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STORM RAINFALL PROBABILITY ATLAS FOR ARIZONA

Final Report

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16. ABSTRACT

Estimates of short duration rainfall intensities are critical input parameters for the design of highway drainage. This is of particular importance in urban areas. Besides highway use during heavy rainfall, property adjacent to highway right-of-way is subject also to flood damage due to heavy runoff.

Precipitation-frequency Atlases in current use in Arizona were prepared using data prior to 1970. Considerable data are available to update these reports. New studies are needed incorporating hydrometeorological considerations in the statistical analyses and regional smoothing. A survey of precipitation data currently available indicates such studies are feasible and could lead to significant improvements over previous studies.

The pre-overhead estimate for preparing the recommended study totals $242,500, which includes: (1) Storm Rainfall Probability Atlas, and (2) In-Storm Temporal and Areal Distribution Manual. This estimate does not include overheads which are sometimes negotiated. The above figure includes $ 24,000 to produce a designer-oriented manual on Temporal/Areal within-storm criteria.

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PREFACE

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LIST OF ACRONYMS

AHDCO = Arizona Hydrometeorological Data Coordinating Organization

ARS = Agricultural Research Service, U.S. Department of Agriculture

ASU = Arizona State University

ATRC = Arizona Transportation Research Center, ASU

BIA = Bureau of Indian Affairs, U.S. Department of Interior

BLM = Bureau of Land Management, U.S. Department of Interior

CAHDMA = Central Arizona Hydrometeorological Data Management Association

Co-op = Cooperative weather station of NOAA

EV = Extreme Value, probability distribution

HMR = Hydrometeorological Report (of the U.S. Department of Commerce)

IDF = Intensity duration frequency

LP3 = Log Pearson Type III method of fitting annual extremes

MCFCD = Maricopa County Flood Control District

NCDC = National Climatic Data Center

NOAA = National Oceanic and Atmospheric Administration, U.S. Department of Commerce

NOAA2 = National Oceanic and Atmospheric Administration Atlas No. 2, Miller et al., 1973.

NWS = National Weather Service, NOAA

NWS-CPM = National Weather Service, Community Preparedness Meteorologist

PC = Personal Computer

PENDOT = Pennsylvania Department of Transportation

PSU = The Pennsylvania State University

P2y24h = 2-year 24-hour rainfall

REPHLEX = Retrievable Procedures for Hydrologic Data from ARS Experimental Watersheds in the United States

SCS = Soil Conservation Service, U.S. Department of Agriculture

SNOTEL = Snow Telemetry, gages operated by the SCS using meteorburst telemetry

SRP = Salt River Project, Phoenix, Arizona

TB = Tipping Bucket recording raingage

TD xxxx = Tape Data xxxx, code used by NCDC for magnetic tape data identifier for a particular data type and element

TP40 = Weather Bureau Technical Paper 40, "Rainfall Frequency Atlas," Hershfield, 1961

UA = University of Arizona

UA AZMET = University of Arizona Cooperative Extension Service Agricultural Meteorological Network

USCOE = U.S. Army Corps of Engineers

USFS = U.S. Forest Service, U.S. Department of Agriculture

USGS = U.S. Geological Survey, U.S. Department of Interior

WB = Weighing bucket recording raingage

WSFO = Weather Service Forecast Office

WSO = Weather Service Office

STORM RAINFALL PROBABILITY ATLAS FOR ARIZONA

B. M. Reich, A. J. Brazel, and R. A. Clark

I EXECUTIVE SUMMARY ON NEED AND JUSTIFICATION

Estimates of short duration (10 to 60 minute) rainfall intensities are critical input parameters for the design of highway drainage. This is particularly important in urbanizing environments, where expensive building and improvement programs are taking place. Besides heavy highway use during intense rainfalls, these locations also contain a concentration of small property owners where flood damage adjacent to highway right-of-way can lead to many complaints, and possible lawsuits. Pavement drainage, culvert sizing, storm drain or channel design, bank protection, or bridging of larger streams are involved. Methods for estimating the flood peak depend, in most areas, on the rainfall intensity of a chosen frequency (return period).

I.1 Local And Arid-West Interest In Restudy

Pilot surveys have recently been undertaken by several Arizona communities to explore what may be done to improve their rainfall intensity manuals. Some counties do not have enough information to adequately depict rainstorm variation across them. Other counties contain more raingages; possibly, more than they are interested in analyzing. Analyses of data from a few gages, even if performed correctly with appropriate statistical methods, will not serve adequately the large areas of other Arizona counties. Regional hydrometeorological considerations must be incorporated into the process of smoothing isolines through the field of individual estimates of rainfall intensity-duration-frequency (IDF)* at each raingage. In addition to providing consistency and economy of scale, a statewide approach carries the important possibility of coordinating the new rainfall IDF maps with the National Weather Service (NWS) and other interested Federal and State agencies. Arizona appears to be better off than our neighbors in the arid-west with regards to the accumulation of additional, yet un-analyzed rainfall intensity data. Nevertheless, in all arid western states there remains need for updated IDF mapping. Federal funds are, unfortunately, no longer available to reanalyze short duration rainfall intensities.

Today's storm runoff analyses require additional rainfall information besides IDF. To insure that floods downstream of construction are not worsened, designers require hydrologic routing to account for stormwater detention. Such computations must be based on the time-distribution of rain within a storm. Watershed runoff models for such designs also use estimates of the areal coverage of heavy, short-duration storms, as well as the time sequencing of different intensities.

I.2 Need To Augment NWS Database

Most intense summer rainstorms in Arizona cover very small areas. Fortunately, longstanding experimental rangeland and forest watershed research has been pursued for many decades throughout Arizona by the Agricultural Research Service (ARS)

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*Acronyms used in this document start on page vi.

and the U.S. Forest Service (USFS) of the U.S. Department of Agriculture and the University of Arizona (UA). These scientific endeavors required the operation of dense networks containing many recording raingages spaced only a few miles apart. Most of these six dense networks are located at higher elevations than the raingages in the NWS network. They contain information on areal and temporal characteristics of short flood-producing storms, which should be analyzed and/or presented in design format for Arizona hydraulic/hydrologic engineers.

These non-NWS data also more than quadruple the number of Arizona stations where rainfall IDF can be computed. The NWS maintains less than forty recording raingages in each of Arizona, Nevada, and Utah. The addition of the ARS, USFS, and UA dense network data places Arizona in a superior position to its neighboring states. Rapid growth-rates (urbanization) in the Southwest makes it necessary to ensure that highway structures capitalize on potentially improved knowledge of rainstorms. This should minimize highway users' exposure to flood hazards. It could also reduce construction costs by eliminating overdesign.

Data shortage was a basic problem when the latest National Oceanic and Atmospheric Administration's "Precipitation-Frequency Atlas of the Western United States" (NOAA2) [1]** (Miller et al., 1973)*** was prepared for the Soil Conservation Service (SCS) using pre-1970 data. Only 38 recording raingage stations in

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**Numbers in square brackets refer to articles in the List of References. The References are a subset of the Bibliography presented in the Appendix A.

***Authors and dates are added in parentheses for the convenience of the reader.

Arizona with 731 station-years of data were used. Data were also limited by being tabulated at the end of each clock hour. On average, each gage sampled 3,100 square miles. The information shortage is aggravated by the rare occurrence and spotty nature of heavy rainfall centers in an arid climate. Research in southeastern Arizona [2] (Osborn et al., 1980) showed, for 30 minute rains, that the highest point rainfall can be more than twice the average depth across 80 square miles of a storm. NOAA2 was limited by a gross spatial network which missed many larger point values. Moreover, the average record length of less than 20 years produced very unsure estimates at each gage site for 100- (or even 50-) year return periods.

Today over 300 recording gages have been operated by various agencies throughout Arizona. Some of these data has been digitized at each time the intensity changed (break-point data) within a storm. This format contains the type of information needed by today's designers. Future analysis should process the rest of the data in this "break-point" format. Longer histories and additional sites will produce about 2,800 station-years of additional data. The longer records should enable more reliable 100-year point estimates. Addition of ARS, USFS, and UA gage sites will give additional points through which isolines can be smoothed across Arizona.

I.3 Advantages Anticipated From New Rainfall Intensity Study

Besides providing state, county, and local government agencies with an updated analysis of a greatly enhanced database of short-duration rainfall measurements, the contemplated investigation will yield other opportunities. Arizona research [2] (Osborn et al., 1980) shows that flood peaks and flood hydrographs in Arizona are heavily influenced by the high rainfall intensities that last for 30 minutes or less. As urbanization thickens across the desert, increased imperviousness will cause these flash floods to become more frequent and severe. As more of us converge upon these areas more of us will suffer adverse impacts of mud and flood. Ever expanding financial and societal benefits will accrue from our first statewide study of rainfall recorded autographically, during downpours of 2 hours to less than 15 minutes throughout the last 20 to 60 years.

