



Bulldog Floodway looking E towards Superstition Mtns, 09-13-2023, FCD O&M Staff

Flood Control District of Maricopa County

Flood Warning Branch

MSP Verification Report & Season Recap: Monsoon Season 2023



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



MSP PRODUCT DESCRIPTION

Weather Outlook:

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

Message 1 – Alert:

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

Message 2 – Flash Flood Watch:

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

Message 3 – Flash Flood Warning:

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

Message 1, 2 and 3 Update:

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

Message 4 – Cancel:

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

Lake Alerts:

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

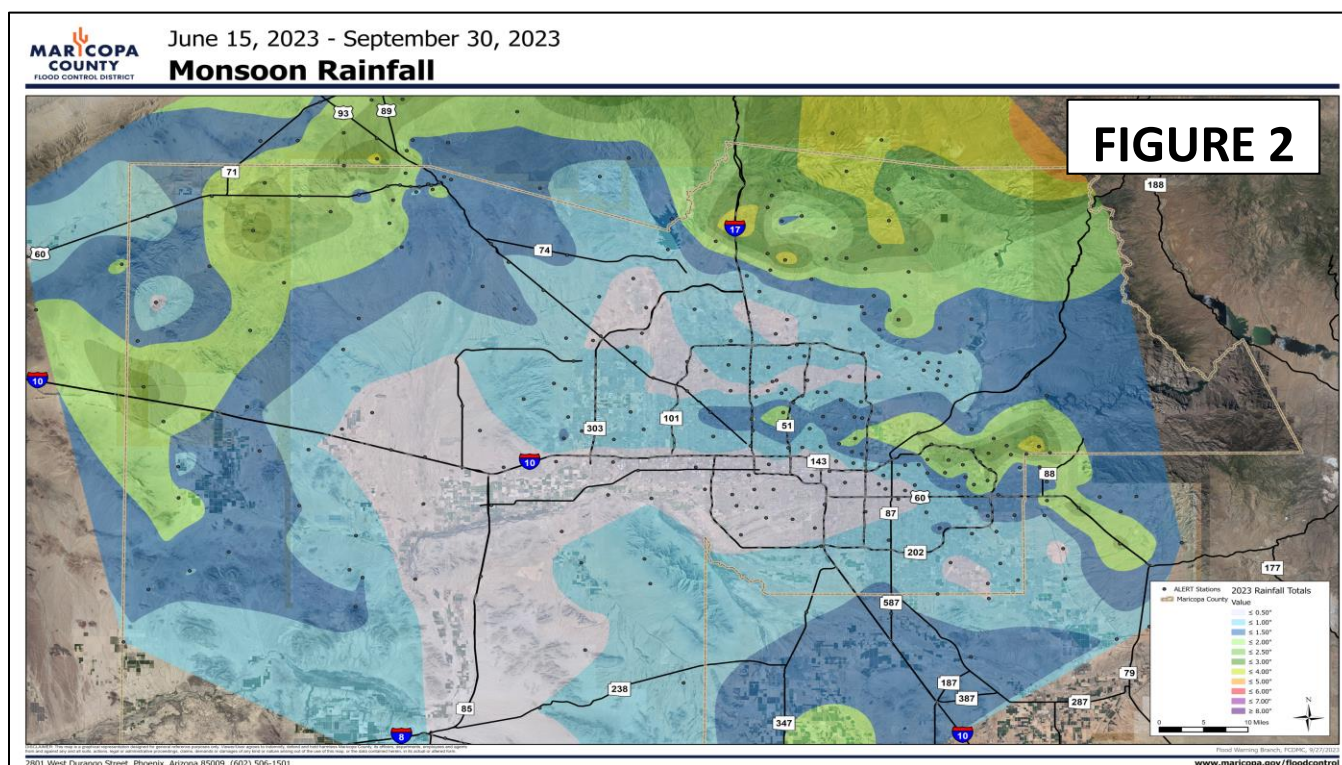
Additional Products:

At the request of clients, site specific products may be issued to support unusual or special operations, such as specific wind forecasts to aid in the fighting of fires, 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](#)

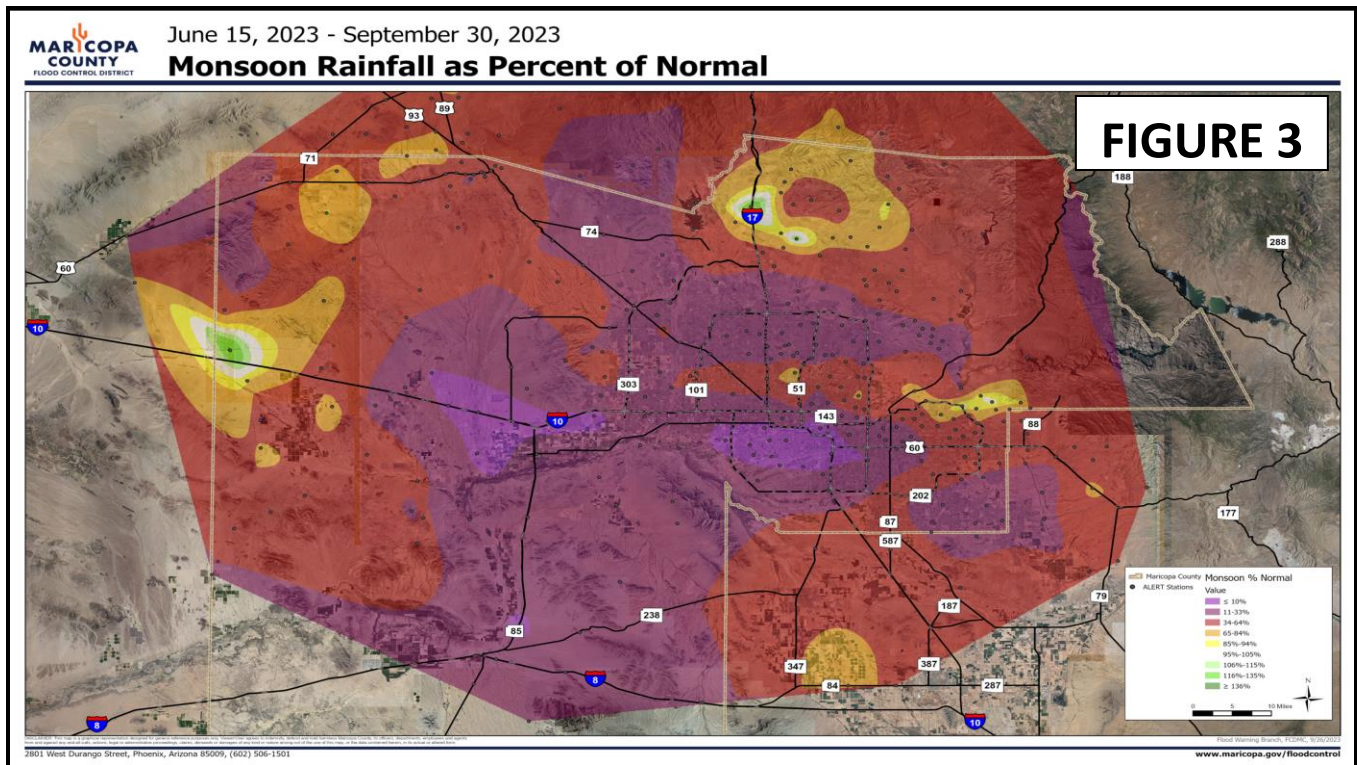
2023 MONSOON SEASON RECAP

According to the FCDMC ALERT rain gage network, the 2023 monsoon season was characterized as being much drier than normal. When averaged across 297 of the oldest County rain gages, 1.27" of rain fell which was 42% of the mean value of 3.03" and ranked as second driest on record. An image showing a 43-year period of record can be viewed [here](#). It's worth noting that only five measurable rain days resulted in 0.15" of rainfall recorded at Phoenix Sky Harbor Airport (the official NWS station with precipitation records dating back to 1896) ranking the 2023 monsoon as the driest on record (typical rainfall is 2.43"). Click [here](#) to see a technical summary plot from Sky Harbor Airport covering the monsoon season courtesy of the University of Arizona CSAP/CLIMAS organization. Figure 2, below, offers a more comprehensive picture of the rainfall distribution across the MSP forecast area. This figure was generated using FCDMC ALERT rain gage data from around the County. The shaded contours depict precipitation totals from June 15th – September 30th. The largest rainfall totals fell across the higher terrain of northern and eastern portions of Maricopa County.



Totals quickly trended downward entering the foothills and populated valley portions of the Phoenix metropolitan area, as well as going southwest towards the Gila Bend area. Figure 3, below, shows the ratio of 2023 monsoon precipitation versus normal monsoon precipitation. Similar to Figure 2, contours were generated using FCDMC ALERT rain gage data from around the County. Only very isolated portions of north-central and west-central Maricopa County benefited from above normal rainfall (green shading). A majority of the County was characterized being abnormally dry achieving 50% or less of normal monsoon precipitation (red/purple shading). As noted above, most of the greater Phoenix urban corridor was particularly dry registering much below normal having 30% or less of normal summer rainfall. Data shown by Figures 2 and 3 serve as a strong reminder to the

importance of having a widely distributed rain gage network to fully capture the distribution of monsoon convective rains.



June Recap/Notable Events:

- After abnormally wet and cool winter/spring seasons, any early onset of monsoon moisture was not anticipated. This outlook verified as Arizona continued to be caught under prevailing dry southwesterly flow from the East Pacific to start the climatological start of the summer season. Overall, the month was characterized as dry and unseasonably cool to start later becoming seasonably hot, but still dry, to finish.
- According to the NWS Phoenix WFO, Sky Harbor Airport registered an average temperature for June of 89.5°F (2 degrees below normal). The dry air mass in general with a cool start and rapid warmup entering July led to an impressive 43 degree spread between the month's observed peak and low temperatures (112°F and 69°F, respectively). No rain was observed either at the airport or by the ALERT network's 362 gages.

July Recap/Notable Events:

- A suppressed monsoon ridge during June over Mexico and southern Great Plains finally advanced north and west towards Arizona; however, it was the historic and dangerous heatwave that took center stage. The following heat records were registered in July:
 - Hottest monthly mean on record for any major U.S. city (102.7°F).
 - 31-day streak of 110s or greater ending July 30th (started June 30th).
 - All-time record warm low of 97°F (July 19th).

- Based on the legacy 3-day 55°F dewpoint average methodology, the onset of the 2023 monsoon for Phoenix began July 11-13th. Moisture combined with the relentless heatwave to exacerbate heat-related health concerns. Monsoon statistics for Phoenix Sky Harbor can be found [here](#).
- Despite increasing monsoon moisture mid-month, it would take another two weeks before moisture, instability, and a favorable Four Corners High pattern setup led to the season's first bout of severe thunderstorms impacting the County on the evening of July 26th. A large cluster of organized severe storms developed first across the Southeast Valley, instigated by a strong outflow boundary originating from storm activity near the Tucson area earlier in the afternoon. New storms intensified while spreading west and north along the prevailing outflow boundary. These storms dropped anywhere from 0.75"-1.00" of rain across portions of the East and Central Valley. Damaging wind gusts in excess of 60mph were noted by local storm reports, as well as a wall of blowing dust along the rapidly northward expanding outflow boundary before any rain arrived.

August Recap/Notable Events:

- An isolated strong thunderstorm developed near the northern end of McDowell Mountain Regional Park (North Scottsdale) during the late afternoon on August 16th. This compact storm had intense rainfall rates that resulted in 1.85" within two hours at a single ALERT rain gage site. The storm was enough to prompt the issuance of a Message 3 and a NWS Flash Flood Warning.
- Although south-central AZ was spared a direct hit by tropical system Hilary, remnant moisture entering the region still allowed for isolated strong thunderstorms to primarily impact southwestern AZ, including western portions of the County, during the early evening hours on the 18th and again over the morning period the 19th. Radar estimated rainfall over the two days near Gila Bend was between 0.50-1.50".
- Late August became very active with the approach of an upper-level low pressure trough. Dynamics and monsoon moisture combined to instigate the development of a large mesoscale convective system over south-central AZ by late afternoon the 31st. The expansive complex of strong to severe thunderstorms pushed north and west from Pinal County into Maricopa County, including the Phoenix metropolitan area, during the evening hours. North-central portions of Maricopa County were hardest hit with heavy rainfall exceeding three inches near the community of New River. Brief runoff was noted along New River.
- Active weather periods still only brought 0.12" of rainfall at Phoenix Sky Harbor (0.81" below August normal).
- Overall, heat continued to be a health issue concern across the County as the monthly average temperature for Phoenix was 98.8°F (4.4 degrees above normal). A maximum daytime high of 117°F was observed on August 28th.

September Recap/Notable Events:

- Although not as robust in intensity and coverage as what was observed on August 31st, an ideal and sluggish Type IV monsoon moisture/low pressure trough setup that began in late August continued through September 2nd to provide enough moisture and instability for bouts of strong to severe afternoon thunderstorms focused west and southwest of the Phoenix area. The Upper Centennial and Wickenburg areas were hit the hardest with 2-day radar estimated totals ranging between 2.00-3.50". An observed value of 1.50" was detected at an ALERT network site on the evening of the 2nd.
- The last active monsoon period of the season occurred between September 12th-13th. A "hybrid" event evolved over the Desert Southwest where remnant subtropical moisture over the East Pacific from weakening tropical system Jova became entrained by unsettled westerly flow aloft over the local region. Ample wind shear and moisture combined to yield supercell thunderstorms at times. This led to a significant thunderstorm outbreak that began late afternoon the 12th and extending shortly after sunrise the 13th. Training strong to severe cells moving west-to-east became problematic over much of the Phoenix metropolitan area, but were particularly impactful over the higher terrain of north-central and eastern portions of the County. Preliminary NWS damage survey estimate winds with the strongest storms over the East Valley approaching 90mph, where power poles were snapped and numerous trees were either downed or had limbs broken. Frequent cloud-to-ground lightning, severe straight-line winds, powerful downbursts, microburst activity, large hail exceeding one inch, and torrential rainfall rates were all observed over portions of the County during the 12-18 hour unsettled period. Much of the County ALERT network received measurable rainfall; however, brief flash and urban street flooding was mostly restricted to the North Scottsdale, East Valley, Superstition, and Lower Salt River Lake Recreational areas during this event. A NWS storm report summary on the significant weather during this event may be viewed [here](#).
- Despite additional opportunities for thunderstorms in September, Phoenix Sky Harbor only added 0.03" of rainfall, making it the driest monsoon on record at the airport.
- Unusually warm summer temperatures resurged for mid-September, but overall was not as extreme compared to July and August. The monthly average temperature for Phoenix was 91.2°F (2.0 degrees above normal). A maximum daytime high of 114°F was observed September 9th.
- The summer season was unprecedentedly hot both in temperatures experienced and duration of dangerous heatwaves. The following were additional Phoenix heat records/statistics from those already discussed in the July recap section:
 - 21 daily high temperature records tied or broken.
 - 25 daily warm-low temperature records tied or broken.
 - Total of 54 days at or above 110°F.
 - Total of 17 days at or above 115°F.
 - Total of 33 days at or above 90°F for overnight lows.
 - Mean daily average summer temperature of 97°F.

MSP Issued Products Recap:

A total of 66 forecast zone-specific messages were issued by the MSP spread across thirty-five different days during the length of the monsoon season. Table 1, below, shows the monthly break down by forecast zone of messages issued including season totals. Of the 66 Messages issued, 57 Message-1 Alerts, 7 were Message-2 Flash Flood Watches, 2 were Message-3 Flash Flood Warnings, and 0 Message-4 Cancel. The Alert Operation Center (AOC) was not activated during this monsoon season as none of the rain events ended up posing any serious threat to County/city dams or District flood control facilities.

TABLE 1: MSP Messages Issued - 2023 Monsoon Season					
Forecast Zone	June	July	August	September	Total
Gila Bend	0	1	4	0	5
Gila River	0	0	1	1	2
Palo Verde	0	0	3	1	4
Rainbow Valley	0	0	3	1	4
West Valley	0	0	2	1	3
Northwest Valley	0	0	1	1	2
Upper Centennial	0	0	3	2	5
Wickenburg	0	0	2	3	5
New River/Cave Creek	0	0	3	3	6
Phoenix North	0	1	1	1	3
Phoenix South	0	1	2	1	4
Scottsdale North	0	1	3	1	5
Scottsdale South	0	1	1	2	4
East Valley	0	1	3	2	6
Southeast Valley	0	1	2	0	3
Lower Salt River Lakes	0	0	0	1	1
Superstition	0	1	1	2	4
All Zones	0	8	35	23	66

Table 2, below, shows the monthly break down by forecast zone of Lake Alerts issued including season totals. There were 42 Lake Alert statements were issued for the County Lakes Program including Lake Pleasant, Horseshoe Lake, Bartlett Lake, Saguaro Lake, Canyon Lake, Apache Lake.

