenix North	1.00	0.91	1.03	1.22	0.60	9.89	-2.91	-18.03	66.67	Hit
09/01/16	Phoenix South	0.50	0.51	0.44	0.63	-	-1.96	13.64	-20.63	-	Hit
09/01/16	Southeast Valley	0.50	0.51	0.44	0.63	-	-1.96	13.64	-20.63	-	Hit
09/07/16	Gila Bend	1.00	1.15	1.82	2.01	-	-13.04	-45.05	-50.25	-	Hit
09/22/16	Phoenix South	0.75	0.71	0.44	0.63	-	5.63	70.45	19.05	-	Hit
09/22/16	Scottsdale North	0.40	0.39	0.44	0.63	-	2.56	-9.09	-36.51	-	Hit
09/22/16	Scottsdale South	0.75	0.71	0.25	0.43	-	5.63	200.00	74.42	-	Hit
09/22/16	Southeast Valley	0.50	0.51	0.25	0.43	-	-1.96	100.00	16.28	-	Hit
09/22/16	Lower Salt River Lakes	0.40	0.08	0.25	0.43	-	400.00	60.00	-6.98	-	Hit
09/22/16	Superstition	0.40	0.00	0.04	0.24	-	-	900.00	66.67	-	Miss
* GAQPE (Radar) estimated data given in ranges: (LT) Lower Total and (UT) Upper Total											