Secondly, the dichotomy between the two latest NWS IDF-Atlases, TP40 [3] (Hershfield, 1961) and NOAA2 can be resolved. Reference is made to NOAA2's introduction of very complicated isolines, which suggest large differences in rainfall intensities switching back and forth at close sites, many times even within a county. Application of the numerous such maps contained in NOAA2 requires much of the user's time and enhances opportunity for error in engineering or hydrology design. Previous paucity of observations coupled with the highly random occurrence of high intensity short-duration rainstorms does not substantiate the highly contorted isolines shown in NOAA2.

The relatively user-friendly form of TP40 resulted in many users not changing to the NWS update (NOAA2). Eliminating this non-uniformity between or among user groups would provide the third incentive for initiating a comprehensive study. Fourthly, the tendency for smaller communities to reanalyze updated records of one local gage would be discouraged by instituting a statewide study. It would provide more control and can provide economy of scale.

Fifth, a single study contractor is more likely to successfully obtain the appropriate data from various groups that have maintained and/or analyzed recording raingages in Arizona.

A sixth benefit from a unified study is the opportunity to harness, through association, the expertise [2] (Osborn et al., 1980) of workers who have missions other than highway design. Some of these people could offer valuable advice on complementing their previous studies in order to solve some highway design needs. Viewed from the communications angle, this project is an opportunity to develop hydrology/hydraulic engineering manuals from research results that may otherwise simply end in scientific engineering journals.

The seventh advance that the proposed research could give highway engineers is a digital rainfall atlas. Entering latitudes & longitudes could instantaneously call up IDF values for flood peak estimation. Answers could be rapidly obtained from a personal computer (PC).

New methods for estimating intensities within design storms over small watersheds would comprise the eighth benefit. Sequences of rainfall increments within a runoff-producing storm provide necessary input for deterministic hydrograph models. The latter may be used through PCs on ungaged urban or rural watersheds to produce flood volumes or peaks and flood forecasting algorithms, as well as for predicting scour or deposition from computerized sediment-transport models. A recent national design storm study [4] (Yen and Chow, 1983) involved data from only five Arizona sites. Perhaps more serious is that it developed "design storm" parameters from an average of 30 storms per year at each site. Such small events represent an entirely different universe from the few flood-producing storms of interest to the highway designer.

The time seems appropriate to take advantage of the additional number of raingages and their longer records. On a one-state basis we can now digitally process the very short duration intensities from a database which has quadrupled since the NOAA2 analysis was restricted largely to daily observations, supplemented by clock-hour accumulations at only 38 short-record Arizona stations. A new study could produce a quantum leap in data-dependent precision in rainfall estimates in Arizona. At the same time, it is now possible to produce design products needed for today's computerized hydrograph models.

I.4 Expected Cost And Time Requirement For New Study

The time-span considered appropriate for completion of this new rainfall intensity study of Arizona is two years. It is anticipated that some delays will be experienced in obtaining the NWS information from Asheville, N.C. and other locations. Checking the digital information will be time consuming, as will the digitization of chart and tabular information. The team considered most appropriate for the project would consist offour graduate students or technicians closely supervised by a team of professional hydrologists/meteorologists and analysis representing the following interests: climatic data analysis and storage, hydrometeorology, statistical hydrology and applications to highway drainage and arid zone hydrology. Fig. 1 indicates how the various proposed research tasks interact.

Eighteen person-months of professional time will be needed to plan and direct student efforts, to check student work, to make professional contacts, to manage the project, and to prepare the final IDF Atlas. Table 1 details items in a hypothetical budget for all but the in-storm Temporal/Areal distributions part. Twelve person-months of secretarial time is included along with communications, computer services and technical consulting. A small amount of travel to NWS and state offices will be needed. A portable microcomputer and digitizer are considered essential equipment. The total project cost is estimated to be $218,500. Indirect costs are not included--these can range from 50 to 100 percent of the Total.

The additional examination of in-storm temporal/areal data and literature will be cost and time effective. The pre-overhead estimate is $242,500 for both tasks: (1) IDF Atlas preparation, and (2) In-Storm Temporal and Areal Distributions Manual. This figure includes $24,000 for Task 2), which represents blocks 26 through 29 in Figure 1. Table 1 was developed for Task 1) on the IDF Probability Atlas alone which could be completed within 24 months, for $218,500; within the same time-frame, and possibly six months sooner, Task 2) on Temporal/Areal Distributions could be completed.

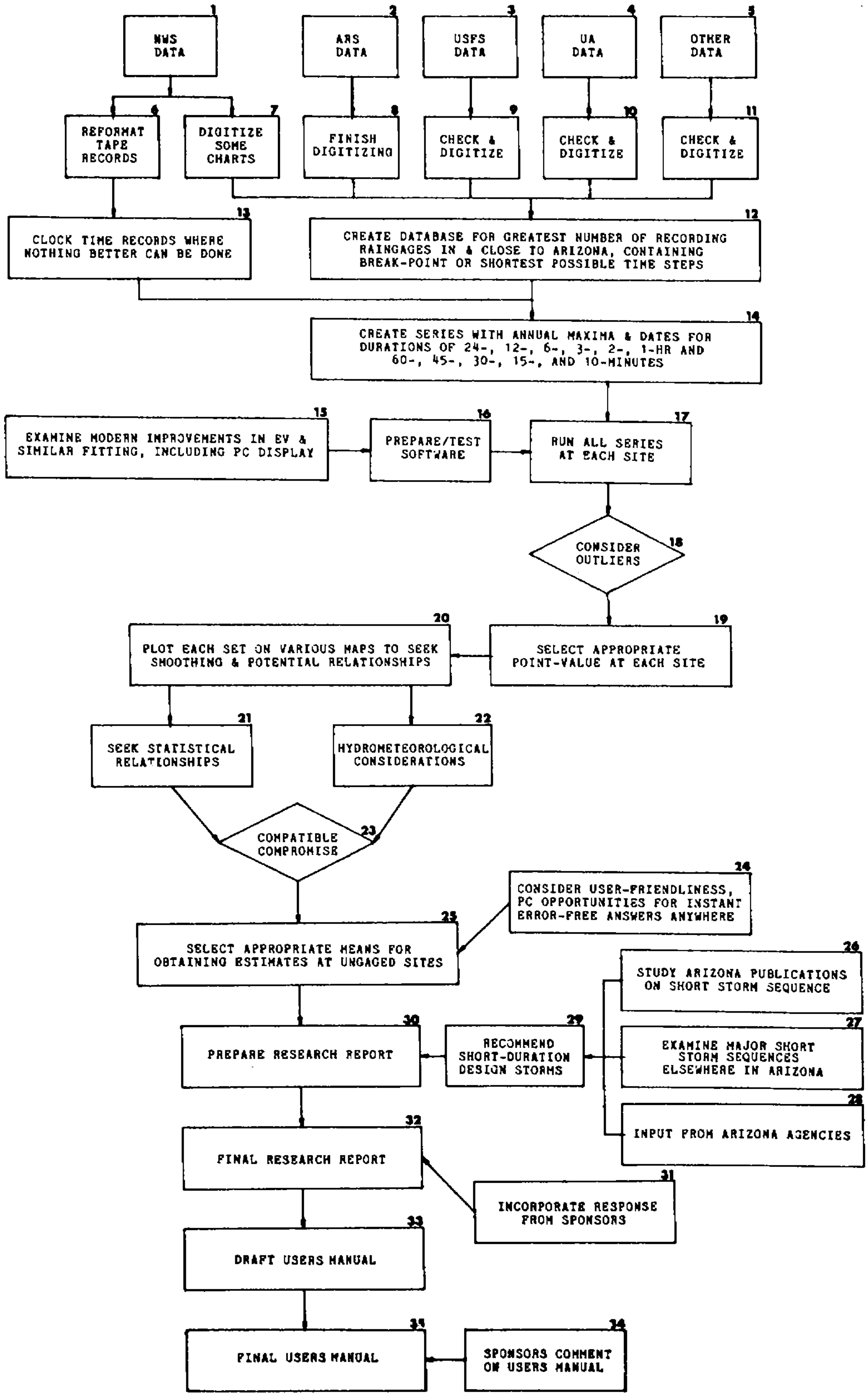


FIGURE 1. FLOWCHART OF RESEARCH TASKS

Table 1. Hypothetical Pre-Overhead Budget for 2 Year Storm Atlas Project

		Person Months	Dollars
Direct Labor			
Director		12	55,000
Hydrometeorologist		2	10,000
Climatologist		3	15,000
Stochastic Hydrologist		1	5,000
4 Part-time Graduate Students		48	66,500
Secretarial		12	12,000
	Sub-total		163,500
Fringe Benefits			10,000
	Sub-total labor plus benefits		173,500
Other Expenses			
Ph.D. Consultant on Site Selection and Precipitation Chart Computerization			5,000
Computer Services			10,000
Communications			4,000
Travel			6,000
Supplies and Data Costs			5,000
Publication Costs			5,000
	Sub-total		35,000
Equipment			
Portable Microcomputer, Accessories and Software			7,000
Map Measuring, Digitizing and Drafting Equipment			3,000
	Sub-total		10,000
	TOTAL		218,500

Note: An Engineering Manual on In-Storm Temporal and Areal Distributions could be prepared for an additional $24,000. This will require: 1 half-time student, 2 additional months for the Director, and 0.8 month for the Climatologist.