TABLE 2: MSP Lake Alerts Issued - 2023 Monsoon Season					
Recreational Zone	June	July	August	September	Total
Lake Pleasant	0	0	2	1	3
Horseshoe Lake	0	0	3	2	5
Bartlett Lake	0	1	5	2	8
Saguaro Lake	0	1	7	0	8
Canyon Lake	0	1	8	0	9
Apache Lake	0	1	8	0	9
All Zones	0	4	33	5	42

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 2023 monsoon season. This chapter is broken down into five sections: Outlooks, Messages, Lake Alerts, and Storm Total Precipitation. Each section discusses the verification metrics used and the criteria followed to compute the statistics displayed in the summary chapter sections. A list of frequently used terms including definitions and acronyms as used throughout this report is listed below.

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

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

Hit: considered a correct forecast.

Miss: considered an incorrect forecast.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

OUTLOOKS:

Forecast Accuracy:

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

Probability of Detection:

A dash was assigned to all days when observed rainfall was below the OSE threshold. On days when observed rainfall met or exceeded the OSE threshold either a hit or a miss was assigned. A hit was selected when the observed rainfall reasonably met the QPF. A miss was assigned when observed rainfall greatly exceeded the QPF or if no QPF was issued. Values were then populated for each

forecast zone and all zones combined. A probability of detection was calculated by month and season total.

False Alarm Rate:

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

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

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

STORM TOTAL PRECIPITATION:

Forecast Accuracy:

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

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

OUTLOOK VERIFICATION

Table 3, below, shows the Outlook verification seasonal totals for each Forecast Zone (FZ). Complete data tables for each FZ, separated by month, can be viewed in [Appendix A: Table A-1](#). Overall, Outlook forecast accuracy during the length of the monsoon season for all FZs combined was 83.6%. Forecast accuracy remained at or above the 75% threshold for all seventeen FZs. Furthermore, fourteen FZs accuracy was above 80% with Scottsdale North coming in the highest at 88.9%.

TABLE 3: MSP Weather Outlook Verification - SEASON TOTALS, 2023							
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)	TS (%)
Gila Bend	90/108	83.3%	10/14	71.4%	4/108	3.7%	65.1%
Gila River	89/108	82.4%	3/7	42.9%	0/108	0%	67.8%
Palo Verde	95/108	87.9%	3/6	50.0%	0/108	0%	78.0%
Rainbow Valley	92/108	85.2%	3/9	33.3%	1/108	0.9%	71.7%
West Valley	94/108	87.0%	3/7	42.9%	0/108	0%	76.3%
Northwest Valley	90/108	83.3%	3/4	75.0%	1/108	0.9%	68.3%
Upper Centennial	92/108	85.2%	9/11	81.8%	3/108	2.8%	69.4%
Wickenburg	85/108	78.7%	6/8	75.0%	5/108	4.6%	56.3%
New River/Cave Creek	85/108	78.7%	7/13	53.9%	2/108	1.9%	59.0%
Phoenix North	84/108	77.8%	3/6	50.0%	0/108	0%	59.3%
Phoenix South	87/108	80.6%	3/6	50.0%	0/108	0%	64.4%
Scottsdale North	95/108	88.9%	6/11	54.6%	0/108	0%	78.0%
Scottsdale South	94/108	87.0%	3/5	60.0%	0/108	0%	76.3%
East Valley	95/108	87.9%	4/7	57.1%	0/108	0%	78.0%
Southeast Valley	91/108	84.3%	4/7	57.1%	1/108	0.9%	70.0%
Lower Salt River Lakes	89/108	82.4%	5/8	62.5%	2/108	1.9%	65.6%
Superstition	88/108	81.5%	7/11	63.6%	1/108	0.9%	83.6%
All Zones	1535/1836	83.6%	82/139	59.0%	20/1836	1.1%	68.6%

The second metric computed was Probability of Detection (POD). 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 59.0%. In general, a POD of over 50% is considered sufficient and over 75% excellent in the forecast community. Three out of the seventeen FZs were at or above the 75% accuracy threshold with the remaining FZs ranging between 33.3% and 71.4%. Being the 2nd driest monsoon on record for the ALERT rain gage network, there were an unusually low number of operationally significant rain opportunities compared to recent wetter monsoons regimes, such as what was observed in summer 2021 and 2022. A very limited sample size likely assisted with more variable FZ POD percentages than what otherwise might be expected from a statistical analysis standpoint.

The third 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 exceptional at 1.1% with all FZs under 5% and eight FZs having a 0.0% FAR.

The final metric included in Table 3 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 nineteen dry days were removed from 108-day total length of the season. Overall, forecast skill was good at 68.6% averaged for all FZs over the length of the active season. Six of the seventeen FZs met or exceeded the 75% accuracy threshold, while the remaining eleven FZs had a TS ranging from 56.3% to 71.7%.

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, below, 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 66 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 very good at 83.3%. Thirteen out of seventeen FZs met or exceeded the 75% accuracy threshold with seven achieving 100%. The lowest accuracy was observed at both the Northwest Valley and Gila River FZs at 50%, but there were only two messages issued on the season for either FZ.

Overall, the area experienced a very dry monsoon with limited rainfall opportunities. As a result, the total number of qualifying messages issued on the season (66) was significantly lower than the seasonal average of one hundred thirty-two (based on MSP Verification Reports since 2012). With the late onset, no messages were issued during the month of June. July was a quiet month overall for thunderstorm activity with only eight total messages being issued for eight different FZs over two operationally significant days (July 26th and 30th). Forecast message accuracy was 100%.

August was the most operationally active month of monsoon 2023 with thirty-five messages issued spread out across nine operationally significant days. A forecast accuracy of 82.9% for the month across all FZs combined was still good being above the 75% threshold. Message issuances were concentrated (30 of 35) over five separate days (August 16th-19th, August 31st).

September saw a continuation of a general lull in typical monsoon thunderstorm activity. There were a total of 23 messages issued during four operationally significant days (September 1st-2nd, September 12th-13th). A combined FZ message accuracy of 78.3% exceeded the 75% threshold. The September 12th-13th period was the busiest stretch of the month with sixteen messages issued (12 of 16 verified).

Lead time was the final metric included for message statement verification this year. The average lead time (data in [Appendix B](#), Table B-3) for all M-1 Alerts combined over the length of the monsoon season was just over forty minutes. The average lead time for M-2 Flash Flood Watches was just over twelve hours.

TABLE 4: MSP Issued Statements Verification, broken down by month and Forecast Zone - Monsoon Season 2023

	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	1/1	100%	3/4	75.0%	0/0	n/a	4/5	80.0%
Gila River	0/0	n/a	0/0	n/a	1/1	100%	0/1	0%	1/2	50.0%
Palo Verde	0/0	n/a	0/0	n/a	3/3	100%	1/1	100%	4/4	100%
Rainbow Valley	0/0	n/a	0/0	n/a	2/3	66.7%	1/1	100%	3/4	75.0%
West Valley	0/0	n/a	0/0	n/a	1/2	50.0%	1/1	100%	2/3	66.7%
Northwest Valley	0/0	n/a	0/0	n/a	0/1	0%	1/1	100%	1/2	50.0%
Upper Centennial	0/0	n/a	0/0	n/a	2/3	66.7%	2/2	100%	4/5	80.0%
Wickenburg	0/0	n/a	0/0	n/a	1/2	50.0%	2/3	66.7%	3/5	60.0%
New River/Cave Creek	0/0	n/a	0/0	n/a	3/3	100%	2/3	66.7%	5/6	83.3%
Phoenix North	0/0	n/a	1/1	100%	1/1	100%	1/1	100%	3/3	100%
Phoenix South	0/0	n/a	1/1	100%	2/2	100%	1/1	100%	4/4	100%
Scottsdale North	0/0	n/a	1/1	100%	3/3	100%	1/1	100%	5/5	100%
Scottsdale South	0/0	n/a	1/1	100%	1/1	100%	1/2	50%	3/4	75%
East Valley	0/0	n/a	1/1	100%	3/3	100%	1/2	50%	5/6	83.3%
Southeast Valley	0/0	n/a	1/1	100%	2/2	100%	0/0	n/a	3/3	100%
Lower Salt River Lakes	0/0	n/a	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%
Superstition	0/0	n/a	1/1	100%	1/1	100%	2/2	100%	4/4	100%
All Zones	0/0	n/a	8/8	100%	29/35	82.9%	18/23	78.3%	55/66	83.3%

LAKE ALERT VERIFICATION

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

Table 5, below, shows the issued Lake Alert verification broken down by recreational zone and month. Complete data tables for each recreational zone can be viewed in [Appendix C](#): Table C-1. There were forty-two Lake Alerts issued over the length of the season with the majority of them occurring in August with thirty-three. Forecast accuracy for the recreational zones combined, over the length of the season, was 52.4%. The Lake Pleasant and Canyon Lake zones met or exceeded the 75% accuracy threshold with the other four zones ranging between 20% and 66.7%. 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 thirty-two minutes.

TABLE 5: MSP Lake Alerts Issued - 2023 Monsoon Season										
Recreational Zone	June		July		August		September		Season Totals	
	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)	Correct Alerts	AOF (%)
Lake Pleasant	0/0	n/a	0/0	n/a	2/2	100%	1/1	100%	3/3	100%
Horseshoe Lake	0/0	n/a	0/0	n/a	0/3	0%	1/2	0%	1/5	20%
Bartlett Lake	0/0	n/a	0/1	0%	2/5	40.0%	1/2	50%	3/8	37.5%
Saguaro Lake	0/0	n/a	0/1	0%	3/7	42.9%	0/0	n/a	3/8	37.5%
Canyon Lake	0/0	n/a	1/1	100%	6/8	75%	0/0	n/a	7/9	77.8%
Apache Lake	0/0	n/a	1/1	100%	4/8	50%	0/0	n/a	5/9	66.7%
All Zones	0/0	n/a	2/4	50%	14/33	42.4%	3/5	60%	22/42	52.4%

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

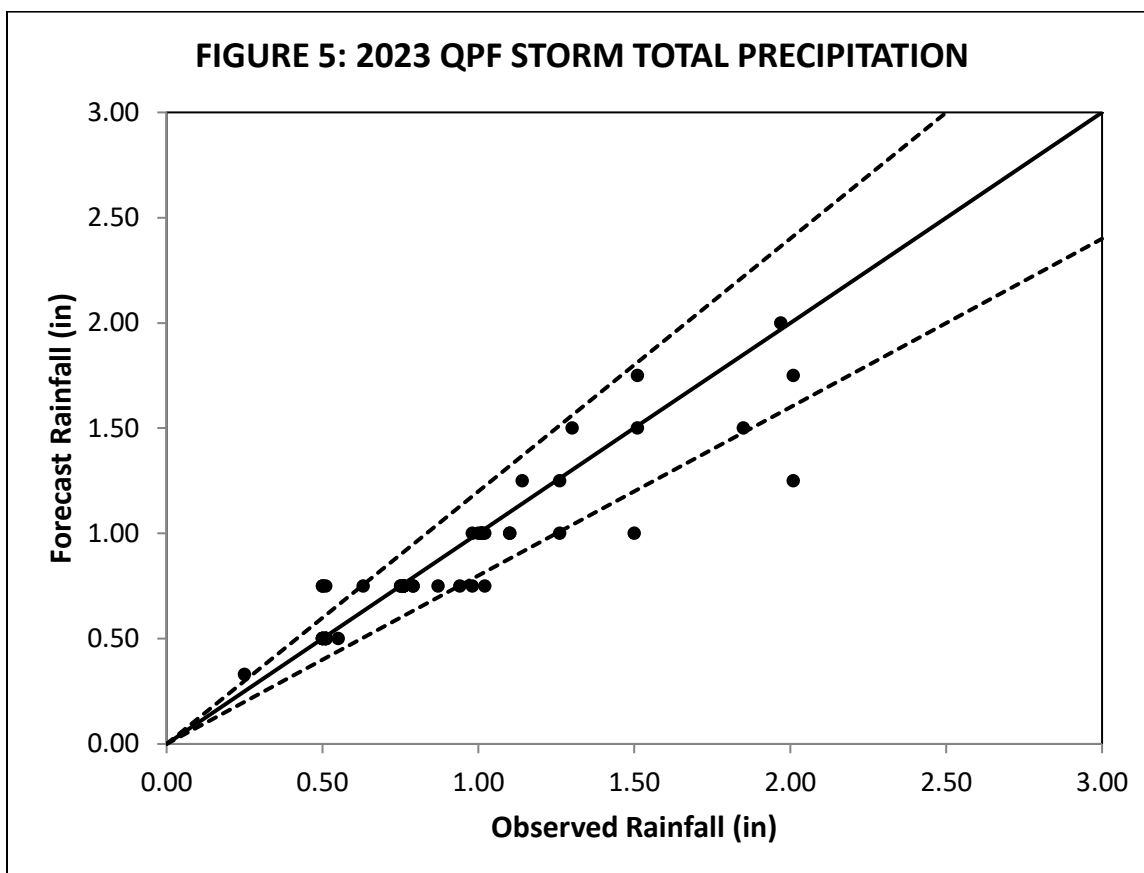


Table 7, on the next page, shows the issued message verification broken down by FZ and month. Complete data tables for each FZ can be viewed in [Appendix E](#): Table E-1. Forecast accuracy for all FZs combined, over the length of the season, was 86.0%. Figure 5 above clearly shows that the majority of missed events over the course of the monsoon tended to be under-forecast (forecast rainfall value less than observed rainfall value) by the MSP. The month of June was dry with no qualifying events to assess. Accuracy in July came in at 87.5% across eight qualifying events spread over two storm days. A

majority of FZs did not have a qualifying event (9 of 17) during July. Accuracy in August dropped slightly to 80.8% across twenty-six events spread across nine storm days. Forecast accuracy was 100% at fifteen of the seventeen FZs with qualifying events. New River/Cave Creek, Palo Verde, and Southeast Valley had the lowest accuracy for the month ranging 0%-50%; however, these FZs only had two qualifying events for the month. Accuracy in September saw an increase to 91.3% with 21 of 23 qualifying events verifying. Similar to the July and August, qualifying events in any given FZ was limited ranging between none to a maximum of three events.

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

TABLE 7: QPF Storm Total Precipitation Verification - Monsoon Season 2023

	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%	2/3	66.7%	0/0	n/a	3/4	75.0%
Gila River	0/0	n/a	0/0	n/a	1/1	100%	0/1	0%	1/2	50.0%
Palo Verde	0/0	n/a	0/0	n/a	1/2	50.0%	1/1	100%	2/3	66.7%
Rainbow Valley	0/0	n/a	0/0	n/a	2/2	100%	1/1	100%	3/3	100%
West Valley	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%	2/2	100%
NW Valley	0/0	n/a	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%
Upper Centennial	0/0	n/a	0/0	n/a	2/2	100%	1/2	50.0%	3/4	75.0%
Wickenburg	0/0	n/a	0/0	n/a	1/1	100%	3/3	100%	4/4	100%
New River/Cave Creek	0/0	n/a	0/0	n/a	1/2	50.0%	3/3	100%	4/5	80.0%
Phoenix North	0/0	n/a	0/1	0%	1/1	100%	1/1	100%	2/3	66.7%
Phoenix South	0/0	n/a	1/1	100%	2/2	100%	1/1	100%	4/4	100%
Scottsdale North	0/0	n/a	1/1	100%	2/2	100%	1/1	100%	4/4	100%
Scottsdale South	0/0	n/a	1/1	100%	1/1	100%	2/2	100%	4/4	100%
East Valley	0/0	n/a	1/1	100%	3/3	100%	2/2	100%	6/6	100%
Southeast Valley	0/0	n/a	1/1	100%	0/2	0%	0/0	n/a	1/3	33.3%
Lower Salt River Lakes	0/0	n/a	0/0	n/a	0/0	n/a	1/1	100%	1/1	100%
Superstition	0/0	n/a	1/1	100%	1/1	100%	2/2	100%	4/4	100%
All Zones	0/0	n/a	7/8	87.5%	21/26	80.8%	21/23	91.3%	49/57	86.0%

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 2023 monsoon season. Outlooks, Messages, Lake Alerts, and QPF Storm Total Precipitation were the four products analyzed in this report.