II PRESENT AND POTENTIAL DATABASES

II.1 Databases

Databases can be organized into three groups:

(1) NWS precipitation gages (recording and nonrecording) used in NOAA2 and those that could be employed in a new analysis,

(2) non-NWS precipitation gages and records not used in NOAA2 that have data of sufficient length to test the old maps and to use in a new analysis, and

(3) precipitation gages (both NWS and non-NWS) with records too short (less than 15 years after 1970) to evaluate return periods, but which could be employed in the analysis of events of interest, and eventually will have archived data for future analyses.

This discussion relies on a series of maps to show networks, tables to summarize the precipitation gage inventory, and detailed tabular appendices (Appendix B) listing stations alphabetically. These tables contain station name, network, latitude, longitude, elevation, county, gage description, length of record, time of observation (24 hour gages only), and (for NWS stations) the NWS ID#. No detailed information is given at this time on the missing data problem, only general statements as to data quality. It has been found in other studies of the hourly precipitation database that missing records per station range from 0 to 36 percent, with a mean of 7.8 percent for any given station [5] (Balling and Brazel, 1986). Probably for the co-op (Cooperative NWS Stations-normally daily reports) sites a similar statistic applies, although the figure may be lower than 7 percent on average, since most observers are at their sites each day. The NWS CPM (Cooperative Program Manager) would flag sites with consistent incomplete data and attempt to rectify any problem.

In developing this section, many sources of information have been used: (1) The Arizona Department of Water Resources gage inventory available on their computer system that they took over in 1980 from the U.S. Army Corps of Engineers (Hydrometeorologic Data Source Inventory); (2) records of station histories of the NWS sites available at the Office of the State Climatologist at Arizona State University; and (3) conferences with personnel from the USGS, USFS, ARS, BIA, UA, BLM, Navajo Nation, Pima County, SCS, SRP, Maricopa County Flood Control District (MCFCD), and Department of Water Resources of Arizona.

II.1.a National Weather Service Network

Gages that were used for the NOAA2 Atlas precipitation frequency analysis of data up to 1970 employed 38 recording and 191 nonrecording precipitation gages in Arizona (see Figs. 2 and 3). The NWS recording and nonrecording gages with records continuing for at least 15 years post 1970 are shown on Figs. 4 and 5. Since NOAA2 did not include an index listing the stations used in the precipitation frequency analysis, it was assumed that NWS stations with records of at least 10-15 years prior to 1970 were employed (p. 2 in the NOAA2 Atlas). There are still 25 recording gages available of the original 38 used in NOAA2. The ones that have dropped out are clustered in Gila, Graham, Santa Cruz, and Yavapai counties for the most part. Of the 13 that

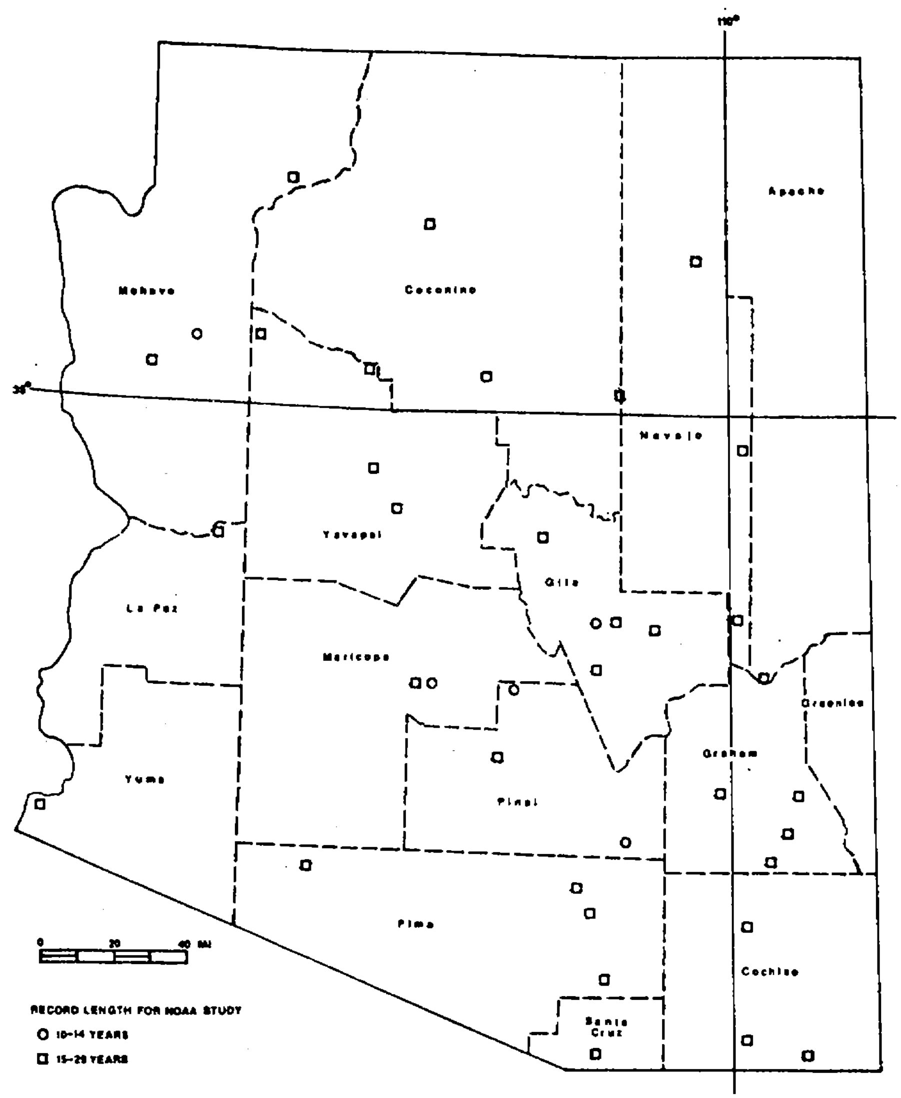


Figure 2. NOAA2 ATLAS RECORDING GAGES

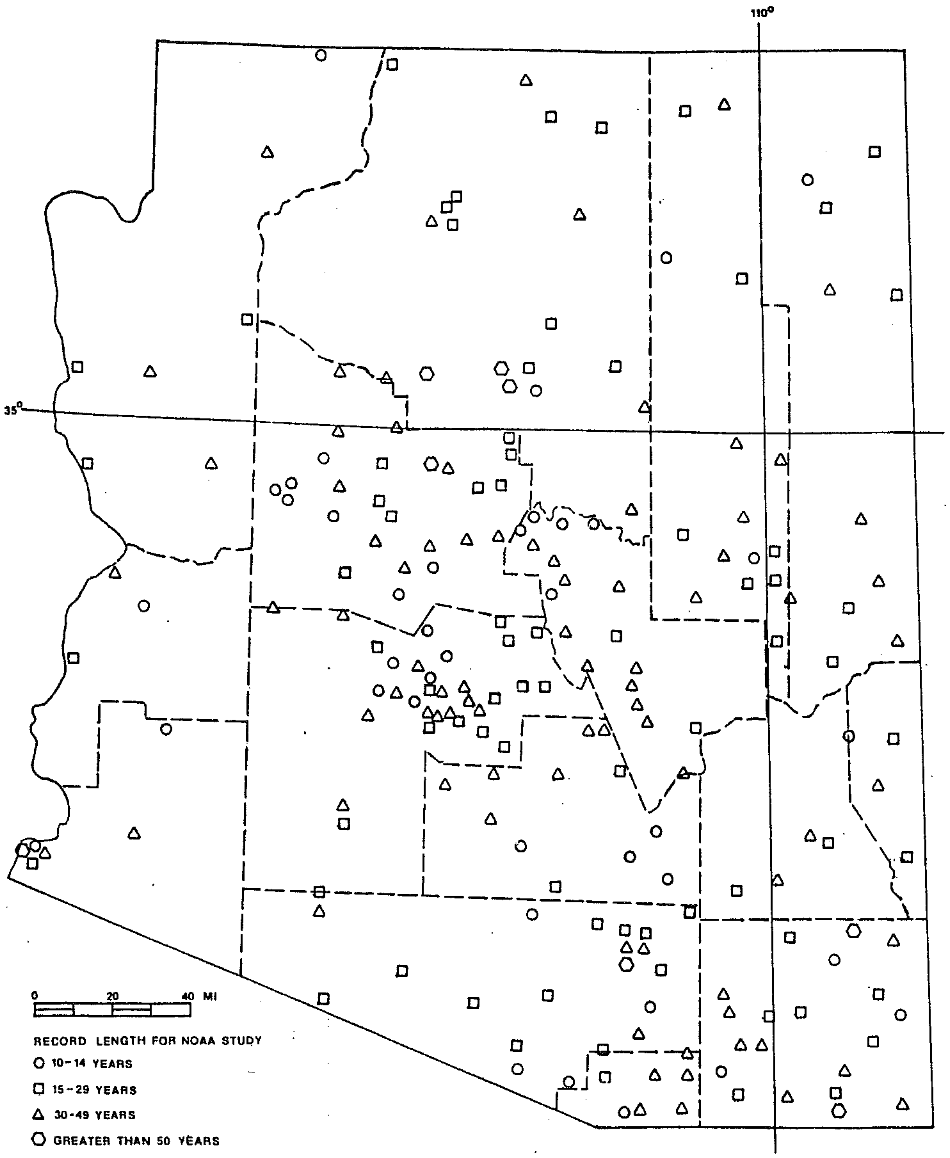


Figure 3.NOAA2 ATLAS NONRECORDING GAGES

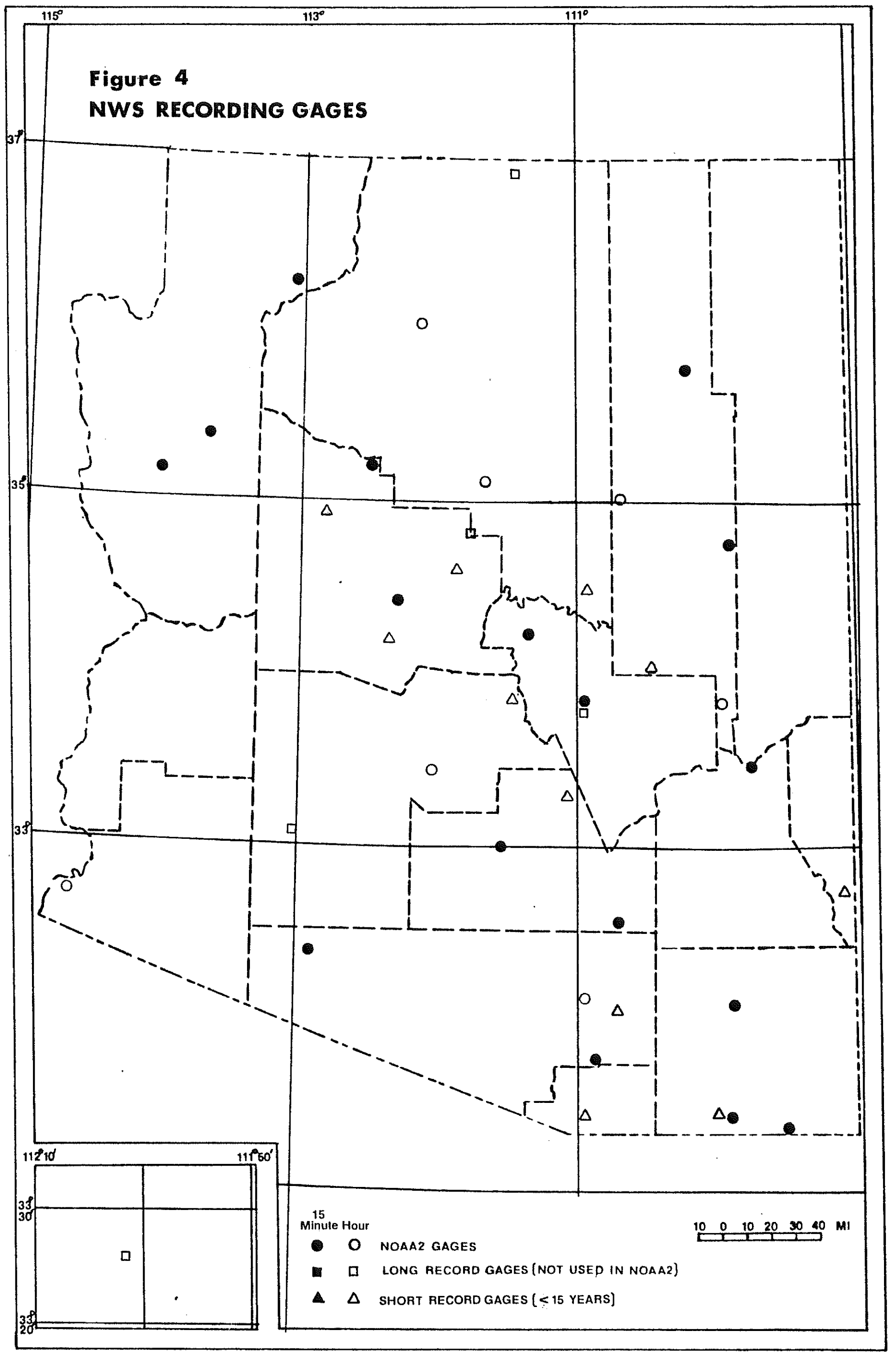


Figure 4
NWS RECORDING GAGES
115°
113°
111°
37°
35°
33°
112°10'
111°50'
33°30'
33°20'
15 Minute
Hour
NOAA2 GAGES
LONG RECORD GAGES (NOT USED IN NOAA2)
SHORT RECORD GAGES (< 15 YEARS)
10 0 10 20 30 40 MI

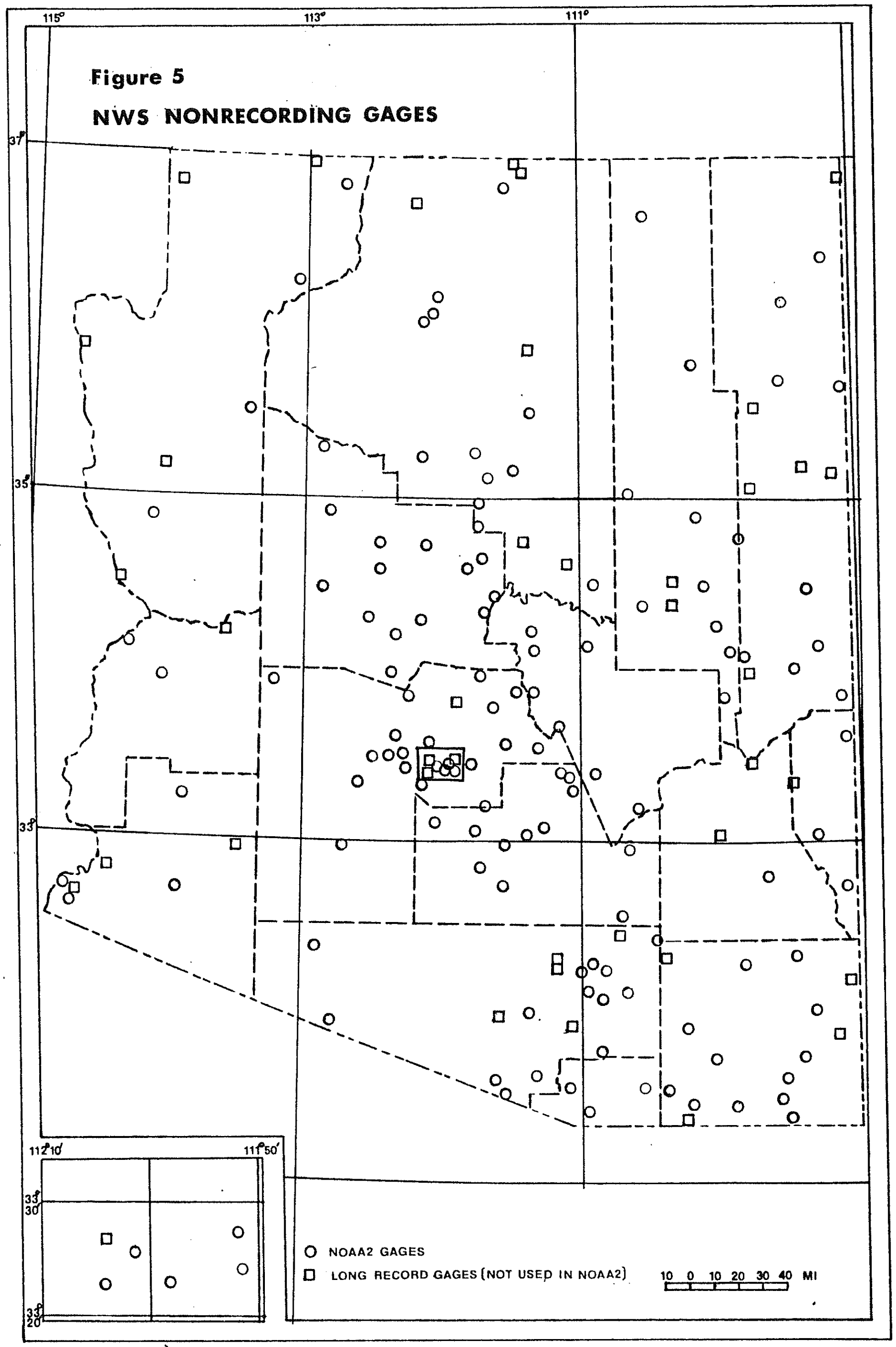


Figure 5
NWS NONRECORDING GAGES
115°
113°
111°
37°
35°
33°
112°10'
111°50'
33°30'
33°20'
NOAA2 GAGES
LONG RECORD GAGES (NOT USED IN NOAA2)
10 0 10 20 30 40 MI

were discontinued, 7 were dropped in Graham and Gila counties alone. Otherwise the geographic distribution of the remaining 25 gages is spread out over the state in a similar fashion to the NOAA2 sites. Given that 15 years post 1970 could be used in a new analysis for short duration estimates, 4 additional and new gages not used in NOAA2 could be employed--Page, Sedona Ranger Station, Painted Rock Dam, and either Workman Creek or Sierra Ancha (difficult to tell from the NOAA2 Atlas base map, since there is no listing of stations used in the Atlas). In addition, 11 recording gages have been added to the NWS network since 1970 but have records less than 15 years as of July 1987 (see Fig. 4). Their distribution will eventually help in coverage particularly in Yavapai, Pinal, Greenlee, Pima, and Santa Cruz counties.