Verification of daily outlooks was conducted using four metrics: Forecast Accuracy (FA), Probability of Detection (POD), False Alarm Rate (FAR), and Threat Score (TS). When comparing all forecast zones combined over the length of the monsoon season, FA was 83.6%, POD was 59.0%, the FAR was 1.1%, and the TS was 68.6%. Forecast Accuracy and False Alarm Rate rate fell into the “excellent” category, while Probability of Detection and Threat Score were still considered “satisfactory” when equating these results with accepted values within the forecast community.

Verification of messages was conducted using the Forecast Accuracy metric. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 83.3%. Any value of over 75% is considered “excellent” within the forecast community. Forecast skill stayed consistently above the 75% threshold each month for July (100%), August (82.9%), and September (78.3%). The 2023 monsoon had an unusual combined low number of seasonal messages issued (66). No messages were warranted for the dry month of June. The average lead time for all M-1 Alerts over the length of the monsoon season was over forty minutes, above average when compared to previous years and an improvement from around 26 minutes in the season prior. The average lead time for M-2 Flash Flood Watches was just over twelve hours.

Verification of Lake Alerts was conducted using Forecast Accuracy. When comparing all forecast zones combined the accuracy was 52.4% is considered “sufficient” in the forecast community. The average lead time for all lakes/reservoirs combined over the length of the season was around thirty-two minutes, which is an improvement from around twelve minutes last summer.

Verification of QPF storm total precipitation was conducted using Forecast Accuracy. 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 86%. Similar to last season, forecast bias was to underpredict storm total rainfall amounts.

TABLE 8: Historic Monsoon Season Verification Comparison										
	Outlooks				Messages		Lake Alerts		QPF STP	
Year	AOF	POD	FAR	TS	Events	AOF	Events	AOF	Events	AOF
2012	79.1%	79.6%	8.9%	n/a	102	86.3%	n/a	n/a	n/a	n/a
2013	79.8%	78.7%	6.2%	n/a	137	88.0%	56	89.3%	54	72.2%
2014	77.7%	76.9%	7.1%	67.4%	263	80.2%	57	84.2%	76	72.4%
2015	74.8%	60.3%	2.8%	67.9%	118	75.4%	40	95%	56	82.1%
2016	84.9%	78%	2.6%	77.5%	112	90.2%	46	82.6%	53	88.7%
2017	83.1%	77.9%	1.8%	72.4%	111	86.5%	53	90.6%	67	93.1%
2018	86.1%	82.2%	1.6%	75.6%	129	89.9%	41	82.9%	110	84.5%
2019	90.1%	72.9%	0.7%	80.9%	78	92.3%	18	83.3%	46	80.4%
2020	92.4%	67.1%	0.4%	84.2%	54	92.6%	17	82.4%	36	97.2%
2021	83.0%	85.5%	3.5%	72.5%	219	92.7%	32	87.5%	122	82.8%
2022	79.3%	78.7%	3.5%	71.8%	206	96.6%	47	87.2%	169	92.9%
2023	83.6%	59.0%	1.1%	68.6%	66	83.3%	42	52.4%	57	86.0%
AVG	82.8%	74.7%	3.4%	73.9%	132.9	87.8%	40.8	83.4%	76.9	84.8%

Table 8, above, was included to add more historical perspective in the verification process. Verification metrics for Outlooks, Messages, Lake Alerts, and QPF STP were included for all previous years. For the 2023 monsoon season, Forecast Accuracy and False Alarm Rate was among the top 5 for the MSP since 2012; however, Probability of Detection and Threat Score metrics were historically among the bottom 5. This monsoon was a historically dry (2nd driest on record for the ALERT rain gage network) and opportunities for operationally significant events, storm days, and products issued were much lower than usual.

Forecast skill for issued messages has continued to exceed the 75% threshold since record keeping began in the 2012 season. Regarding issued messages, this was the second least active season only being slightly higher than 2020. Forecast accuracy for Lake Alerts did worsen compared to the historical record. Discussion on improvements of techniques for observing and documenting lightning, heavy rainfall, and wind measurement may assist with the post-event verification process. STP skill came well above the long-term average and exceeded the target 75% threshold, despite a dramatic two-thirds drop in the number of qualifying events compared to 2022.

When all was said and done, the 2023 monsoon season was considered well below normal in terms of active days and rainfall. The season also recorded the third least number of products issued (messages and Lake Alerts combined) by the MSP. It is hoped that this report will serve 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 2023 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 measurable 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 2023														
	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
	Gila Bend							Gila River						
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	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 2023

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
06/27/23	0	0.00	0.00	0.00	h	-	-	06/27/23	0	0.00	0.00	0.00	h	-	-
06/28/23	0	0.00	0.00	0.00	h	-	-	06/28/23	0	0.00	0.00	0.00	h	-	-
06/29/23	0	0.00	0.00	0.00	h	-	-	06/29/23	0	0.00	0.00	0.00	h	-	-
06/30/23	0	0.00	0.00	0.00	h	-	-	06/30/23	0	0.00	0.00	0.00	h	-	-
16 days					16	0/0	0	16 days					16	0/0	0
07/01/23	0	0.00	0.00	0.00	h	-	-	07/01/23	0	0.00	0.00	0.00	h	-	-
07/02/23	0	0.00	0.00	0.00	h	-	-	07/02/23	0	0.00	0.00	0.00	h	-	-
07/03/23	0	0.00	0.00	0.00	h	-	-	07/03/23	0	0.00	0.00	0.00	h	-	-
07/04/23	0	0.00	0.00	0.00	h	-	-	07/04/23	0	0.00	0.00	0.00	h	-	-
07/05/23	0	0.00	0.00	0.00	h	-	-	07/05/23	0	0.00	0.00	0.00	h	-	-
07/06/23	0	0.00	0.00	0.00	h	-	-	07/06/23	0	0.00	0.00	0.00	h	-	-
07/07/23	0	0.00	0.00	0.00	h	-	-	07/07/23	0	0.00	0.00	0.00	h	-	-
07/08/23	0	0.00	0.00	0.00	h	-	-	07/08/23	0	0.00	0.00	0.00	h	-	-
07/09/23	0	0.00	0.00	0.00	h	-	-	07/09/23	0	0.00	0.00	0.00	h	-	-
07/10/23	0	0.00	0.00	0.00	h	-	-	07/10/23	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	07/11/23	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	07/12/23	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	07/13/23	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	07/14/23	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	07/15/23	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	07/16/23	0	0.00	0.00	0.00	h	-	-
07/17/23	10	0.50	0.00	0.05-0.10	m	-	-	07/17/23	10	0.00-trace	0.00	0.26-0.50	m	-	-
07/18/23	0	0.00	0.00	0.51-0.75	m	m	-	07/18/23	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	07/19/23	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	07/20/23	0	0.00	0.00	0.00	h	-	-
07/21/23	0	0.00	0.00	0.00	h	-	-	07/21/23	0	0.00	0.00	0.11-0.25	m	-	-
07/22/23	10	trace-0.25	0.00	0.11-0.25	h	-	-	07/22/23	10	trace-0.10	0.00	0.00	m	-	-
07/23/23	20	0.25	0.00	0.00	m	-	-	07/23/23	20	0.25	0.00	0.00	m	-	-
07/24/23	30	0.50	0.00	1.51-2.00	h	h	-	07/24/23	20	0.25	0.00	0.51-0.75	h	m	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
07/25/23	20	0.50	0.00	0.11-0.25	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
07/26/23	20	trace-0.50	0.31	0.00	m	-	-	10	trace-0.25	0.00	0.11-0.25	h	-	-
07/27/23	10	trace-0.25	0.00	0.00	m	-	-	10	trace-0.25	0.00	0.00	m	-	-
07/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
07/29/23	30	trace-0.50	0.00	0.11-0.25	h	-	-	20	trace-0.25	0.00	0.00	m	-	-
07/30/23	50	0.50-1.00	0.12	1.01-1.25	h	h	-	30	0.25-0.50	0.00	0.51-0.75	h	h	-
07/31/23	30	0.50-1.00	0.00	0.11-0.25	m	-	x	40	0.25-0.75	0.00	0.51-0.75	h	h	-
31 days					24	2/3	1					23	2/3	0
08/01/23	20	trace-0.25	0.00	0.26-0.50	h	-	-	10	trace-0.25	0.00	0.05-0.10	h	-	-
08/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.76-1.00	m	m	-
08/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/23	10	trace-0.10	0.00	0.05-0.10	h	-	-	10	trace-0.10	0.00	0.00	m	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/11/23	0	0.00	0.00	0.76-1.00	m	m	-	10	0.10-0.25	0.00	0.76-1.00	h	m	-
08/12/23	40	1.00	0.00	0.00	m	-	x	20	trace-0.35	0.00	0.00	m	-	-
08/13/23	30	0.50-1.00	0.00	1.51-2.00	h	h	-	<10	0.00	0.00	0.00	h	-	-
08/14/23	10	trace-0.10	0.00	0.00	m	-	-	20	trace-0.25	0.00	0.00	m	-	-
08/15/23	20	trace-0.50	0.08	0.76-1.00	h	h	-	20	trace-0.25	0.00	0.51-0.75	h	m	-
08/16/23	30	0.50-1.00	0.00	1.26-1.50	h	h	-	20	0.25-0.50	0.04	0.26-0.50	h	-	-
08/17/23	40	0.25-0.75	0.16	0.76-1.00	h	h	-	20	trace-0.35	0.00	0.26-0.50	h	-	-
08/18/23	70	1.25	0.20	1.26-1.50	h	h	-	30	0.25	0.00	0.11-0.25	h	-	-
08/19/23	50	1.00	0.00	0.05-0.10	m	-	x	20	trace-0.10	0.00	0.00	m	-	-
08/20/23	40	0.50-1.00	0.00	0.05-0.10	m	-	x	30	0.25-0.50	0.00	0.11-0.25	h	-	-
08/21/23	20	trace-0.25	0.04	0.11-0.25	h	-	-	30	0.25-0.75	0.08	0.26-0.50	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
08/22/23	30	trace-0.50	0.00	0.00	m	-	-	20	trace-0.25	0.00	0.00	m	-	-
08/23/23	30	trace-0.50	0.00	0.51-0.75	h	h	-	20	trace-0.15	0.00	0.00	m	-	-
08/24/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.26-0.50	m	-	-	0	0.00	0.00	0.00	h	-	-
08/26/23	10	trace-0.25	0.00	0.51-0.75	h	m	-	<10	0.00	0.00	0.05-0.10	m	-	-
08/27/23	10	trace-0.25	0.00	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
08/28/23	10	trace-0.25	0.00	0.11-0.25	h	-	-	10	trace-0.10	0.00	0.00	m	-	-
08/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/23	10	trace-0.25	0.00	1.51-2.00	h	m	-	10	trace-0.10	0.00	0.00	m	-	-
08/31/23	40	0.50-1.25	0.12	0.76-1.00	h	h	-	30	trace-0.50	0.91	1.51-2.00	h	h	-
31 days					22	7/10	3					21	1/4	0
09/01/23	40	0.25-0.75	0.12	0.51-0.75	h	h	-	30	trace-0.50	0.00	0.05-0.10	h	-	-
09/02/23	10	trace-0.25	0.04	0.26-0.50	h	-	-	0	0.00	0.00	0.11-0.25	m	-	-
09/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/23	10	trace-0.10	0.00	0.26-0.50	h	-	-	20	trace-0.10	0.00	0.05-0.10	h	-	-
09/12/23	30	0.25-0.75	0.00	0.00	m	-	-	30	0.25-0.75	0.00	0.26-0.50	h	-	-
09/13/23	10	trace-0.25	0.00	0.00	m	-	-	30	trace-0.50	0.00	0.26-0.50	h	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/23	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 2023

	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					28	1/1	0					29	0/0	0
	Palo Verde							Rainbow Valley						
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/23	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 2023														
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
06/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0/0	0					16	0/0	0
07/01/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.08	0.26-0.50	m	-	-
07/23/23	10	0.25	0.00	0.00	m	-	-	10	0.25	0.00	0.00	m	-	-
07/24/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.12	2.01-2.50	h	m	-
07/25/23	0	0.00	0.00	0.05-0.10	m	-	-	0	0.00	0.00	0.00	h	-	-
07/26/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
07/27/23	0	0.00	0.00	0.00	h	-	-	10	trace-0.25	0.00	0.00	m	-	-
07/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/23	20	trace-0.25	0.08	0.26-0.50	h	-	-	20	trace-0.25	0.20	0.51-0.75	h	m	-
07/30/23	30	0.25-0.75	0.00	0.11-0.25	h	-	-	30	0.25-0.75	0.04	1.01-1.25	h	h	-
07/31/23	30	0.25-0.75	0.00	0.00	m	-	-	30	0.25-0.75	0.00	0.26-0.50	h	-	-
31 days					26	0/0	0					27	1/3	0
08/01/23	10	trace-0.25	0.00	0.00	m	-	-	20	trace-0.25	0.08	0.51-0.75	h	m	-
08/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.26-0.50	m	-	-
08/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/09/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.11-0.25	h	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.76-1.00	m	m	-
08/12/23	<10	0.00	0.00	0.00	h	-	-	30	0.25-0.75	0.00	0.00	m	-	-
08/13/23	10	trace-0.10	0.00	0.51-0.75	h	m	-	<10	0.00	0.00	0.26-0.50	m	-	-
08/14/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
08/15/23	20	trace-0.25	0.00	0.05-0.10	h	-	-	20	trace-0.25	0.00	0.76-1.00	h	m	-
08/16/23	20	0.25-0.50	0.35	0.51-0.76	h	h	-	30	0.25-0.75	0.00	1.26-1.50	h	h	-
08/17/23	20	trace-0.25	0.31	0.76-1.00	h	m	-	30	trace-0.40	0.04	0.76-1.00	h	m	-
08/18/23	60	1.00	0.16	0.26-0.50	m	-	-	50	1.00	0.00	0.05-0.10	m	-	x
08/19/23	50	1.00	0.04	0.26-0.50	m	-	-	40	trace-0.50	0.00	0.05-0.10	h	-	-
08/20/23	30	0.25-0.50	0.08	0.11-0.25	h	-	-	30	0.25-0.50	0.00	0.11-0.25	h	-	-
08/21/23	20	trace-0.25	0.16	0.26-0.50	h	-	-	20	trace-0.25	0.20	0.26-0.50	h	-	-
08/22/23	<10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
08/23/23	30	trace-0.30	0.00	0.11-0.25	h	-	-	30	trace-0.25	0.00	0.26-0.50	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
08/24/23	0	0.00	0.00	0.00	h	-	-	08/24/23	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.00	h	-	-	08/25/23	0	0.00	0.00	0.00	h	-	-
08/26/23	<10	0.00	0.00	0.00	h	-	-	08/26/23	<10	0.00	0.00	0.11-0.25	m	-	-
08/27/23	0	0.00	0.00	0.00	h	-	-	08/27/23	0	0.00	0.00	0.11-0.25	m	-	-
08/28/23	0	0.00	0.00	0.00	h	-	-	08/28/23	0	0.00	0.00	0.26-0.50	m	-	-
08/29/23	0	0.00	0.00	0.00	h	-	-	08/29/23	0	0.00	0.00	0.00	h	-	-
08/30/23	0	0.00	0.00	0.00	h	-	-	08/30/23	0	0.00	0.00	0.00	h	-	-
08/31/23	20	trace-0.50	0.63	1.01-1.25	h	h	-	08/31/23	20	trace-0.50	0.83	1.51-2.00	h	h	-
31 days					25	2/4	0						21	2/6	1
09/01/23	50	0.75-1.25	0.75	1.26-1.50	h	h	-	09/01/23	20	trace-0.50	0.08	0.11-0.25	h	-	-
09/02/23	<10	0.00	0.04	0.76-1.00	m	m	-	09/02/23	<10	0.00	0.00	0.26-0.50	m	-	-
09/03/23	0	0.00	0.00	0.00	h	-	-	09/03/23	0	0.00	0.00	0.00	h	-	-
09/04/23	0	0.00	0.00	0.00	h	-	-	09/04/23	0	0.00	0.00	0.00	h	-	-
09/05/23	0	0.00	0.00	0.00	h	-	-	09/05/23	0	0.00	0.00	0.00	h	-	-
09/06/23	0	0.00	0.00	0.00	h	-	-	09/06/23	0	0.00	0.00	0.00	h	-	-
09/07/23	0	0.00	0.00	0.00	h	-	-	09/07/23	0	0.00	0.00	0.00	h	-	-
09/08/23	0	0.00	0.00	0.00	h	-	-	09/08/23	0	0.00	0.00	0.00	h	-	-
09/09/23	0	0.00	0.00	0.00	h	-	-	09/09/23	0	0.00	0.00	0.00	h	-	-
09/10/23	0	0.00	0.00	0.00	h	-	-	09/10/23	0	0.00	0.00	0.00	h	-	-
09/11/23	20	trace-0.10	0.00	0.05-0.10	h	-	-	09/11/23	10	trace-0.10	0.00	0.00	m	-	-
09/12/23	20	trace-0.50	0.00	0.00	m	-	-	09/12/23	20	trace-0.50	0.00	0.11-0.25	h	-	-
09/13/23	0	0.00	0.00	0.00	h	-	-	09/13/23	10	trace-0.25	0.00	0.11-0.25	h	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	09/14/23	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	09/15/23	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	09/16/23	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	09/17/23	0	0.00	0.00	0.00	h	-	-
09/18/23	0	0.00	0.00	0.00	h	-	-	09/18/23	0	0.00	0.00	0.00	h	-	-
09/19/23	0	0.00	0.00	0.00	h	-	-	09/19/23	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	09/20/23	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