Of the original 191 co-op 24-hour nonrecording sites, only 136 remain from NOAA2 data (see Fig. 5). Thirty new sites have sufficient data (ca. 15 years post 1970) for a new analysis. These sites will aid in Apache, Northern Coconino, Central, and Northern Mohave, Graham, and Greenlee counties for the most part. Twenty-three new sites have been established since 1970, but have too short a record as of 1987 for use in a new analysis. These 23 sites have been added in 12 of the 15 counties of the state and are not clustered in any one particular region of the state.

Thus, referring to Table 2, the number of nonrecording gages used in NOAA2 was 191; recording gages, 38. In a new analysis, 166 of the 191 nonrecording gages have sufficient record lengths of at least 15 years post 1970. Twenty five of the original 38 recording gages have records past 1970 (up to 15 years post 1970), four new ones have about 15 years record post 1970, and 13

Table 2. Number of Precipitation Gages in Arizona

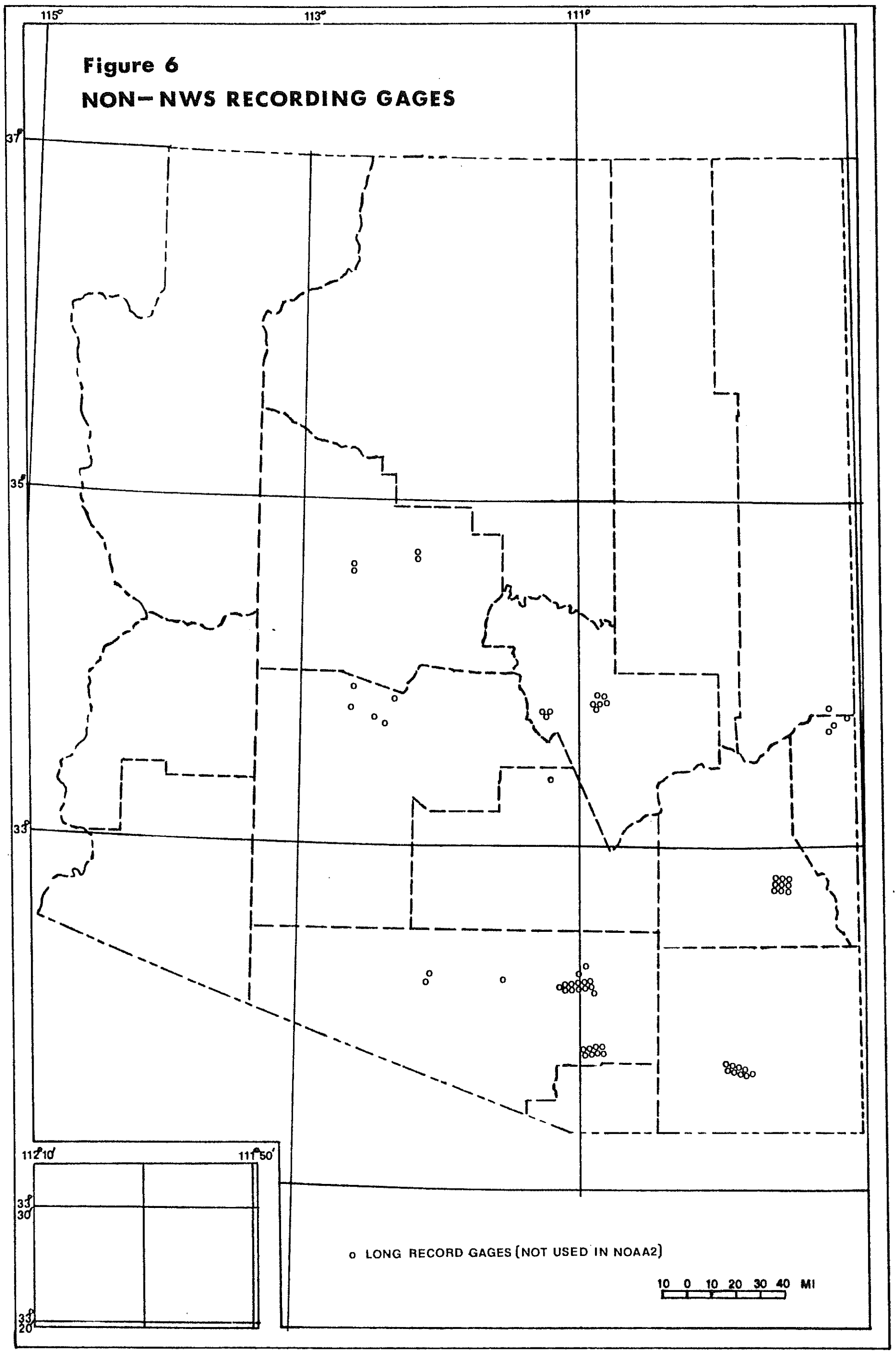
Network*	NOAA2 Atlas Nonrecording	NOAA2 Atlas Recording	New Analysis Nonrecording	New Analysis Recording
NWS	191	38	166	29
USFS	0	0	-	17
ARS-USDA	0	0	-	26
BIA	0	0	-	3
USCOE	0	0	-	1
UA	0	0	-	14
MCFCD	0	0	-	5
	191	38	166	95

*See Table 4 for agency name and address.

that were originally used do not have record lengths up to 15 years post 1970 and are now closed. This does not mean to imply that these 13 stations can not be further analyzed at all, but there is basically insufficient new data post 1970 (based on the 15 year criteria).

II.1.b Other Networks Available

Fig. 6 shows the distribution of non-NWS recording gages not used in NOAA2 which, in fact, have record lengths exceeding 15 years (either during the period prior to 1970 or afterward). These gages are listed by network in Table 2. The non-NWS networks are concentrated in Pima, Cochise, Graham, Maricopa, Gila, and Yavapai counties--critical regions of intense summer rains and in counties that have suffered attrition in the NWS network, with the exception of Cochise county. Many of the gages are located in clustered deployment in small and moderately sized watersheds, as opposed to being spread out over each of these counties, since the various agencies are either researching watersheds for runoff behavior or using the gages for flood warning purposes. The data provided by these networks pose both advantages and disadvantages as a result. Superposition of the NWS network map (Fig. 4) on Fig. 6 (see Fig. 7) shows that geographic gaps evident in the NWS network are somewhat filled in for Yavapai, Gila, Maricopa, Graham, Greenlee, Cochise, Pima, and Pinal counties. There is also an excellent opportunity to compare network results with NWS data in Gila county (USFS gages), in Southern Pima county (ARS gages), and in the Tucson area (UA gages). The disadvantages of these data networks lay in


115°
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NON-NWS RECORDING GAGES
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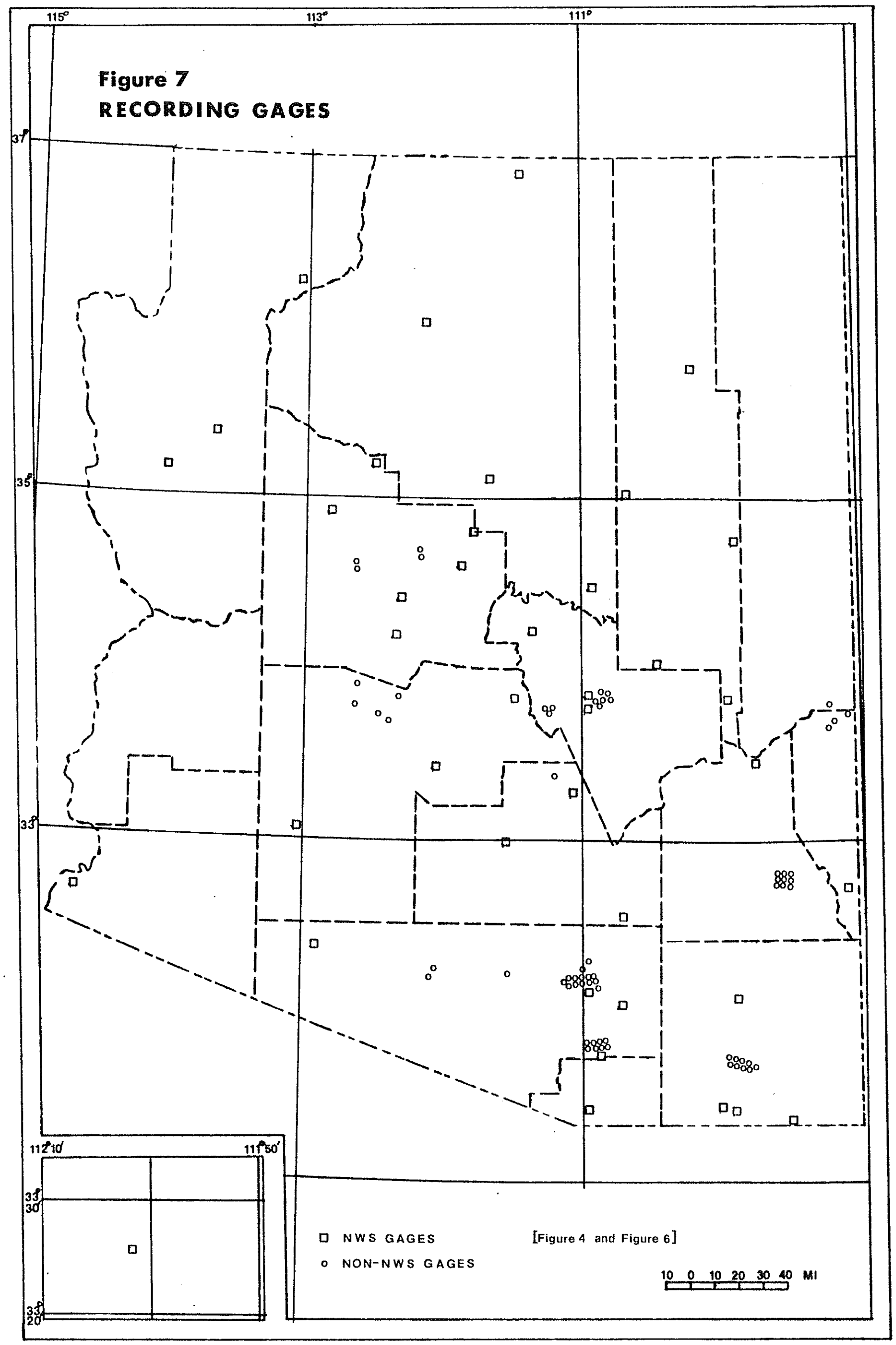
115°
113°
111°
Figure 7
RECORDING GAGES
37°
35°
33°
112°10'
111°50'
33°30'
33°20'
NWS GAGES
NON-NWS GAGES
[Figure 4 and Figure 6]
10 0 10 20 30 40 MI

data acquisition, computerization, and calibration interrelationships with NWS gages. All NWS data are available on computer tapes from NCDC (National Climatic Data Center) at relatively low cost. The data from other networks would have to be quality controlled and centralized into a major data base before an analysis could be undertaken. A later section addresses these issues.

II.1.c New Sites With Presently Short Periods Of Record

Through discussions with various agencies and as a result of analysis of the Arizona Department of Water Resources gage inventory, Table 3 was constructed to summarize the networks that have gathered precipitation data of short record length (less than 15 years). Most of the recording gages have been gathering data for only 5 to 10 years, many of them for even shorter periods of time. The inventory indicates that there are 381 recording gages in this category. A determination of nonrecording gages yields at least 292 additional sites. The Navajo Nation, BIA, USFS, MCFCD, City of Phoenix (plus ASU), Pima County, and ARS networks have geographically dense, clustered networks in Apache, Yavapai, Gila, Greenlee, Maricopa, Pima, and Cochise counties. Other networks which are spread out more geographically are those of the SCS, UA AZMET, USGS, and BLM. Generally, the SCS maintains year-round precipitation gages in the higher elevations of central and eastern Arizona as part of the SNOTEL system. UA AZMET has sites in important agricultural locations of southern Arizona. The USGS has a wide distribution of sites located along many important strems in Arizona. BLM

Table 3. Precipitation Gages--Short Term Records Only

Network*	Nonrecording	Recording	Gage Type	Resolution
ARS	-	81	WB	0.01"
BIA	-	7	TB	0.01"
BLM	53	22	WB	0.01"
SCS	-	18	TB	0.10"
USGS	-	99	TB	0.01"
Navajo Nation	-	10	WB	0.01"
ASU	-	1	TB	0.01"
UA AZMET	-	15	TB	0.01"
City of Phoenix	-	10	TB	0.01"
MCFCD	150	62	TB	0.04"
Pima County	130+	25	TB	0.01"
	333	368		

*See Table 4 for agency name and address.

maintains a network in southeastern Arizona spread within Graham and Cochise counties. Currently, agencies B]perating these networks archive their own data, and the NWS River Forecast Center in Salt Lake City has gathered on computer much of these network data.

II.2 Nature Of The Precipitation Data

II.2.a National Weather Service Network

The precipitation data, both nonrecording and recording, can be obtained on magnetic computer tapes from the National Climatic Data Center (NCDC), Asheville, North Carolina. Two tapes (coded TD xxxx) are relevant to new analyses on precipitation: TD 3240, the Hourly Precipitation Data, and TD 3260, the 15 Minute Data. Hourly data on tape are for the period 1948 to 1983. More recent years would have to be extracted from a national data file for Arizona stations and involves more effort on NCDC's part. This would involve a sorting by state, to get Arizona's data, and merging of each year (1984 to present). To obtain one year's 15 minute tape data or hourly tape data would cost approximately $120 for each tape. Thus, to obtain the NWS hourly and 15 minute records for 1984-1987 would cost approximately $1,000. To obtain the hourly (1943-1983) and 15 minute data (only 1971-1983 on tape) would cost circa $120 each or $240. Hence to obtain a new data base of all available 15 minute and hourly data for the NWS stations covering the period 1971 to the present would cost approximately $1300. If one were to desire data prior to 1948, these could be obtained by purchasing copies of the original triple registered charts (weighing bucket records (WB)) for $3.00

a daily chart. This would cost $1095 per station year. Another source is the tabulated data from the Hydrologic Bulletin (U.S. Department of Commerce in cooperation with the War Department, compiled at the Weather Bureau Office, Hydrologic Unit, San Francisco, California). These records are hourly and daily. These would cost about $240 to obtain in paper copy format (copy charges at $0.25 per page) from the Office of the State Climatologist. No computer tapes at NCDC contain these older data prior to 1948. The data after 1970 in the NWS network consist primarily of Fisher and Porter gage data with a resolution of only 0.10 inches. Some sites have Universal gages with better resolution of the data (ca. 0.01 inches). These latter sites include Flagstaff, Grand Canyon, Page, Alamo Dam, Painted Rock Dam, Phoenix WSFO, Winslow WSO, Tucson WSO, and Yuma WSO. Thus, nine of the 29 sites that could be used in a new analysis would have finer resolution data, and 20 of the remaining sites in the NWS network would have only the 0.10 inch resolution. The data tape TD 3260 lists all data to the nearest 0.01 inches, but flags sites that record to only the nearest 0.10 inches.

In terms of the nonrecording gages, an important consideration in analyzing 24 hour extremes is the observation time. For sites recording near sunset or in the afternoon, rainfall may artificially be partitioned between two days and in essence reported as separate events. It is unlikely that recording times in morning hours would bias summertime intense 24 hour rain extremes, since the majority of rain occurs from mid-afternoon to midnight or shortly thereafter. Approximately 56 percent of the co-op network record daily precipitation sometime in the afternoon hours ranging from noon to 1900 hours. Another 38 percent of the network records precipitation some time in the morning, usually near 0800 hours. Only 13 percent of the network records precipitation at midnight, or day's end.

The cost of procuring co-op data on tape for all stations for their length of record would be an estimated $200. Daily precipitation values for all 166 sites for the 1971-present period could be extracted and put on file for new analysis quite easily.