	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
09/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					28	1/2	0					28	0/0	0
	West Valley							Northwest Valley						
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/23	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 2023

Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
16 days					16	0/0	0					16	0/0	0
07/01/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/23	0	0.00	0.00	0.11-0.25	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
07/23/23	10	0.25	0.00	0.00	m	-	-	20	0.25	0.00	0.00	m	-	-
07/24/23	10	trace-0.10	0.00	0.11-0.25	h	-	-	20	0.25	0.00	0.05-0.10	h	-	-
07/25/23	0	0.00	0.00	0.05-0.10	m	-	-	0	0.00	0.00	0.05-0.10	m	-	-
07/26/23	10	trace-0.10	0.39	0.26-0.50	h	-	-	20	trace-0.25	0.04	0.05-0.10	h	-	-
07/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/23	0	0.00	0.00	0.05-0.10	m	-	-	0	0.00	0.04	0.11-0.25	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
07/29/23	20	trace-0.25	0.08	0.76-1.00	h	m	-	07/29/23	30	0.25-0.50	0.16	0.51-0.75	h	h	-
07/30/23	30	0.25-0.50	0.08	0.26-0.50	h	-	-	07/30/23	30	0.25-0.50	0.20	0.25-0.50	h	-	-
07/31/23	30	0.25-0.50	0.00	0.00	m	-	-	07/31/23	30	0.50-1.00	0.00	0.00	m	-	x
31 days					26	0/1	0	31 days					26	1/1	1
08/01/23	10	trace-0.25	0.00	0.11-0.25	h	-	-	08/01/23	10	trace-0.25	0.00	0.00	m	-	-
08/02/23	0	0.00	0.00	0.00	h	-	-	08/02/23	0	0.00	0.04	0.26-0.50	m	-	-
08/03/23	0	0.00	0.00	0.00	h	-	-	08/03/23	0	0.00	0.00	0.00	h	-	-
08/04/23	0	0.00	0.00	0.00	h	-	-	08/04/23	0	0.00	0.00	0.00	h	-	-
08/05/23	0	0.00	0.00	0.00	h	-	-	08/05/23	0	0.00	0.00	0.00	h	-	-
08/06/23	0	0.00	0.00	0.00	h	-	-	08/06/23	0	0.00	0.00	0.00	h	-	-
08/07/23	10	trace-0.25	0.00	0.00	m	-	-	08/07/23	10	trace-0.25	0.00	0.00	m	-	-
08/08/23	0	0.00	0.00	0.00	h	-	-	08/08/23	0	0.00	0.00	0.00	h	-	-
08/09/23	10	trace-0.10	0.00	0.11-0.25	h	-	-	08/09/23	10	trace-0.10	0.00	0.05-0.10	h	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	08/10/23	0	0.00	0.00	0.00	h	-	-
08/11/23	0	0.00	0.00	0.26-0.50	m	-	-	08/11/23	0	0.00	0.00	0.05-0.10	m	-	-
08/12/23	10	trace-0.25	0.00	0.11-0.25	h	-	-	08/12/23	<10	0.00	0.04	0.11-0.25	m	-	-
08/13/23	10	trace-0.10	0.04	0.51-0.75	h	m	-	08/13/23	10	trace-0.10	0.04	0.51-0.75	h	m	-
08/14/23	10	trace-0.25	0.00	0.00	m	-	-	08/14/23	20	trace-0.25	0.00	0.00	m	-	-
08/15/23	20	trace-0.25	0.12	0.26-0.50	h	-	-	08/15/23	20	trace-0.50	0.31	0.26-0.50	h	-	-
08/16/23	20	0.25-0.50	0.12	0.26-0.50	h	-	-	08/16/23	20	0.25-0.50	0.00	0.11-0.25	h	-	-
08/17/23	20	trace-0.25	0.04	0.51-0.75	h	m	-	08/17/23	20	trace-0.50	0.20	0.26-0.50	h	-	-
08/18/23	50	0.50	0.00	0.11-0.25	m	-	-	08/18/23	60	0.50	0.00	0.05-0.10	m	-	-
08/19/23	20	trace-0.50	0.00	0.11-0.25	h	-	-	08/19/23	30	trace-0.50	0.00	0.05-0.10	h	-	-
08/20/23	30	0.25-0.50	0.04	0.11-0.25	h	-	-	08/20/23	40	0.25-0.50	0.00	0.11-0.25	h	-	-
08/21/23	30	trace-0.50	0.20	0.51-0.75	h	h	-	08/21/23	30	trace-0.50	0.16	0.26-0.50	h	-	-
08/22/23	10	trace-0.25	0.00	0.00	m	-	-	08/22/23	20	trace-0.25	0.00	0.00	m	-	-
08/23/23	30	trace-0.25	0.00	0.26-0.50	h	-	-	08/23/23	40	trace-0.50	0.00	0.00	m	-	-
08/24/23	0	0.00	0.00	0.00	h	-	-	08/24/23	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.00	h	-	-	08/25/23	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
08/26/23	<10	0.00	0.00	0.11-0.25	m	-	-	<10	0.00	0.00	0.05-0.10	m	-	-
08/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/23	0	0.00	0.04	1.01-1.25	m	m	-	10	trace-0.10	0.00	0.26-0.50	h	-	-
08/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/23	30	trace-0.50	0.59	0.76-1.00	h	h	-	40	0.50-1.00	0.94	1.01-1.25	h	h	-
31 days					24	2/5	0					21	1/2	0
09/01/23	30	0.25-0.75	0.04	0.11-0.25	h	-	-	30	0.25-0.75	0.08	0.11-0.25	h	-	-
09/02/23	<10	0.00	0.00	0.05-0.10	m	-	-	<10	0.00	0.04	0.11-0.25	m	-	-
09/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
09/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/23	20	trace-0.10	0.00	0.05-0.10	h	-	-	30	trace-0.25	0.00	0.05-0.10	h	-	-
09/12/23	20	trace-0.50	1.02	1.01-1.25	h	h	-	30	trace-0.50	0.31	0.51-0.75	h	h	-
09/13/23	20	trace-0.25	0.00	0.00	m	-	-	20	trace-0.50	0.00	0.00	m	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/23	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 2023

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
09/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					28	1/1	0					27	1/1	0
	Upper Centennial							Wickenburg						
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0/0	0					16	0/0	0
07/01/23	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 2023

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
07/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.11-0.25	m	-	-
07/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/23	10	trace-0.25	0.00	0.00	m	-	-	10	trace-0.25	0.00	0.00	m	-	-
07/23/23	20	0.25	0.00	0.00	m	-	-	20	0.25	0.00	0.00	m	-	-
07/24/23	20	0.25	0.28	1.26-1.50	h	m	-	20	0.25	0.00	0.11-0.25	h	-	-
07/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/23	20	trace-0.25	0.00	0.26-0.50	h	-	-	20	trace-0.25	0.67	0.76-1.00	h	m	-
07/27/23	0	0.00	0.20	0.76-1.00	m	m	-	0	0.00	0.28	0.51-0.75	m	m	-
07/28/23	0	0.00	0.00	0.05-0.01	m	-	-	0	0.00	0.00	0.00	h	-	-
07/29/23	30	0.25-0.50	0.00	0.26-0.50	h	-	-	30	0.25-0.50	0.04	0.05-0.10	m	-	-
07/30/23	30	0.50-1.00	0.00	0.05-0.10	m	-	x	40	0.50-1.00	0.00	0.11-0.25	m	-	x

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
07/31/23	40	0.50-1.00	0.00	0.11-0.25	m	-	x	07/31/23	40	0.50-1.00	0.00	0.00	m	-	x
31 days					25	0/2	2	31 days					24	0/2	2
08/01/23	10	trace-0.25	0.00	0.00	m	-	-	08/01/23	10	trace-0.25	0.00	0.00	m	-	-
08/02/23	30	0.50-1.00	0.04	1.51-2.00	h	h	-	08/02/23	10	0.25-0.50	0.00	0.00	m	-	-
08/03/23	0	0.00	0.00	0.00	h	-	-	08/03/23	0	0.00	0.00	0.00	h	-	-
08/04/23	0	0.00	0.00	0.00	h	-	-	08/04/23	0	0.00	0.00	0.00	h	-	-
08/05/23	0	0.00	0.00	0.00	h	-	-	08/05/23	0	0.00	0.00	0.00	h	-	-
08/06/23	0	0.00	0.00	0.00	h	-	-	08/06/23	0	0.00	0.00	0.00	h	-	-
08/07/23	10	trace-0.25	0.00	0.00	m	-	-	08/07/23	10	trace-0.25	0.00	0.00	m	-	-
08/08/23	10	0.50-1.00	0.00	0.00	m	-	-	08/08/23	10	0.25-0.50	0.00	0.00	m	-	-
08/09/23	10	0.25-0.50	0.00	0.00	m	-	-	08/09/23	10	0.25-0.50	0.00	0.00	m	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	08/10/23	0	0.00	0.00	0.00	h	-	-
08/11/23	0	0.00	0.00	0.00	h	-	-	08/11/23	0	0.00	0.00	0.00	h	-	-
08/12/23	<10	0.00	0.00	0.00	h	-	-	08/12/23	<10	0.00	0.00	0.00	h	-	-
08/13/23	30	0.50-1.00	0.08	2.01-2.50	h	h	-	08/13/23	30	0.50-1.00	0.35	0.51-0.75	h	h	-
08/14/23	10	trace-0.25	0.00	0.05-0.10	h	-	-	08/14/23	10	trace-0.25	0.00	0.00	m	-	-
08/15/23	20	trace-0.50	0.08	0.26-0.50	h	-	-	08/15/23	20	trace-0.50	0.04	0.11-0.25	h	-	-
08/16/23	30	0.50-1.00	0.16	0.26-0.50	h	-	-	08/16/23	30	0.50-1.00	0.43	0.26-0.50	h	-	-
08/17/23	30	trace-0.50	0.43	0.76-1.00	h	h	-	08/17/23	30	trace-0.50	0.83	0.76-1.00	h	h	-
08/18/23	60	1.00	0.04	0.26-0.50	m	-	-	08/18/23	50	1.00	0.20	0.05-0.10	m	-	x
08/19/23	50	1.00	0.08	0.51-0.75	m	h	-	08/19/23	40	0.75	0.04	0.11-0.25	m	-	x
08/20/23	70	1.00-1.50	0.08	0.05-0.10	m	-	x	08/20/23	70	1.00-1.50	0.00	0.05-0.10	m	-	x
08/21/23	20	trace-0.25	0.12	0.26-0.50	h	-	-	08/21/23	30	trace-0.25	0.31	0.26-0.50	h	-	-
08/22/23	10	trace-0.25	0.00	0.05-0.10	h	-	-	08/22/23	10	trace-0.25	0.00	0.00	m	-	-
08/23/23	40	trace-0.50	0.12	0.51-0.76	h	h		08/23/23	40	trace-0.50	0.00	0.00	m	-	-
08/24/23	0	0.00	0.00	0.00	h	-	-	08/24/23	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.00	h	-	-	08/25/23	0	0.00	0.00	0.00	h	-	-
08/26/23	10	trace-0.25	0.08	0.26-0.50	h	-	-	08/26/23	10	trace-0.25	0.00	0.11-0.25	h	-	-
08/27/23	10	trace-0.25	0.00	0.00	m	-	-	08/27/23	10	trace-0.25	0.00	0.00	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
08/28/23	10	trace-0.25	0.00	0.00	m	-	-	08/28/23	10	trace-0.25	0.00	0.00	m	-	-
08/29/23	0	0.00	0.00	0.00	h	-	-	08/29/23	0	0.00	0.00	0.00	h	-	-
08/30/23	0	0.00	0.00	0.00	h	-	-	08/30/23	0	0.00	0.00	0.00	h	-	-
08/31/23	40	0.50-1.25	0.59	2.01-2.50	h	h	-	08/31/23	40	0.50-1.25	1.14	1.51-2.00	h	h	-
31 days					22	6/6	1						18	3/3	3
09/01/23	70	1.00-1.50	0.63	1.26-1.50	h	h	-	09/01/23	70	1.00-1.25	0.24	0.76-1.00	h	h	-
09/02/23	10	trace-0.50	1.57	1.51-2.00	h	h	-	09/02/23	10	trace-0.50	1.34	1.26-1.50	h	h	-
09/03/23	0	0.00	0.00	0.00	h	-	-	09/03/23	0	0.00	0.00	0.00	h	-	-
09/04/23	0	0.00	0.00	0.00	h	-	-	09/04/23	0	0.00	0.00	0.00	h	-	-
09/05/23	0	0.00	0.00	0.00	h	-	-	09/05/23	0	0.00	0.00	0.00	h	-	-
09/06/23	0	0.00	0.00	0.00	h	-	-	09/06/23	0	0.00	0.00	0.00	h	-	-
09/07/23	0	0.00	0.00	0.00	h	-	-	09/07/23	0	0.00	0.00	0.00	h	-	-
09/08/23	0	0.00	0.00	0.00	h	-	-	09/08/23	0	0.00	0.00	0.00	h	-	-
09/09/23	<10	trace-0.04	0.00	0.11-0.25	h	-	-	09/09/23	<10	trace-0.04	0.00	0.00	m	-	-
09/10/23	0	0.00	0.00	0.00	h	-	-	09/10/23	0	0.00	0.00	0.00	h	-	-
09/11/23	40	trace-0.25	0.00	0.05-0.10	h	-	-	09/11/23	40	trace-0.25	0.00	0.00	m	-	-
09/12/23	30	trace-0.50	0.24	0.51-0.75	h	h	-	09/12/23	30	trace-0.50	0.35	0.51-0.75	h	h	-
09/13/23	10	trace-0.25	0.00	0.00	m	-	-	09/13/23	20	trace-0.50	0.00	0.00	m	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	09/14/23	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	09/15/23	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	09/16/23	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	09/17/23	0	0.00	0.00	0.00	h	-	-
09/18/23	0	0.00	0.00	0.00	h	-	-	09/18/23	0	0.00	0.00	0.00	h	-	-
09/19/23	0	0.00	0.00	0.00	h	-	-	09/19/23	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	09/20/23	0	0.00	0.00	0.00	h	-	-
09/21/23	0	0.00	0.00	0.00	h	-	-	09/21/23	0	0.00	0.00	0.00	h	-	-
09/22/23	0	0.00	0.00	0.00	h	-	-	09/22/23	0	0.00	0.00	0.00	h	-	-
09/23/23	0	0.00	0.00	0.00	h	-	-	09/23/23	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	09/24/23	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
09/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					29	3/3	0					27	3/3	0
Date	New River/Cave Creek							Phoenix North						
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
06/17/23	0	0.00	0.00	0.05-0.10	m	-	-	0	0.00	0.00	0.00	h	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					15	0/0	0					15	0/0	0
07/01/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/23	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 2023														
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
07/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/23	0	0.00	0.16	0.51-0.75	m	m	-	0	0.00	0.00	0.11-0.25	m	-	-
07/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/23	10	trace-0.25	0.00	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
07/22/23	10	trace-0.25	0.04	0.26-0.50	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/23	30	0.50	0.00	0.00	m	-	-	20	0.35	0.00	0.00	h	-	-
07/24/23	20	0.25	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
07/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/23	20	trace-0.25	0.12	0.11-0.25	h	-	-	20	trace-0.10	0.98	0.76-1.00	h	m	-
07/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/23	0	0.00	0.20	0.51-0.75	m	m	-	0	0.00	0.00	0.11-0.25	m	-	-
07/29/23	30	0.25-0.50	0.20	0.26-0.50	h	-	-	20	trace-0.25	0.08	0.26-0.50	h	-	-
07/30/23	40	0.50-1.00	0.04	0.51-1.00	h	h	-	30	0.25-0.50	0.08	0.11-0.25	h	-	-
07/31/23	40	0.50-1.00	0.04	0.05-0.10	m	-	x	30	0.25-0.75	0.00	0.00	m	-	-
31 days					25	1/3	1					27	0/1	0

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
08/01/23	10	trace-0.25	0.00	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
08/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/23	10	trace-0.25	0.12	0.26-0.50	h	-	-	10	trace-0.25	0.31	0.51-0.75	h	m	-
08/08/23	10	0.25-0.50	0.00	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
08/09/23	10	0.25-0.50	0.00	0.05-0.10	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/11/23	0	0.00	0.16	0.51-0.75	m	m	-	0	0.00	0.00	0.11-0.25	m	-	-
08/12/23	10	0.50	0.00	0.00	m	-	-	<10	0.00	0.00	0.00	h	-	-
08/13/23	30	0.50-1.00	0.04	0.11-0.25	m	-	x	10	trace-0.10	0.00	0.00	m	-	-
08/14/23	30	trace-0.50	0.00	0.11-0.25	h	-	-	20	trace-0.25	0.00	0.00	m	-	-
08/15/23	20	trace-0.50	0.83	0.76-1.00	h	h	-	20	trace-0.25	0.59	0.51-0.75	h	m	-
08/16/23	30	0.50-1.00	0.55	0.76-1.00	h	h	-	20	0.25-0.50	0.55	0.51-0.75	m	h	-
08/17/23	30	0.25-0.75	0.51	0.51-0.75	h	h	-	20	trace-0.25	0.20	0.26-0.50	h	-	-
08/18/23	30	0.50	0.00	0.05-0.10	m	-	-	30	0.33	0.00	0.05-0.10	m	-	-
08/19/23	20	trace-0.50	0.00	0.05-0.10	h	-	-	10	trace-0.25	0.00	0.00	m	-	-
08/20/23	70	1.00-1.50	0.08	0.26-0.50	m	-	-	40	0.25-0.75	0.00	0.11-0.25	h	-	-
08/21/23	40	0.50-1.00	0.51	0.51-0.75	h	h	-	40	0.25-0.75	0.04	0.26-0.50	h	-	-
08/22/23	20	trace-0.25	0.08	0.11-0.25	h	-	-	20	trace-0.25	0.00	0.00	m	-	-
08/23/23	50	trace-0.50	0.00	0.00	m	-	-	40	trace-0.50	0.00	0.00	m	-	-
08/24/23	0	0.00	0.00	0.05-0.10	m	-	-	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.26-0.50	m	-	-	0	0.00	0.00	0.00	h	-	-
08/26/23	10	trace-0.25	0.31	0.76-1.00	h	m	-	<10	0.00	0.00	0.00	h	-	-
08/27/23	10	trace-0.25	0.16	1.01-1.25	h	m	-	0	0.00	0.00	0.26-0.50	m	-	-
08/28/23	20	trace-0.25	0.55	0.76-1.00	h	m	-	10	trace-0.10	0.00	0.00	m	-	-
08/29/23	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 2023

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
08/30/23	0	0.00	0.00	0.05-0.10	m	-	-	08/30/23	0	0.00	0.00	0.11-0.25	m	-	-
08/31/23	50	0.50-1.25	3.15	3.01-4.00	h	h	-	08/31/23	30	0.25-0.75	0.63	1.51-2.00	h	h	-
31 days					19	5/9	1	31 days					19	2/4	0
09/01/23	70	1.00-1.50	0.04	0.05-0.10	m	-	x	09/01/23	40	0.25-0.50	0.04	0.11-0.25	h	-	x
09/02/23	10	trace-0.50	0.00	0.00	m	-	-	09/02/23	0	0.00	0.00	0.00	h	-	-
09/03/23	0	0.00	0.00	0.00	h	-	-	09/03/23	0	0.00	0.00	0.00	h	-	-
09/04/23	0	0.00	0.00	0.00	h	-	-	09/04/23	0	0.00	0.00	0.05-0.10	m	-	-
09/05/23	0	0.00	0.00	0.00	h	-	-	09/05/23	0	0.00	0.00	0.05-0.10	m	-	-
09/06/23	0	0.00	0.00	0.00	h	-	-	09/06/23	0	0.00	0.00	0.05-0.10	m	-	-
09/07/23	0	0.00	0.00	0.00	h	-	-	09/07/23	0	0.00	0.00	0.05-0.10	m	-	-
09/08/23	0	0.00	0.00	0.00	h	-	-	09/08/23	0	0.00	0.00	0.05-0.10	m	-	-
09/09/23	<10	trace-0.04	0.00	0.00	m	-	-	09/09/23	0	0.00	0.00	0.00	h	-	-
09/10/23	0	0.00	0.00	0.00	h	-	-	09/10/23	0	0.00	0.00	0.05-0.10	m	-	-
09/11/23	50	trace-0.35	0.00	0.05-0.10	h	-	-	09/11/23	40	trace-0.25	0.00	0.05-0.10	h	-	-
09/12/23	50	0.50-1.50	1.65	2.51-3.00	h	h	-	09/12/23	40	0.50-1.25	0.47	0.76-1.00	h	h	-
09/13/23	30	0.25-0.75	0.00	0.00	m	-	-	09/13/23	30	trace-0.50	0.00	0.00	m	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	09/14/23	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	09/15/23	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	09/16/23	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	09/17/23	0	0.00	0.00	0.00	h	-	-
09/18/23	0	0.00	0.00	0.00	h	-	-	09/18/23	0	0.00	0.00	0.00	h	-	-
09/19/23	0	0.00	0.00	0.00	h	-	-	09/19/23	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	09/20/23	0	0.00	0.00	0.00	h	-	-
09/21/23	0	0.00	0.00	0.00	h	-	-	09/21/23	0	0.00	0.00	0.00	h	-	-
09/22/23	0	0.00	0.00	0.00	h	-	-	09/22/23	0	0.00	0.00	0.00	h	-	-
09/23/23	0	0.00	0.00	0.00	h	-	-	09/23/23	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	09/24/23	0	0.00	0.00	0.00	h	-	-
09/25/23	0	0.00	0.00	0.00	h	-	-	09/25/23	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	09/26/23	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

	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
09/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					26	1/1	0					23	1/1	0
	Phoenix South							Scottsdale North						
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
06/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					15	0/0	0					15	0/0	0
07/01/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/23	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 2023

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
07/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.51-0.75	m	m	-
07/22/23	0	0.00	0.04	0.26-0.50	m	-	-	10	trace-0.25	0.00	0.00	m	-	-
07/23/23	20	0.35	0.00	0.00	m	-	-	20	0.50	0.00	0.00	m	-	-
07/24/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
07/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/23	10	trace-0.10	0.79	0.76-1.00	h	m	-	20	trace-0.10	0.31	0.76-1.00	h	m	-
07/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/23	20	trace-0.25	0.00	0.11-0.25	h	-	-	30	0.25-0.50	0.00	0.11-0.25	h	-	-
07/30/23	30	0.25-0.50	0.20	0.26-0.50	h	-	-	30	0.25-0.75	0.00	0.26-0.50	h	-	-
07/31/23	30	0.25-0.50	0.00	0.00	m	-	-	30	0.25-0.75	0.28	0.11-0.25	h	-	-
31 days					27	0/1	0					27	0/2	0
08/01/23	10	trace-0.25	0.00	0.00	m	-	-	0	0.00	0.00	0.00	h	-	-
08/02/23	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 2023

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
08/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/23	10	trace-0.25	0.39	0.26-0.50	h	-	-	10	trace-0.25	0.59	0.51-0.75	h	m	-
08/08/23	0	0.00	0.00	0.00	h	-	-	10	0.25-0.50	0.00	0.00	m	-	-
08/09/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/11/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.28	0.51-0.75	m	m	-
08/12/23	10	trace-0.25	0.00	0.00	m	-	-	<10	0.00	0.00	0.00	h	-	-
08/13/23	<10	0.00	0.00	0.00	h	-	-	20	0.25-0.50	0.00	0.00	m	-	-
08/14/23	20	trace-0.25	0.00	0.00	m	-	-	30	trace-0.50	0.00	0.11-0.25	h	-	-
08/15/23	20	trace-0.25	0.39	0.26-0.50	h	-	-	20	trace-0.50	0.08	0.51-0.75	h	h	-
08/16/23	20	0.25-0.50	0.12	0.26-0.50	h	-	-	30	0.25-0.75	1.85	1.51-2.00	h	h	-
08/17/23	20	trace-0.25	0.12	0.51-0.75	h	m	-	20	trace-0.50	0.39	0.26-0.50	h	-	-
08/18/23	20	0.25	0.00	0.11-0.25	h	-	-	30	0.33	0.00	0.00	m	-	-
08/19/23	<10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.25	0.00	0.00	m	-	-
08/20/23	30	0.25-0.50	0.00	0.11-0.25	h	-	-	50	0.50-1.00	0.12	0.51-0.75	h	h	-
08/21/23	40	0.25-0.75	0.16	0.51-0.75	h	h	-	40	0.50-1.00	0.43	1.01-1.25	h	h	-
08/22/23	20	trace-0.25	0.00	0.00	m	-	-	20	trace-0.50	0.00	0.11-0.25	h	-	-
08/23/23	30	trace-0.25	0.00	0.00	m	-	-	40	trace-0.50	0.00	0.00	m	-	-
08/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/23	<10	0.00	0.00	0.00	h	-	-	<10	0.00	0.00	0.00	h	-	-
08/27/23	0	0.00	0.00	0.00	h	-	-	10	trace-0.10	0.08	0.26-0.50	h	-	-
08/28/23	10	trace-0.10	0.00	1.01-1.25	h	m	-	10	trace-0.25	0.16	0.51-0.75	h	m	-
08/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/23	<10	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
08/31/23	20	trace-0.50	0.55	1.26-1.50	h	h	-	40	0.25-0.75	1.26	1.51-2.00	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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					22	3/7	0					24	6/10	0
31 days					22	2/4	0					24	5/8	0
09/01/23	30	trace-0.50	0.00	0.11-0.25	h	-	-	40	0.25-0.75	0.20	0.26-0.50	h	-	-
09/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/05/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/06/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/07/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/08/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/23	0	0.00	0.00	0.11-0.25	m	-	-	0	0.00	0.00	0.00	h	-	-
09/11/23	20	trace-0.10	0.00	0.00	m	-	-	40	trace-0.25	0.00	0.05-0.10	h	-	-
09/12/23	30	0.50-1.00	0.71	1.26-1.50	h	h	-	40	0.50-1.00	1.46	2.01-2.50	h	h	-
09/13/23	20	trace-0.50	0.00	0.11-0.25	h	-	-	30	trace-0.50	0.00	0.00	m	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/23	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 2023

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
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					23	1/1	0					29	1/1	0
	Scottsdale South							East Valley						
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
16 days					16	0/0	0					15	0/0	0
07/01/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/23	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 2023

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
07/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/23	10	trace-0.10	0.00	0.05-0.10	h	-	-	10	trace-0.10	0.00	0.00	m	-	-
07/23/23	20	0.35	0.00	0.00	m	-	-	20	0.50	0.00	0.00	m	-	-
07/24/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
07/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/23	10	trace-0.10	1.02	1.26-1.50	h	m	-	20	trace-0.25	0.87	1.01-1.25	h	m	-
07/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/29/23	20	trace-0.25	0.00	0.00	m	-	-	20	trace-0.25	0.00	0.11-0.25	h	-	-
07/30/23	30	0.25-0.75	0.24	0.26-0.50	h	-	-	40	0.25-0.75	0.12	0.26-0.50	h	-	-
07/31/23	30	0.25-0.50	0.00	0.05-0.10	m	-	-	40	0.25-0.75	0.55	1.26-1.50	h	h	-
31 days					27	0/1	0					28	1/2	0
08/01/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/23	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 2023

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
08/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/23	10	trace-0.25	0.08	0.11-0.25	h	-	-	10	trace-0.25	0.71	1.01-1.25	h	m	-
08/08/23	0	0.00	0.00	0.00	h	-	-	10	0.10-0.25	0.00	0.00	m	-	-
08/09/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.12	0.26-0.50	h	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/11/23	0	0.00	0.00	0.05-0.10	m	-	-	10	0.10-0.25	0.00	0.00	m	-	-
08/12/23	<10	0.00	0.00	0.00	h	-	-	<10	0.00	0.00	0.00	h	-	-
08/13/23	<10	0.00	0.00	0.00	h	-	-	<10	0.00	0.00	0.00	h	-	-
08/14/23	20	trace-0.25	0.00	0.05-0.10	h	-	-	30	trace-0.35	0.00	0.11-0.25	h	-	-
08/15/23	20	trace-0.25	0.04	0.11-0.25	h	-	-	30	trace-0.50	0.24	0.26-0.50	h	-	-
08/16/23	20	0.25-0.50	0.12	0.76-1.00	h	h	-	20	0.25-0.50	0.00	0.26-0.50	h	-	-
08/17/23	20	trace-0.25	0.04	0.05-0.10	h	-	-	20	trace-0.50	0.75	0.51-0.75	h	h	-
08/18/23	20	0.25	0.00	0.00	m	-	-	20	0.25	0.00	0.00	m	-	-
08/19/23	<10	trace-0.10	0.00	0.00	m	-	-	<10	trace-0.10	0.00	0.00	m	-	-
08/20/23	40	0.25-0.50	0.04	0.26-0.50	h	-	-	40	0.25-0.75	0.08	0.26-0.50	h	-	-
08/21/23	30	0.25-0.75	0.08	0.11-0.25	h	-	-	40	0.25-0.75	0.08	0.26-0.50	h	-	-
08/22/23	20	trace-0.25	0.00	0.00	m	-	-	20	trace-0.25	0.00	0.00	m	-	-
08/23/23	20	trace-0.25	0.00	0.00	m	-	-	20	trace-0.15	0.00	0.00	m	-	-
08/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/23	<10	0.00	0.00	0.00	h	-	-	<10	0.00	0.00	0.00	h	-	-
08/27/23	0	0.00	0.04	0.05-0.10	m	-	-	0	0.00	0.31	0.51-0.75	m	m	-
08/28/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.10	0.00	0.00	m	-	-
08/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/23	<10	0.00	0.00	0.00	h	-	-	10	trace-0.10	0.08	0.11-0.25	h	-	-
08/31/23	30	trace-0.50	0.28	0.51-0.75	h	h	-	30	trace-0.50	0.47	0.76-1.00	h	h	-
31 days					23	2/2	0					23	2/4	0
09/01/23	30	0.10-0.50	0.00	0.11-0.25	h	-	-	30	0.10-0.50	0.00	0.00	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

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
09/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/23	20	trace-0.10	0.00	0.00	m	-	-	30	trace-0.15	0.00	0.05-0.10	h	-	-
09/12/23	30	0.50-1.00	0.91	1.01-1.25	h	h	-	40	0.50-1.25	0.98	1.01-1.25	h	h	-
09/13/23	20	trace-0.50	0.00	0.00	m	-	-	30	trace-0.50	0.00	0.05-0.10	h	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	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 2023														
	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	1/1	0					29	1/1	0
	Southeast Valley							Lower Salt River Lakes						
06/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
06/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	0/0	0					15	0/0	0
07/01/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/09/23	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 2023