II.2.b Non-NWS Network Data

Several agencies have gathered recording precipitation data in Arizona between ca. 1940 and the present (see Table 4 for agency names and addresses). Many of these stations have adequate data bases to develop short duration precipitation statistics comparable to the analyses resulting from the NWS gage database employed in NOAA2. Table 2 lists six agencies that have data in various forms that could be employed. The most significant ones are those of the U.S. Forest Service (Rocky Mountain Forest and Range Experiment Stations) in rugged areas of central and southern Arizona and the Agricultural Research Service-USDA gages in selected watersheds of southern Arizona. Extensive research activity in rainfall analyses has taken place through the auspices of the ARS for particularly the Walnut Gulch watershed near Tombstone, Arizona and in selected watersheds near Safford, for Granite Reef Dam near Phoenix, and the Santa Rita Experimental Range of Arizona. Some of these data are retrievable

Table 4. Agency Names and Adresses

Agency	Address
Agricultural Research Service	Southwestern Rangeland Research Center 2000 East Allen Road Tucson, Az 85719
Bureau of Indian Affairs	Navajo Area Offices Window Rock, Az 86515
Bureau of Land Management	Safford District Office 425 E. 4th Street Safford, Az 85546
	Arizona Strip District Off. 390 North 3050 East St. George, Utah 84770
National Weather Service	National Climatic Data Center Asheville, N. C. 28801
Soil Conservation Service	201 E. Indianola Ave. Phoenix, Az 85012
U.S. Army Corps of Engr.	Hydrology Section P. O. Box 2711 Los Angeles, Calif. 90053
U.S. Forest Service	Rocky Mountain Forest & Range Experiment Station Forest Service Lab Arizona State University Tempe, Az 85287-1304
U.S. Geological Survey	Water Resources Division 201 N. Central Ave. Phoenix, Az 85004
Navajo Nation	P. O. Box 308 Window Rock, Az 86515
Arizona State University	Office of State Climatologist Department of Geography Arizona State University Tempe, AZ 85287-0309
UA AZMET	Cooperative Extension Serv. University of Arizona Tucson, AZ 85721

Table 4 Continued

Agency	Address
City of Phoenix	Eng. Supr. 125 E. Washington Phoenix, Az 85004
Maricopa County Flood Control District	3335 W. Durango Phoenix, Az 85009
Pima County Transportation and Flood Control District	1313 South Mission Road Tucson, AZ 85713-1398
University of Arizona	Water Resources Research Center University of Arizona Tucson, AZ 85721

from the so-called REPHLEX system (Retrievable Procedures for Hydrologic Data From ARS Experimental Watersheds in the United States)--a computer data bank that includes short duration precipitation data. Some of these data are digitized to break point, but are not verified. In consultation with ARS personnel studying the Walnut Gulch watershed, much of the data would have to be reduced from charts and would require considerable costs in labor and processing. The USFS gages have been employed in extensive research of vegetation manipulation and runoff processes in Central Arizona highland environments of Chaparral, Ponderosa Pine, and Mixed Conifer vegetative zones. It is estimated at this time that a large amount, perhaps majority, of these data would require considerable data reduction from strip chart recordings. However, record lengths of many of the stations in both of these networks span the period of the early 1950's to present. There is a great advantage in additionally analyzing these data sets. For the USFS gages, most of the sites are in mountainous locations never analyzed before, where elevational gradients and variable aspects are evident. An understanding of the effect of topography on rainfall intensity will be greatly enhanced by including these data set in any future analysis. For the ARS sites, most gages are located in a portion of the state with summer concentrations of moisture, derived from thunderstorm activity. Also the gage network is very dense over a small area and can be effectively employed to study both thunderstorm rainfall intensities as well as spatial components of short duration rainfall.

The University of Arizona Water Research Center gages in

Tucson, Arizona should be analyzed, since short duration rainfall in urban locales is important for drainage design purposes. These data are readily available through the university. It is assumed that data acquisition from the other listed sources in Table 2 would be feasible, especially if the researcher were close at hand and had the capability to computerize all data banks available. The cost of adding these six data sources to an analysis would depend exactly on how much of the data are in raw chart form. Budget estimates are shown in Table 1.

III.3.c Precipitation Data Collection Activity in the Future

As Table 3 indicates, a variety of governmental agencies--federal to local--have networks recording precipitation in Arizona. For ease in future hydrometeorological analyses on a statewide and regional basis, a large coordination effort is required to ensure data archiving, compatibility, and general preservation of all observations. This effort will eventually provide for detailed sub-regional and regional studies by any future investigating team. This effort of coordination also would result in economies of scale in terms of man-power and funds.

The Atlas study recommended in this report should contain an analysis of required coordination efforts to put into effect a system that will allow archiving of all precipitation data and provision of user availability of these data. We would recommend two additional tasks in the proposed study: (1) developing recommendations on archiving procedures of the high quality recording data, particularly from the flood warning networks in the state, and (2) developing procedures for handling all other useful short duration rainfall data which probably will be found to be in a variety of formats.

An example of the problem of providing increased data availability and in compatible formats is the situation in Pima County. There, paper copy records (see Fig. 8) are available on storm precipitation. These records have not been entirely computerized and summarized into a computer data bank and made compatible with other conventionally available short duration rainfall data from other stations in the area. This situation has been exacerbated by shortage of personnel to perform such duties and is certainly not due to lack of foresight of the agency. The processing of these records requires a study on data extraction techniques, computer programming, and analysis of these data. It is necessarily a time-consuming process. Our recommendation would be that all agency data from around the state be studied, and a determination be made of the most efficient method(s) of maximizing data use from all archived sources.

Also, myriad examples abound of the lack of coordination resulting in either duplication of effort and/or over-funding to accomplish a readily available and most useful product for hydrometeorological data users. An example is provided by the State of Pennsylvania situation. Our literature search led to the surprise discovery that Pennsylvania State University (PSU)[6] (Aron et al, 1986) completed a study on IDF for the Pennsylvania Department of Transportation (PENDOT) sixteen years after a re-study [7] (Reich et al, 1970), of TP40 for that

PIMA COUNTY COOPERATIVE STORM RAINFALL NETWORK REPORT

YEAR: 87 MONTH: May NAME: Brian Reich GAGE #: 76

LOCATION: ______ TELEPHONE: ______

If over 1" falls in less than 1 hour, please call: 882-2608 (Monday through Friday, 8 A.M. to 5 P.M.).

DAY	FIRST STORM				SECOND STORM				THIRD STORM				DAY TOTAL INCHES
	TIME		IN.	NOTE #	TIME		IN.	NOTE #	TIME		IN.	NOTE #	
	START	STOP			START	STOP			START	STOP			
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14	±7pm		0.01										0.01
15	12:20pm	1pm	0.03										0.03
16													
17													
18													
19													
20	±4pm	6:30pm	0.07		±10pm	±mn	0.03						0.10
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													
31													

NOTES REMARKS YEAR'S TOTAL= ______ MONTHLY TOTAL = 0.14

NOTES	REMARKS
1	
2	
3	
4	
5	
6	
7	
8	

If you were unable to arrange for a neighbor to read the gage while you were away, please make a note by writing "unattended" in that day's space.

The second month's report is on the reverse side. When both are completed, please mail the form to: PIMA COUNTY FLOOD CONTROL DISTRICT
1313 S. Mission Road
Tucson, Arizona 85713

state's Department of Environmental Resources. The surprise was shared by the earlier sponsors, who recently [8] (Pa. Department of Environmental Resources, 1983) published ten tables to simplify the 13 year old PSU design manual. The latter state department was unaware that another agency was negotiating for a restudy. The original PSU study [9] (Kerr et al, 1970) used 216 daily stations with 15 or more years of data; along with 52 stations averaging 30 years of data. The study's isolines through Pennsylvania corresponded to the more general pattern drawn later by NWS [10] (Frederick et al, 1977) for the eastern half of the country. These gradual transitions to higher rainfall intensities are in contrast to the highly convoluted isolines produced in 1986 by Aron [6].

The conclusion from these examples is that some sort of centralization process at a state and/or regional level is desirable, since there is a diversity in data sources, observation practices, instrumentation, and archiving methods by various agencies. An informational channel must constantly be kept open among data disseminators, data users, and researchers to ensure economies of scale and reduction of duplication of effort. In Arizona, this dialog has been initiated admirably as part of the original Central Arizona Hydrometeorological Data Management Association (CAHDMA), or what is now called the Arizona Hydrometeorological Data Coordinating Organization (AHDCO). As part of the Atlas study, the above aspects should be addressed, particularly the two tasks mentioned above.

III REVIEW OF LITERATURE

An extensive search was made for papers and reports dealing with the analysis of storm rainfall, its analysis, hydrometeorology, and prior IDF reports to highway engineers. One hundred and thirty seven papers and reports are listed alphabetically by author in Appendix A. Emphasis was on Arizona, which involved about one third of the references. A similar proportion concerned other parts of the arid western United States. The non-arid United States and overseas studies comprised a quarter of the documents. The remainder were on selected topics in hydrometeorology--primarily the interaction of rainfall with regional topography in the interpretation of statistically "anomalous" results. This physical science is an essential aid in drawing isolines between the very sparse network of recording raingages. About twenty additional references on statistical analysis techniques were omitted from this list. They will be included in another Arizona Transportation Research Center (ATRC) State-of-the-Art report on "Frequency Methods for Arizona Streams," scheduled for completion later in 1987.