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
07/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/11/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/12/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/17/23	10	0.00-trace	0.24	0.76-1.00	m	m	-	0	0.00	0.00	0.00	h	-	-
07/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/21/23	0	0.00	0.04	0.05-0.10	m	-	-	10	trace-0.10	0.04	0.26-0.50	h	-	-
07/22/23	10	trace-0.10	0.00	0.00	m	-	-	10	trace-0.25	0.00	0.05-0.10	h	-	-
07/23/23	30	0.50	0.00	0.00	m	-	-	30	0.75	0.00	0.00	m	-	-
07/24/23	20	0.25	0.00	0.51-0.75	m	m	-	20	0.50	0.00	0.00	m	-	-
07/25/23	10	trace-0.10	0.00	0.00	m	-	-	10	0.25	0.00	0.00	m	-	-
07/26/23	20	trace-0.25	0.35	0.51-0.75	h	m	-	30	trace-0.25	0.00	0.11-0.25	h	-	-
07/27/23	10	trace-0.25	0.00	0.11-0.25	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/23	0	0.00	0.12	0.26-0.50	m	-	-	0	0.00	0.00	0.76-1.00	m	m	-
07/29/23	30	trace-0.25	0.00	0.00	m	-	-	40	0.25-0.50	0.00	0.11-0.25	h	-	-
07/30/23	40	0.25-0.75	0.04	0.11-0.25	h	-	x	50	0.50-1.00	0.35	0.76-1.00	h	h	-
07/31/23	40	0.25-0.75	0.31	0.51-0.75	h	h	-	50	0.50-1.00	0.04	0.11-0.25	m	-	x
31 days					23	1/4	1					26	1/2	1
08/01/23	0	0.00	0.00	0.00	h	-	-	10	trace-0.25	0.00	0.00	m	-	-
08/02/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/03/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/23	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 2023

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
08/07/23	10	trace-0.25	0.00	0.11-0.25	h	-	-	10	trace-0.25	0.00	0.11-0.25	h	-	-
08/08/23	10	0.10-0.25	0.00	0.00	h	-	-	10	0.25-0.50	0.00	0.00	m	-	-
08/09/23	10	trace-0.10	0.08	0.11-0.25	h	-	-	10	trace-0.10	0.08	0.26-0.50	h	-	-
08/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/11/23	20	0.10-0.25	0.00	0.00	m	-	-	20	0.10-0.25	0.00	0.76-1.00	h	m	-
08/12/23	<10	0.00	0.00	0.00	h	-	-	30	0.75	0.00	0.00	m	-	-
08/13/23	<10	0.00	0.00	0.00	h	-	-	30	0.25-0.50	0.00	0.11-0.25	h	-	-
08/14/23	30	trace-0.50	0.04	0.26-0.50	h	-	-	40	0.25-0.75	0.00	0.11-0.25	h	-	x
08/15/23	30	trace-0.50	0.08	0.11-0.25	h	-	-	30	trace-0.50	0.00	1.26-1.50	h	h	-
08/16/23	20	0.25-0.50	0.04	0.26-0.50	h	-	-	30	0.50-1.00	0.00	0.26-0.50	h	-	-
08/17/23	20	trace-0.50	0.24	2.01-2.50	h	h	-	30	trace-0.50	0.00	0.26-0.50	h	-	-
08/18/23	20	0.25	0.00	0.00	m	-	-	20	0.33	0.00	0.00	m	-	-
08/19/23	<10	trace-0.10	0.00	0.00	m	-	-	<10	trace-0.10	0.00	0.00	m	-	-
08/20/23	40	0.25-0.50	0.04	0.26-0.50	h	-	-	50	0.75-1.50	0.39	0.26-0.50	h	-	-
08/21/23	40	0.25-0.75	0.08	0.76-1.00	m	h	-	50	0.50-1.00	0.12	1.01-1.25	h	h	-
08/22/23	20	trace-0.25	0.00	0.05-0.10	h	-	-	30	trace-0.50	0.12	0.26-0.50	h	-	-
08/23/23	20	trace-0.15	0.00	0.00	m	-	-	20	trace-0.50	0.00	0.00	m	-	-
08/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/25/23	0	0.00	0.00	0.05-0.10	m	-	-	0	0.00	0.00	0.00	h	-	-
08/26/23	<10	0.00	0.00	0.00	h	-	-	10	trace-0.25	0.00	0.11-0.25	h	-	-
08/27/23	0	0.00	0.00	0.11-0.25	m	-	-	10	trace-0.25	0.00	0.11-0.25	h	-	-
08/28/23	10	trace-0.10	0.00	0.00	m	-	-	20	trace-0.25	0.00	1.26-1.50	h	m	-
08/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/23	10	trace-0.10	0.00	0.05-0.10	h	-	-	10	trace-0.25	0.00	0.05-0.10	h	-	-
08/31/23	30	trace-0.50	0.83	2.01-2.50	h	h	-	40	0.50-1.25	0.16	1.26-1.50	h	h	-
31 days					23	3/3	0					25	3/5	1
09/01/23	30	0.10-0.50	0.00	0.05-0.10	h	-	-	50	0.25-0.75	0.04	0.05-0.10	m	-	x
09/02/23	0	0.00	0.00	0.00	h	-	-	<10	0.00	0.00	0.00	h	-	-
09/03/23	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 2023

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
09/04/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
09/05/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
09/06/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
09/07/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
09/08/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
09/09/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.05-0.10	m	-	-
09/11/23	30	trace-0.15	0.00	0.05-0.10	h	-	-	40	trace-0.25	0.00	0.05-0.10	h	-	-
09/12/23	40	0.50-1.25	0.08	0.26-0.50	h	-	-	50	0.50-1.50	2.05	3.01-4.00	h	h	-
09/13/23	30	trace-0.50	0.00	0.00	m	-	-	40	0.25-0.75	0.00	0.26-0.50	h	-	-
09/14/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/19/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/20/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/23	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					29	0/0	0					23	1/1	0

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
	Superstition													
06/15/23	0	0.00	0.00	0.00	h	-	-							
06/16/23	0	0.00	0.00	0.00	h	-	-							
06/17/23	0	0.00	0.00	0.00	h	-	-							
06/18/23	0	0.00	0.00	0.00	h	-	-							
06/19/23	0	0.00	0.00	0.00	h	-	-							
06/20/23	0	0.00	0.00	0.00	h	-	-							
06/21/23	0	0.00	0.00	0.00	h	-	-							
06/22/23	0	0.00	0.00	0.00	h	-	-							
06/23/23	0	0.00	0.00	0.00	h	-	-							
06/24/23	0	0.00	0.00	0.00	h	-	-							
06/25/23	0	0.00	0.00	0.00	h	-	-							
06/26/23	0	0.00	0.00	0.00	h	-	-							
06/27/23	0	0.00	0.00	0.00	h	-	-							
06/28/23	0	0.00	0.00	0.00	h	-	-							
06/29/23	0	0.00	0.00	0.00	h	-	-							
06/30/23	0	0.00	0.00	0.05-0.10	m	-	-							
16 days					15	0/0	0							
07/01/23	0	0.00	0.00	0.00	h	-	-							
07/02/23	0	0.00	0.00	0.00	h	-	-							
07/03/23	0	0.00	0.00	0.00	h	-	-							
07/04/23	0	0.00	0.00	0.00	h	-	-							
07/05/23	0	0.00	0.00	0.00	h	-	-							
07/06/23	0	0.00	0.00	0.00	h	-	-							
07/07/23	0	0.00	0.00	0.00	h	-	-							
07/08/23	0	0.00	0.00	0.00	h	-	-							
07/09/23	0	0.00	0.00	0.00	h	-	-							
07/10/23	0	0.00	0.00	0.00	h	-	-							
07/11/23	0	0.00	0.00	0.00	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023															
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification			
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	
07/12/23	0	0.00	0.00	0.00	h	-	-								
07/13/23	0	0.00	0.00	0.00	h	-	-								
07/14/23	0	0.00	0.00	0.00	h	-	-								
07/15/23	0	0.00	0.00	0.00	h	-	-								
07/16/23	0	0.00	0.00	0.00	h	-	-								
07/17/23	0	0.00	0.00	0.00	h	-	-								
07/18/23	0	0.00	0.00	0.00	h	-	-								
07/19/23	0	0.00	0.00	0.00	h	-	-								
07/20/23	0	0.00	0.00	0.00	h	-	-								
07/21/23	10	trace-0.25	0.00	0.00	m	-	-								
07/22/23	10	trace-0.25	0.00	0.00	m	-	-								
07/23/23	30	0.75	0.00	0.00	m	-	-								
07/24/23	20	0.50	0.00	0.00	m	-	-								
07/25/23	10	0.25	0.00	0.00	m	-	-								
07/26/23	20	trace-0.25	1.02	1.51-2.00	h	m	-								
07/27/23	0	0.00	0.08	0.05-0.10	m	-	-								
07/28/23	0	0.00	0.16	0.51-0.75	m	m	-								
07/29/23	30	0.25-0.50	0.39	0.26-0.50	h	-	-								
07/30/23	50	0.50-1.00	0.16	0.26-0.50	h	-	-								
07/31/23	50	0.50-1.00	0.51	1.01-1.25	h	h	-								
31 days					24	1/3	0								
08/01/23	0	0.00	0.00	0.00	h	-	-								
08/02/23	0	0.00	0.00	0.00	h	-	-								
08/03/23	0	0.00	0.00	0.00	h	-	-								
08/04/23	0	0.00	0.00	0.00	h	-	-								
08/05/23	0	0.00	0.00	0.00	h	-	-								
08/06/23	0	0.00	0.00	0.00	h	-	-								
08/07/23	10	trace-0.25	0.12	0.11-0.25	h	-	-								
08/08/23	10	0.50-1.00	0.04	0.11-0.25	h	-	-								

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023

Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/09/23	10	trace-0.10	0.39	0.26-0.50	h	-	-							
08/10/23	0	0.00	0.00	0.00	h	-	-							
08/11/23	20	0.10-0.25	0.00	0.11-0.25	h	-	-							
08/12/23	20	0.75	0.00	0.00	m	-	-							
08/13/23	20	0.25-0.50	0.00	0.00	m	-	-							
08/14/23	30	trace-0.50	0.47	1.01-0.25	h	h	-							
08/15/23	30	trace-0.50	0.24	0.51-0.75	h	h	-							
08/16/23	30	0.50-1.00	0.00	0.26-0.50	h	-	-							
08/17/23	30	trace-0.50	0.31	0.51-0.75	h	h	-							
08/18/23	20	0.25	0.00	0.00	m	-	-							
08/19/23	<10	trace-0.10	0.00	0.00	m	-	-							
08/20/23	70	0.75-1.50	0.12	0.26-0.50	m	-	-							
08/21/23	50	0.50-1.00	0.31	0.51-0.75	h	h	-							
08/22/23	30	trace-0.50	0.00	0.00	m	-	-							
08/23/23	20	trace-0.30	0.00	0.00	m	-	-							
08/24/23	0	0.00	0.00	0.05-0.10	m	-	-							
08/25/23	0	0.00	0.00	0.00	h	-	-							
08/26/23	10	trace-0.25	0.00	0.05-0.10	h	-	-							
08/27/23	10	trace-0.25	0.43	0.51-0.75	h	m	-							
08/28/23	20	trace-0.25	0.31	1.51-2.00	h	m	-							
08/29/23	0	0.00	0.00	0.00	h	-	-							
08/30/23	10	trace-0.10	0.00	0.05-0.10	h	-	-							
08/31/23	40	0.50-1.25	0.35	0.76-1.00	h	h	-							
31 days					23	5/7	0							
09/01/23	50	0.25-0.75	0.00	0.05-0.10	m	-	x							
09/02/23	<10	0.00	0.00	0.00	h	-	-							
09/03/23	0	0.00	0.00	0.00	h	-	-							
09/04/23	0	0.00	0.00	0.00	h	-	-							
09/05/23	0	0.00	0.00	0.00	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2023														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/06/23	0	0.00	0.00	0.00	h	-	-							
09/07/23	0	0.00	0.00	0.00	h	-	-							
09/08/23	0	0.00	0.00	0.00	h	-	-							
09/09/23	<10	trace-0.04	0.00	0.00	m	-	-							
09/10/23	0	0.00	0.00	0.00	h	-	-							
09/11/23	40	trace-0.25	0.00	0.00	m	-	-							
09/12/23	50	0.50-1.50	2.64	2.51-3.00	h	h	-							
09/13/23	40	0.25-0.75	0.12	0.05-0.10	m	-	x							
09/14/23	0	0.00	0.00	0.00	h	-	-							
09/15/23	0	0.00	0.00	0.00	h	-	-							
09/16/23	0	0.00	0.00	0.00	h	-	-							
09/17/23	0	0.00	0.00	0.00	h	-	-							
09/18/23	0	0.00	0.00	0.00	h	-	-							
09/19/23	0	0.00	0.00	0.00	h	-	-							
09/20/23	0	0.00	0.00	0.00	h	-	-							
09/21/23	0	0.00	0.00	0.00	h	-	-							
09/22/23	0	0.00	0.00	0.00	h	-	-							
09/23/23	0	0.00	0.00	0.00	h	-	-							
09/24/23	0	0.00	0.00	0.00	h	-	-							
09/25/23	0	0.00	0.00	0.00	h	-	-							
09/26/23	0	0.00	0.00	0.00	h	-	-							
09/27/23	0	0.00	0.00	0.00	h	-	-							
09/28/23	0	0.00	0.00	0.00	h	-	-							
09/29/23	0	0.00	0.00	0.00	h	-	-							
09/30/23	0	0.00	0.00	0.00	h	-	-							
30 days					26	1/1	1							

TABLE A-2: This table shows the verification data of MSP issued precipitation forecasts contained in the daily Outlooks for the 2023 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 2023						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
JUNE						
Gila Bend	16/16	100%	0/0	n/a	0/16	0%
Gila River	16/16	100%	0/0	n/a	0/16	0%
Palo Verde	16/16	100%	0/0	n/a	0/16	0%
Rainbow Valley	16/16	100%	0/0	n/a	0/16	0%
West Valley	16/16	100%	0/0	n/a	0/16	0%
Northwest Valley	16/16	100%	0/0	n/a	0/16	0%
Upper Centennial	16/16	100%	0/0	n/a	0/16	0%
Wickenburg	16/16	100%	0/0	n/a	0/16	0%
New River/Cave Creek	15/16	93.8%	0/0	n/a	0/16	0%
Phoenix North	15/16	93.8%	0/0	n/a	0/16	0%
Phoenix South	15/16	93.8%	0/0	n/a	0/16	0%
Scottsdale North	15/16	100%	0/0	n/a	0/16	0%
Scottsdale South	16/16	100%	0/0	n/a	0/16	0%
East Valley	15/16	93.8%	0/0	n/a	0/16	0%
Southeast Valley	16/16	100%	0/0	n/a	0/16	0%
Lower Salt River Lakes	15/16	93.8%	0/0	n/a	0/16	0%

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2023						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
Superstition	15/16	93.8%	0/0	n/a	0/16	0%
All Zones	265/272	97.4%	0/0	n/a	0/272	0%
JULY						
Gila Bend	24/31	77.4%	2/3	66.6%	1/31	3.2%
Gila River	23/31	74.2%	2/3	66.6%	0/31	0%
Palo Verde	26/31	83.9%	0/0	0%	0/31	0%
Rainbow Valley	27/31	87.1%	1/3	33.3%	0/31	0%
West Valley	26/31	83.9%	0/1	0%	0/31	0%
Northwest Valley	26/31	83.9%	1/1	100%	1/31	3.2%
Upper Centennial	25/31	80.6%	0/2	0%	2/31	6.5%
Wickenburg	24/31	77.4%	0/2	0%	2/31	6.5%
New River/Cave Creek	25/31	80.6%	1/3	33.3%	1/31	3.2%
Phoenix North	27/31	87.1%	0/1	0%	0/31	0%
Phoenix South	27/31	87.1%	0/1	0%	0/31	0%
Scottsdale North	27/31	87.1%	0/2	0%	0/31	0%
Scottsdale South	27/31	87.1%	0/1	0%	0/31	0%
East Valley	28/31	90.3%	1/2	50.0%	0/31	0%
Southeast Valley	23/31	74.2%	1/4	25.0%	1/31	3.2%
Lower Salt River Lakes	26/31	83.9%	1/2	50.0%	1/31	3.2%
Superstition	24/31	77.4%	1/3	33.3%	0/31	0%
All Zones	435/527	82.5%	11/34	32.4%	9/527	1.7%
AUGUST						
Gila Bend	22/31	71.0%	7/12	58.3%	3/31	9.7%
Gila River	24/31	77.4%	1/4	25.0%	0/31	0%
Palo Verde	25/31	80.6%	2/4	50.0%	0/31	0%
Rainbow Valley	21/31	67.7%	2/6	33.3%	1/31	3.2%
West Valley	24/31	77.4%	2/5	40.0%	0/31	0%
Northwest Valley	21/31	67.7%	1/2	50.0%	0/31	0%
Upper Centennial	22/31	71.0%	6/6	100%	1/31	3.2%

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2023						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
Wickenburg	18/31	58.1%	3/3	100%	3/31	9.7%
New River/Cave Creek	19/31	61.3%	5/9	55.5%	1/31	3.2%
Phoenix North	19/31	61.3%	2/4	50.0%	0/31	0%
Phoenix South	22/31	71.0%	2/4	50.0%	0/31	0%
Scottsdale North	24/31	77.4%	5/8	62.5%	0/31	0%
Scottsdale South	23/31	74.2%	2/2	100%	0/31	0%
East Valley	23/31	74.2%	2/4	50%	0/31	0%
Southeast Valley	23/31	74.2%	3/3	100%	0/31	0%
Lower Salt River Lakes	25/31	80.6%	3/5	60%	1/31	3.2%
Superstition	23/31	74.2%	5/7	71.4%	0/31	0%
All Zones	375/527	71.2%	53/86	61.6%	10/527	1.9%
SEPTEMBER						
Gila Bend	28/30	93.3%	1/1	100%	0/30	0%
Gila River	29/30	96.7%	0/0	n/a	0/30	0%
Palo Verde	28/30	93.3%	1/2	50.0%	0/30	0%
Rainbow Valley	28/30	93.2%	0/0	n/a	0/30	0%
West Valley	28/30	93.3%	1/1	100%	0/30	0%
Northwest Valley	27/30	90.0%	1/1	100%	0/30	0%
Upper Centennial	29/30	96.7%	3/3	100%	0/30	0%
Wickenburg	27/30	90.0%	3/3	100%	0/30	0%
New River/Cave Creek	26/30	86.7%	1/1	100%	0/30	0%
Phoenix North	23/30	76.7%	1/1	100%	0/30	0%
Phoenix South	23/30	76.7%	1/1	100%	0/30	0%
Scottsdale North	29/30	96.7%	1/1	100%	0/30	0%
Scottsdale South	28/30	93.3%	1/1	100%	0/30	0%
East Valley	29/30	96.7%	1/1	100%	0/30	0%
Southeast Valley	29/30	96.7%	0/0	n/a	0/30	0%
Lower Salt River Lakes	23/30	76.7%	1/1	100%	0/30	0%
Superstition	26/30	86.7%	1/1	100%	1/30	3.3%

TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2023						
Forecast Zone	Accurate Forecasts	AOF (%)	Sig. Events Detected	POD (%)	False Alarms	FAR (%)
All Zones	460/510	90.2%	18/19	94.7%	1/510	0.2%

APPENDIX B: MSP MESSAGES – VERIFICATION TABLES

TABLE B-1: This table shows each of the individual MSP Statements issued during the 2023 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 2023							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
07/26/23	21:47	East Valley	1	Waters	Now-11pm	-	0.50-0.75/1.00
07/26/23	21:47	Southeast Valley	1	Waters	Now-11pm	-	0.50-0.75/1.00
07/26/23	21:47	Superstition	1	Waters	Now-11pm	-	0.50-0.75/1.00
07/26/23	22:19	Scottsdale South	1	Waters	Now-11:30pm	-	0.33-0.50/0.75
07/26/23	22:28	Scottsdale North	1	Waters	10:45pm-12:00am	-	0.33-0.50/0.75
07/26/23	22:28	Phoenix North	1	Waters	10:45pm-12:00am	-	0.33-0.50/0.75
07/26/23	22:28	Phoenix South	1	Waters	10:45pm-12:00am	-	0.33-0.50/0.75
07/30/23	21:09	Gila Bend	1	Malloy	Now-11:00pm	-	0.50-1.00/1.50
08/01/23	14:14	Rainbow Valley	1	Waters	2:15pm-3:30pm	-	0.33-0.50/0.75
08/08/23	5:50	Phoenix South	1	Henz	Now-7:30am	-	0.25-0.50/1.00
08/08/23	5:50	East Valley	1	Henz	Now-7:30am	-	0.25-0.50/1.00
08/16/23	17:50	Palo Verde	1	Malloy	Now-7:30pm	-	0.50-1.00/1.50
08/16/23	17:51	Scottsdale North	1	Malloy	Now-7:30pm	-	0.50-1.00/1.50
08/16/23	19:12	Scottsdale North	3	Malloy	Now-8:30pm	-	-

TABLE B-1: MSP Statements Issued - Monsoon Season 2023							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
08/17/23	17:31	Southeast Valley	1	Henz	Now-7:00pm	-	0.50-0.75/1.25
08/17/23	18:57	East Valley	1	Henz	Now-8:30pm	-	0.50-0.75/1.25
08/18/23	11:30	Gila Bend	2	Henz	5pm(8/18/23)-	-	-
08/18/23	11:30	Northwest Valley	2	Henz	5pm(8/18/23)-	-	-
08/18/23	11:30	Palo Verde	2	Henz	5pm(8/18/23)-	-	-
08/18/23	11:30	Rainbow Valley	2	Henz	5pm(8/18/23)-	-	-
08/18/23	11:30	Upper Centennial	2	Henz	5pm(8/18/23)-	-	-
08/18/23	11:30	West Valley	2	Henz	5pm(8/18/23)-	-	-
08/18/23	11:30	Wickenburg	2	Henz	5pm(8/18/23)-	-	-
08/18/23	17:01	Gila Bend	1	Waters	5:30pm-7:30pm	-	0.50-0.75/1.25
08/19/23	7:36	Gila Bend	1	Henz	Now-9:15am	-	0.75-1.25/1.75
08/19/23	8:54	Palo Verde	1	Henz	Now-11:15am	-	0.75-1.25/1.75
08/23/23	18:59	Upper Centennial	1	Waters	7:00-8:00pm	-	0.50-0.75/1.00
08/27/23	17:23	New River/Cave Creek	1	Malloy	Now-7:30pm	-	0.50-0.75/1.00
08/31/23	20:05	Gila Bend	1	Henz	Now-9:45pm	-	0.50-0.75/1.25
08/31/23	20:18	Gila River	1	Henz	Now-10:00pm	-	0.50-0.75/1.25-1.50
08/31/23	20:18	Southeast Valley	1	Henz	Now-10:00pm	-	0.50-0.75/1.25-1.50
08/31/23	20:30	East Valley	1	Henz	Now-10:00pm	-	0.50-0.75/1.25-1.50
08/31/23	20:30	Superstition	1	Henz	Now-10:00pm	-	0.50-0.75/1.25-1.50
08/31/23	20:51	Phoenix South	1	Henz	Now-10:30pm	-	0.50-0.75/1.25-1.50
08/31/23	20:51	Scottsdale South	1	Henz	Now-10:30pm	-	0.50-0.75/1.25-1.50
08/31/23	21:03	Rainbow Valley	1	Malloy	Now-10:30pm	-	0.75-1.25/1.50
08/31/23	21:16	Scottsdale North	1	Malloy	Now-11:30pm	-	0.75-1.25/1.75
08/31/23	21:16	Phoenix North	1	Malloy	Now-11:30pm	-	0.75-1.25/1.75
08/31/23	21:16	New River/Cave Creek	1	Malloy	Now-11:30pm	-	0.75-1.25/1.75
08/31/23	21:40	West Valley	1	Malloy	Now-11:30pm	-	0.75-1.25/1.50
08/31/23	22:06	New River/Cave Creek	3	Henz	Now-1:00am	-	-
08/31/23	22:40	Wickenburg	1	Malloy	Now-12:30am	-	0.75-1.25/1.75
08/31/23	22:40	Upper Centennial	1	Malloy	Now-12:30am	-	0.75-1.25/1.75

TABLE B-1: MSP Statements Issued - Monsoon Season 2023							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
09/01/23	12:08	Palo Verde	1	Waters	Now-1:30pm	-	0.50-0.75/1.00
09/01/23	13:46	Upper Centennial	1	Waters	2:00-3:30pm	-	0.50-0.75/1.00
09/01/23	13:46	Wickenburg	1	Waters	2:00-3:30pm	-	0.50-0.75/1.00
09/02/23	13:58	Rainbow Valley	1	Waters	2:00-3:30pm	-	0.33-0.50/0.75
09/02/23	13:58	Gila River	1	Waters	2:00-3:30pm	-	0.33-0.50/0.75
09/02/23	16:30	Upper Centennial	1	Waters	4:30-6:00pm	-	0.50-0.75/1.00
09/02/23	16:30	Wickenburg	1	Waters	4:30-6:00pm	-	0.50-0.75/1.00
09/12/23	17:04	New River/Cave Creek	1	Malloy	Now-8:00pm	-	0.75-1.50/2.00
09/12/23	18:26	Wickenburg	1	Malloy	Now-8:00pm	-	0.50-1.00/1.25
09/12/23	18:56	West Valley	1	Malloy	Now-9:00pm	-	0.50-1.00/1.25
09/12/23	19:56	Northwest Valley	1	Malloy	Now-10:00pm	-	0.50-1.00/1.50
09/12/23	19:56	Phoenix North	1	Malloy	Now-10:00pm	-	0.50-1.00/1.50
09/12/23	19:56	Phoenix South	1	Malloy	Now-10:00pm	-	0.50-1.00/1.50
09/12/23	23:18	New River/Cave Creek	1	Malloy	Now-1:00am	-	0.50-1.00/1.50
09/12/23	23:18	Scottsdale North	1	Malloy	Now-1:00am	-	0.50-1.00/1.50
09/12/23	23:47	Scottsdale South	1	Malloy	Now-1:00am	-	0.50-0.75/1.25
09/13/23	0:34	East Valley	1	Malloy	Now-1:30am	-	0.50-0.75/1.25
09/13/23	0:34	Superstition	1	Malloy	Now-1:30am	-	0.50-0.75/1.25
09/13/23	5:20	East Valley	1	Malloy	Now-8:00am	-	0.75-1.50/2.00
09/13/23	5:20	Superstition	1	Malloy	Now-8:00am	-	0.75-1.50/2.00
09/13/23	5:20	Lower Salt River Lakes	1	Malloy	Now-8:00am	-	0.75-1.50/2.00
09/13/23	6:49	Scottsdale South	1	Malloy	Now-9:00am	-	0.50-1.00/1.50
09/13/23	7:01	New River/Cave Creek	1	Waters	Now-8:00am	-	0.50-0.75/1.00

TABLE B-2: This table shows the raw verification data of MSP issued Messages for the 2023 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 2023											
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
07/26/23	East Valley	1	-	0.50-0.75/1.00	0.67	1.01-1.25	-	-	-	-	Hit
07/26/23	Southeast Valley	1	-	0.50-0.75/1.00	0.35	0.51-0.75	-	-	-	-	Hit
07/26/23	Superstition	1	-	0.50-0.75/1.00	1.02	1.51-2.00	-	-	-	-	Hit
07/26/23	Scottsdale South	1	-	0.33-0.50/0.75	1.02	1.26-1.50	-	x	x	-	Hit
07/26/23	Scottsdale North	1	-	0.33-0.50/0.75	0.31	0.76-1.00	-	-	-	-	Hit
07/26/23	Phoenix North	1	-	0.33-0.50/0.75	0.98	1.01-1.25	-	-	-	-	Hit
07/26/23	Phoenix South	1	-	0.33-0.50/0.75	0.79	0.76-1.00	-	-	-	-	Hit
07/30/23	Gila Bend	1	-	0.50-1.00/1.50	0.16	1.01-1.25	-	-	-	-	Hit
08/01/23	Rainbow Valley	1	-	0.33-0.50/0.75	0.08	0.51-0.75	-	-	-	-	Hit
08/08/23	Phoenix South	1	-	0.25-0.50/1.00	0.39	0.26-0.50	-	-	-	-	Hit
08/08/23	East Valley	1	-	0.25-0.50/1.00	0.71	1.01-1.25	-	-	-	-	Hit
08/16/23	Palo Verde	1	-	0.50-1.00/1.50	0.55	0.51-0.75	-	x	-	-	Hit

TABLE B-2: MSP Statements Issued - Monsoon Season 2023											
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
08/16/23	Scottsdale North	1	-	0.50-1.00/1.50	1.85	1.51-2.00	-	x	-	-	Hit
08/16/23	Scottsdale North	3	-	-	1.85	1.51-2.00	-	x	-	-	Hit
08/17/23	Southeast Valley	1	-	0.50-0.75/1.25	0.24	2.01-2.50	-	-	-	-	Hit
08/17/23	East Valley	1	-	0.50-0.75/1.25	0.75	0.51-0.75	-	-	-	-	Hit
08/18/23	Gila Bend	2	-	-	-	-	-	-	-	-	Hit
08/18/23	Northwest Valley	2	-	-	-	-	-	-	-	-	Miss
08/18/23	Palo Verde	2	-	-	-	-	-	-	-	-	Hit
08/18/23	Rainbow Valley	2	-	-	-	-	-	-	-	-	Miss
08/18/23	Upper Centennial	2	-	-	-	-	-	-	-	-	Miss
08/18/23	West Valley	2	-	-	-	-	-	-	-	-	Miss
08/18/23	Wickenburg	2	-	-	-	-	-	-	-	-	Miss
08/18/23	Gila Bend	1	-	0.50-0.75/1.25	0.04	0.76-1.00	-	-	-	-	Hit
08/19/23	Gila Bend	1	-	0.75-1.25/1.75	0.20	0.26-0.50	-	-	-	-	Miss
08/19/23	Palo Verde	1	-	0.75-1.25/1.75	0.16	0.26-0.50	-	-	-	-	Hit
08/23/23	Upper Centennial	1	-	0.50-0.75/1.00	0.00	0.51-0.75	-	-	-	-	Hit
08/27/23	New River/Cave Creek	1	-	0.50-0.75/1.00	0.16	1.01-1.25	-	-	-	-	Hit
08/31/23	Gila Bend	1	-	0.50-0.75/1.25	0.04	0.76-1.00	-	-	-	-	Hit
08/31/23	Gila River	1	-	0.50-0.75/1.25-1.50	0.00	1.51-2.00	-	-	-	-	Hit
08/31/23	Southeast Valley	1	-	0.50-0.75/1.25-1.50	0.94	2.01-2.50	-	-	-	-	Hit
08/31/23	East Valley	1	-	0.50-0.75/1.25-1.50	0.12	0.76-1.00	-	-	-	-	Hit
08/31/23	Superstition	1	-	0.50-0.75/1.25-1.50	0.12	0.76-1.00	-	-	-	-	Hit
08/31/23	Phoenix South	1	-	0.50-0.75/1.25-1.50	0.39	1.26-1.50	-	-	-	-	Hit
08/31/23	Scottsdale South	1	-	0.50-0.75/1.25-1.50	0.16	0.51-0.75	-	-	x	-	Hit
08/31/23	Rainbow Valley	1	-	0.75-1.25/1.50	0.79	1.01-1.25	-	-	-	-	Hit
08/31/23	Scottsdale North	1	-	0.75-1.25/1.75	1.14	1.51-2.00	-	x	x	-	Hit
08/31/23	Phoenix North	1	-	0.75-1.25/1.75	0.87	2.01-2.50	-	-	-	-	Hit
08/31/23	New River/Cave Creek	1	-	0.75-1.25/1.75	3.03	4.01-5.00	-	x	x	-	Hit
08/31/23	West Valley	1	-	0.75-1.25/1.50	0.35	0.76-1.00	-	-	-	-	Hit
08/31/23	New River/Cave Creek	3	-	-	3.03	4.01-5.00	-	x	x	-	Hit

TABLE B-2: MSP Statements Issued - Monsoon Season 2023											
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
08/31/23	Wickenburg	1	-	0.75-1.25/1.75	0.04	1.51-2.00	-	-	-	-	Hit
08/31/23	Upper Centennial	1	-	0.75-1.25/1.75	0.08	2.01-2.50	-	-	-	-	Hit
09/01/23	Palo Verde	1	-	0.50-0.75/1.00	0.63	1.26-1.50	-	x	-	-	Hit
09/01/23	Upper Centennial	1	-	0.50-0.75/1.00	0.39	1.26-1.50	-	-	-	-	Hit
09/01/23	Wickenburg	1	-	0.50-0.75/1.00	0.28	0.76-1.00	-	-	-	-	Hit
09/02/23	Rainbow Valley	1	-	0.33-0.50/0.75	0.04	0.26-0.50	-	-	-	-	Hit
09/02/23	Gila River	1	-	0.33-0.50/0.75	0.00	0.11-0.25	-	-	-	-	Miss
09/02/23	Upper Centennial	1	-	0.50-0.75/1.00	1.50	1.51-2.00	-	-	-	-	Hit
09/02/23	Wickenburg	1	-	0.50-0.75/1.00	0.98	1.26-1.50	-	-	-	-	Hit
09/12/23	New River/Cave Creek	1	-	0.75-1.50/2.00	0.59	0.76-1.00	-	-	-	-	Hit
09/12/23	Wickenburg	1	-	0.50-1.00/1.25	0.35	0.26-0.50	-	-	-	-	Miss
09/12/23	West Valley	1	-	0.50-1.00/1.25	0.79	0.76-1.00	-	-	-	-	Hit
09/12/23	Northwest Valley	1	-	0.50-1.00/1.50	0.31	0.51-0.75	-	-	-	-	Hit
09/12/23	Phoenix North	1	-	0.50-1.00/1.50	0.31	0.51-0.75	-	-	-	-	Hit
09/12/23	Phoenix South	1	-	0.50-1.00/1.50	0.71	0.51-0.75	-	-	-	-	Hit
09/12/23	New River/Cave Creek	1	-	0.50-1.00/1.50	1.10	0.76-1.00	-	x	-	-	Hit
09/12/23	Scottsdale North	1	-	0.50-1.00/1.50	1.10	0.76-1.00	-	-	-	-	Hit
09/12/23	Scottsdale South	1	-	0.50-0.75/1.25	0.31	0.26-0.50	-	-	-	-	Miss
09/13/23	East Valley	1	-	0.50-0.75/1.25	0.04	0.26-0.50	-	-	-	-	Miss
09/13/23	Superstition	1	-	0.50-0.75/1.25	0.31	0.51-0.75	-	-	-	-	Hit
09/13/23	East Valley	1	-	0.75-1.50/2.00	0.39	0.51-0.75	-	-	-	-	Hit
09/13/23	Superstition	1	-	0.75-1.50/2.00	1.97	1.51-2.00	-	x	-	-	Hit
09/13/23	Lower Salt River Lakes	1	-	0.75-1.50/2.00	1.30	2.51-3.00	-	-	-	-	Hit
09/13/23	Scottsdale South	1	-	0.50-1.00/1.50	0.12	0.51-0.75	-	-	x	-	Hit
09/13/23	New River/Cave Creek	1	-	0.50-0.75/1.00	0.00	0.26-0.50	-	-	-	-	Miss

TABLE B-3: This table shows the lead time data of MSP issued Messages for the 2023 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 2023							
Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
07/26/23	22:19	Scottsdale South	1	Waters	Now-11:30pm	20:32	12
08/16/23	17:50	Palo Verde	1	Malloy	Now-7:30pm	17:59	9
08/16/23	17:51	Scottsdale North	1	Malloy	Now-7:30pm	18:42	51
08/18/23	11:30	Gila Bend	2	Henz	5pm(8/18/23)-	8/18 11:30	331
08/18/23	11:30	Palo Verde	2	Henz	5pm(8/18/23)-	8/18 11:30	1284
08/31/23	20:51	Scottsdale South	1	Henz	Now-10:30pm	22:04	73
08/31/23	21:16	Scottsdale North	1	Malloy	Now-11:30pm	22:15	59
08/31/23	21:16	New River/Cave Creek	1	Malloy	Now-11:30pm	21:51	35
09/01/23	12:08	Palo Verde	1	Waters	Now-1:30pm	13:15	67
09/12/23	23:18	New River/Cave Creek	1	Malloy	Now-1:00am	23:44	26
09/13/23	5:20	Superstition	1	Malloy	Now-8:00am	5:57	37
09/13/23	6:49	Scottsdale South	1	Malloy	Now-9:00am	7:24	35

APPENDIX C: MSP LAKE ALERTS – VERIFICATION TABLES

TABLE C-1: This table shows each of the individual MSP Lake Alerts issued during the 2023 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 2023									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
07/22/23	17:19	Bartlett	Henz	Now-6:30pm	-	-	-	-	Miss
07/30/23	16:40	Apache	Malloy	Now-6:30pm	x	-	x	2	Hit
07/30/23	16:40	Canyon	Malloy	Now-6:30pm	x	-	x	56	Hit
07/30/23	16:40	Saguaro	Malloy	Now-6:30pm	-	-	-	-	Miss
08/13/23	16:46	Apache	Malloy	Now-6:00pm	-	-	-	-	Miss
08/13/23	16:46	Canyon	Malloy	Now-6:00pm	-	-	-	-	Miss
08/13/23	16:46	Saguaro	Malloy	Now-6:00pm	-	-	-	-	Miss
08/16/23	13:07	Apache	Malloy	Now-4:00pm	x	-	-	65	Hit
08/16/23	13:07	Canyon	Malloy	Now-4:00pm	x	-	-	65	Hit
08/16/23	13:07	Saguaro	Malloy	Now-4:00pm	x	-	-	2	Hit
08/20/23	14:12	Apache	Malloy	Now-7:30pm	-	-	-	-	Miss
08/20/23	14:12	Bartlett	Malloy	Now-7:30pm	-	-	-	-	Miss

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2023									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
08/20/23	14:12	Canyon	Malloy	Now-7:30pm	x	-	-	23	Hit
08/20/23	14:12	Horseshoe	Malloy	Now-7:30pm	-	-	-	-	Miss
08/20/23	14:12	Pleasant	Malloy	Now-7:30pm	-	x	-	153	Hit
08/20/23	14:12	Saguaro	Malloy	Now-7:30pm	-	-	-	-	Miss
08/21/23	16:20	Apache	Henz	Now-6:00pm	x	-	-	21	Hit
08/21/23	17:54	Bartlett	Henz	Now-7:15pm	x	-	-	2	Hit
08/21/23	16:20	Canyon	Henz	Now-6:00pm	x	-	-	59	Hit
08/22/23	18:45	Apache	Malloy	Now-8:00pm	x	-	-	33	Hit
08/22/23	18:45	Canyon	Malloy	Now-8:00pm	x	-	-	16	Hit
08/22/23	18:45	Saguaro	Malloy	Now-8:00pm	x	-	-	16	Hit
08/26/23	17:09	Apache	Malloy	Now-6:30pm	-	-	-	-	Miss
08/26/23	15:46	Bartlett	Malloy	Now-6:30pm	-	-	-	-	Miss
08/26/23	17:09	Canyon	Malloy	Now-6:30pm	-	-	-	-	Miss
08/26/23	15:46	Horseshoe	Malloy	Now-6:30pm	-	-	-	-	Miss
08/26/23	17:09	Saguaro	Malloy	Now-6:30pm	-	-	-	-	Miss
08/27/23	17:56	Apache	Malloy	Now-7:30pm	-	-	-	-	Miss
08/27/23	16:06	Bartlett	Malloy	Now-5:30pm	x	-	-	3	Hit
08/27/23	17:56	Canyon	Malloy	Now-7:30pm	x	-	-	11	Hit
08/27/23	17:56	Saguaro	Malloy	Now-7:30pm	-	-	-	-	Miss
08/31/23	20:28	Apache	Malloy	Now-10:30pm	-	-	x	0	Hit
08/31/23	20:53	Bartlett	Malloy	Now-10:30pm	-	-	-	-	Miss
08/31/23	20:28	Canyon	Malloy	Now-10:30pm	-	-	x	0	Hit
08/31/23	20:53	Horseshoe	Malloy	Now-10:30pm	-	-	-	-	Miss
08/31/23	20:53	Pleasant	Malloy	Now-10:30pm	-	x	x	52	Hit
08/31/23	20:28	Saguaro	Malloy	Now-10:30pm	-	-	x	0	Hit
09/01/23	12:58	Bartlett	Malloy	Now-3:00pm	-	-	-	-	Miss
09/01/23	12:58	Horseshoe	Malloy	Now-3:00pm	-	-	-	-	Miss
09/12/23	17:41	Bartlett	Malloy	Now-7:00pm	x	-	x	104	Hit
09/12/23	16:38	Horseshoe	Malloy	Now-6:30pm	x	x	x	7	Hit

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2023									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
09/12/23	16:05	Pleasant	Malloy	Now-6:00pm	x	-	-	15	Hit

APPENDIX E: QPF STORM TOTAL PRECIPITATION – VERIFICATION TABLES

TABLE E-1: This table shows each of the individual MSP Lake Alerts issued during the 2023 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 2023											
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
07/26/23	East Valley	1.00	0.67	1.01	1.25	-	49.25	-0.99	-20.00	-	Hit
07/26/23	Southeast Valley	0.50	0.35	0.51	0.75	-	42.86	-1.96	-33.33	-	Hit
07/26/23	Superstition	1.00	1.02	1.51	2.00	-	-1.96	-33.77	-50.00	-	Hit
07/26/23	Scottsdale South	0.75	1.02	1.26	1.50	-	-26.47	-40.48	-50.00	-	Hit
07/26/23	Scottsdale North	0.75	0.31	0.76	1.00	-	141.94	-1.32	-25.00	-	Hit
07/26/23	Phoenix North	0.75	0.98	1.01	1.25	-	-23.47	-25.74	-40.00	-	Miss
07/26/23	Phoenix South	0.75	0.79	0.76	1.00	-	-5.06	-1.32	-25.00	-	Hit
07/30/23	Gila Bend	1.00	0.16	1.01	1.25	-	525.00	-0.99	-20.00	-	Hit
08/01/23	Rainbow Valley	0.5	0.08	0.51	0.75	-	525.00	-1.96	-33.33	-	Hit

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2023

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
08/08/23	Phoenix South	0.5	0.39	0.26	0.50	-	28.21	92.31	0.00	-	Hit
08/08/23	East Valley	1	0.71	1.01	1.25	-	40.85	-0.99	-20.00	-	Hit
08/16/23	Palo Verde	0.50	0.55	0.51	0.75	-	-9.09	-1.96	-33.33	-	Hit
08/16/23	Scottsdale North	1.50	1.85	1.51	2.00	-	-18.92	-0.66	-25.00	-	Hit
08/17/23	Southeast Valley	1.25	0.24	2.01	2.50	-	420.83	-37.81	-50.00	-	Miss
08/17/23	East Valley	0.75	0.75	0.51	0.75	-	0.00	47.06	0.00	-	Hit
08/18/23	Gila Bend	0.75	0.04	0.76	1.00	-	1775.00	-1.32	-25.00	-	Hit
08/19/23	Gila Bend	0.75	0.20	0.26	0.50	-	275.00	188.46	50.00	-	Miss
08/19/23	Palo Verde	0.75	0.16	0.26	0.50	-	368.75	188.46	50.00	-	Miss
08/23/23	Upper Centennial	0.50	0.00	0.51	0.75	-	-	-1.96	-33.33	-	Hit
08/27/23	New River/Cave Creek	1.00	0.16	1.01	1.25	-	525.00	-0.99	-20.00	-	Hit
08/31/23	Gila Bend	0.75	0.04	0.76	1.00	-	1775.00	-1.32	-25.00	-	Hit
08/31/23	Gila River	1.50	0.00	1.51	2.00	-	-	-0.66	-25.00	-	Hit
08/31/23	Southeast Valley	0.75	0.94	2.01	2.50	-	-20.21	-62.69	-70.00	-	Miss
08/31/23	East Valley	0.75	0.12	0.76	1.00	-	525.00	-1.32	-25.00	-	Hit
08/31/23	Superstition	0.75	0.12	0.76	1.00	-	525.00	-1.32	-25.00	-	Hit
08/31/23	Phoenix South	1.25	0.39	1.26	1.50	-	220.51	-0.79	-16.67	-	Hit
08/31/23	Scottsdale South	0.50	0.16	0.51	0.75	-	212.50	-1.96	-33.33	-	Hit
08/31/23	Rainbow Valley	0.75	0.79	1.01	1.25	-	-5.06	-25.74	-40.00	-	Hit
08/31/23	Scottsdale North	1.25	1.14	1.51	2.00	-	9.65	-17.22	-37.50	-	Hit
08/31/23	Phoenix North	0.75	0.87	2.01	2.50	-	-13.79	-62.69	-70.00	-	Hit
08/31/23	New River/Cave Creek	1.75	3.03	4.01	5.00	-	-42.24	-56.36	-65.00	-	Miss
08/31/23	West Valley	0.75	0.35	0.76	1.00	-	114.29	-1.32	-25.00	-	Hit
08/31/23	Wickenburg	1.75	0.04	1.51	2.00	-	4275.00	15.89	-12.50	-	Hit
08/31/23	Upper Centennial	1.75	0.08	2.01	2.50	-	2087.50	-12.94	-30.00	-	Hit
09/01/23	Palo Verde	0.75	0.63	1.26	1.50	-	19.05	-40.48	-50.00	-	Hit
09/01/23	Upper Centennial	1.00	0.39	1.26	1.50	-	156.41	-20.63	-33.33	-	Hit
09/01/23	Wickenburg	1.00	0.28	0.76	1.00	-	257.14	31.58	0.00	-	Hit
09/02/23	Rainbow Valley	0.50	0.04	0.26	0.50	-	1150.00	92.31	0.00	-	Hit

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2023

Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
09/02/23	Gila River	0.33	0.00	0.11	0.25	-	-	200.00	32.00	-	Miss
09/02/23	Upper Centennial	1.00	1.50	1.51	2.00	-	-33.33	-33.77	-50.00	-	Miss
09/02/23	Wickenburg	1.00	0.98	1.26	1.50	-	2.04	-20.63	-33.33	-	Hit
09/12/23	New River/Cave Creek	0.75	0.59	0.76	1.00	-	27.12	-1.32	-25.00	-	Hit
09/12/23	Wickenburg	0.50	0.35	0.26	0.50	-	42.86	92.31	0.00	-	Hit
09/12/23	West Valley	0.75	0.79	0.76	1.00	-	-5.06	-1.32	-25.00	-	Hit
09/12/23	Northwest Valley	0.50	0.31	0.51	0.75	-	61.29	-1.96	-33.33	-	Hit
09/12/23	Phoenix North	0.50	0.31	0.51	0.75	-	61.29	-1.96	-33.33	-	Hit
09/12/23	Phoenix South	0.75	0.71	0.51	0.75	-	5.63	47.06	0.00	-	Hit
09/12/23	New River/Cave Creek	1.00	1.10	0.76	1.00	-	-9.09	31.58	0.00	-	Hit
09/12/23	Scottsdale North	1.00	1.10	0.76	1.00	-	-9.09	31.58	0.00	-	Hit
09/12/23	Scottsdale South	0.50	0.31	0.26	0.50	-	61.29	92.31	0.00	-	Hit
09/13/23	East Valley	0.50	0.04	0.26	0.50	-	1150.00	92.31	0.00	-	Hit
09/13/23	Superstition	0.50	0.31	0.51	0.75	-	61.29	-1.96	-33.33	-	Hit
09/13/23	East Valley	0.75	0.39	0.51	0.75	-	92.31	47.06	0.00	-	Hit
09/13/23	Superstition	2.00	1.97	1.51	2.00	-	1.52	32.45	0.00	-	Hit
09/13/23	Lower Salt River Lakes	1.50	1.30	2.51	3.00	-	15.38	-40.24	-50.00	-	Hit
09/13/23	Scottsdale South	0.50	0.12	0.51	0.75	-	316.67	-1.96	-33.33	-	Hit
09/13/23	New River/Cave Creek	0.50	0.00	0.26	0.50	-	#DIV/0!	92.31	0.00	-	Hit
* GAQPE (Radar) estimated data given in ranges: (LT) Lower Total and (UT) Upper Total											