Each of the articles reviewed has been annotated with one or more key-words from Table 5 to indicate its major content or audience. Items can be sorted or searched according to key-words. Most of them are in too much detail for busy highway/hydraulic consulting engineers or others serving various action agencies. Those not interested in pursuing a special technical aspect are directed to the List of References in Section IV, which highlights some major problems that Arizona has

Table 5. Key-words Assigned to Reviewed Publications, Listed in Appendix A

1. Applicable
2. Arid-U.S.
3. Arizona
4. Computer
5. Data-analysis
6. Depth-area
7. Elevation
8. Fed-document
9. Frequency
10. Hydrometeorology
11. IDF-curves
12. Major-storms
13. Isohyetal-maps
14. < 6-hours
15. Non-arid
16. Overseas
17. Prob-max-precip
18. Regional-extrapolation
19. Sci/eng-journal
20. Statistical
21. Stochastic
22. Theory
23. Time-distribution
24. University
25. Year-or-season-rain

and the technology to meet them. This table avoids some of the redundancy which occurs through similar papers reappearing in different scientific journals, with different emphasis. Because of the page limitations imposed by various journals, and the requirement that each article should be self-explanatory, authors are frequently constrained at presenting a comprehensive or clear explanation to users who come from a wide array of backgrounds. Thus, many scientific articles are written for a small subset of scientists. A detailed discussion of each of the 137 papers listed in Appendix A will not be presented here. However, it is considered appropriate to concentrate on the 20 references transferred from it into the List of References. These cover the salient aspects that would help administrators/engineers consider the history and constraints of this necessary element of highway hydraulics.

III.1 TP40, An Early National IDF Atlas

In 1961, the Weather Bureau of the U.S. Department of Commerce published Technical Paper No. 40 (TP40), "Rainfall Frequency Atlas of the United States, for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years" [3] (Hershfield, 1961). For the entire country it used 2,081 stations that had clock-hour data. Their records were from the period 1938 through 1957; none being less than 5 years. The Arizona subset was 40 stations. Another subset of 200 stations nationwide was used to interrelate rainfall intensities as short as 30 minutes by establishing average ratios to clock-hour amounts. Furthermore, sixty-minute amounts are distinguished from clock-hour amounts in that the former represent the maximum 60-minute depth regardless when the continuous rain occurred. A relationship was developed between the 1-hour depth and the 6- and 24-hour depths for the 2.33 year and longer return-periods, to 100-years.

Mapping relied on a larger network of 6,185 gages that recorded daily. Maximum annual rainfall data for selected durations at each of these sites yielded a series. Each of these was then fitted by an extreme value (EV) probability distribution [11] (Gumbel, 1958). Thereafter generalized relationships between the daily estimates and those for durations of 30-minutes, 1-, 2-, 3-, 6-, and 12-hour estimates were used to complete the atlas and included 1-, 2-, 5-, 10-, 25-, 50-, and 100-year frequencies. The isolines were smoothed through the national network of daily raingages.

Arizona was represented on the completed maps by about five square inches. For example, the 100-year 1-hour (P100y1h) isoline for 3, 2.5, 2, and 1.5 inches depicted four continuous, concentric areas, as shown in Fig. 9. This early report provided a very user-friendly design manual. In the pre-computer era it extracted a high level of information from a minimal history of short-duration rainfall intensity measurements. The transition of storm estimates across Arizona was sufficiently gradual that most counties were contained within a pair of isolines. For example the 1-hour 100-year return period changes gradually from 2 inches on Maricopa County's western boundary to 3 inches at its eastern extremity. The isoline trends were north-south with very gentle curvature.

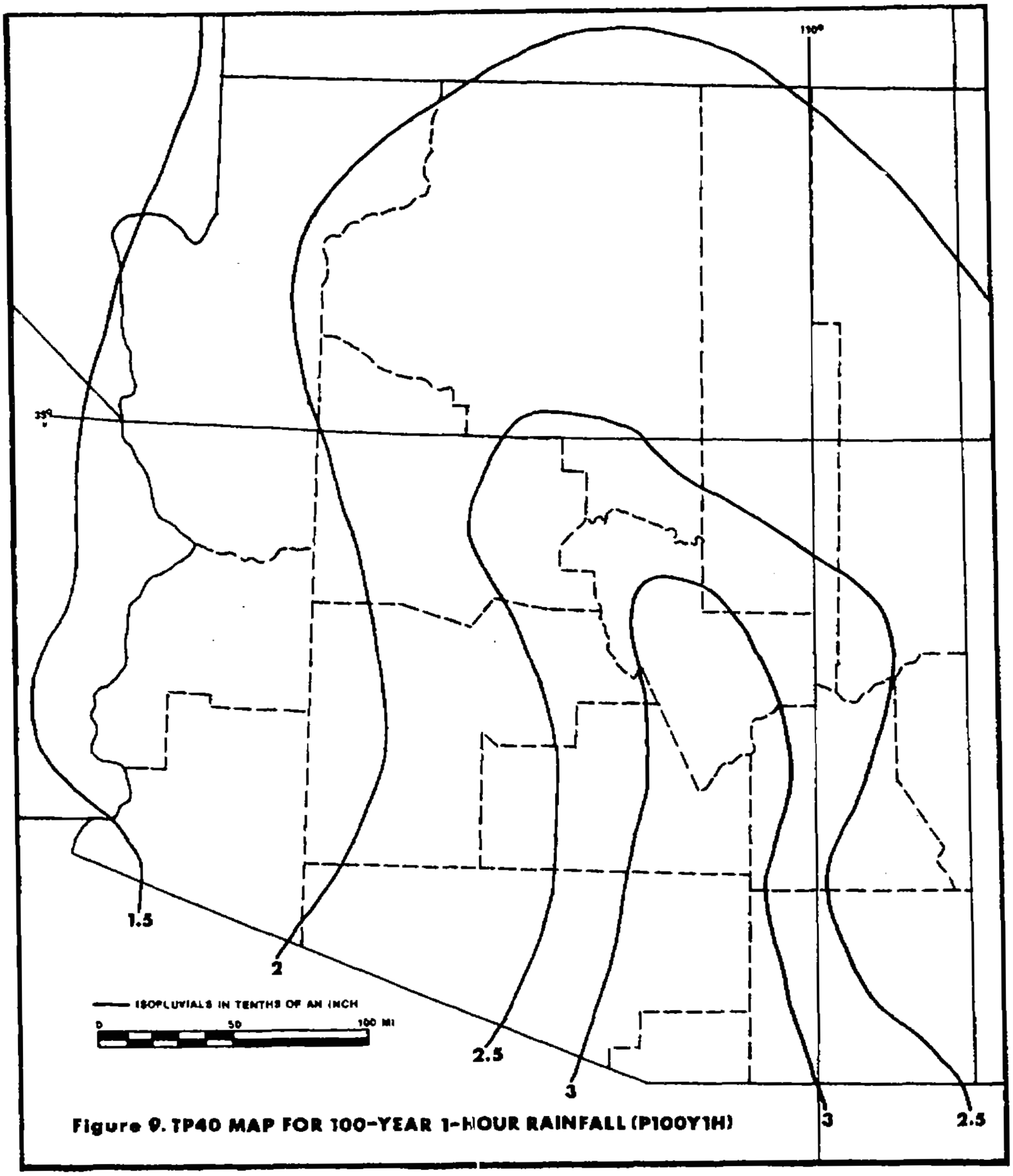

Figure 9. TP40 MAP FOR 100-YEAR 1-HOUR RAINFALL (P100Y1H)

III.2 NOAA2: An Attempt To Extrapolate Between The Same Gages

This study [1] (Miller et al., 1973) had the advantage of mainframe computers, and about ten years of additional record at thirty-eight NWS Arizona sites. In a similar manner to TP40, this study of the eleven contiguous western states provided some benefits to Arizona from stations beyond its borders. The NOAA2 study developed equations for the 2-year 24-hour rainfall (P2y24h) involving the following factors: terrain slope, annual precipitation, barrier to airflow, elevation, distance from moisture, location, and roughness. These equations were applied to a dense grid on topographic maps. This information was subsequently fitted by tight, contorted isolines for every tenth of an inch. NOAA2 presented a set of very detailed synthetic maps for selected return periods (2 yr to 100 yr) for both 6- and 24-hour durations. The maps of Arizona were 110 square inches in area. The impression which this "preciseness" has caused on potential users can be appreciated by examining Fig. 10, for P100y6h. Hydrologists who endeavour to determine floods from NOAA2 are confronted with averaging among the intricately scalloped isolines for P100y6h or similar maps from the atlas. Nevertheless, some of the general overall trends which shine through all the detail have been explained elsewhere [12] (Hansen et al., 1977) on hydrometeorological grounds. For instance, the sharp gradient of isohyets in the northeast quarter of the state to the lee of the Mogollon Rim is caused by atmospheric moisture depletion that occurred close to the orographic lifting.

Excellent descriptions of the physical processes responsible for major storms were also given in Hydrometeorological Report

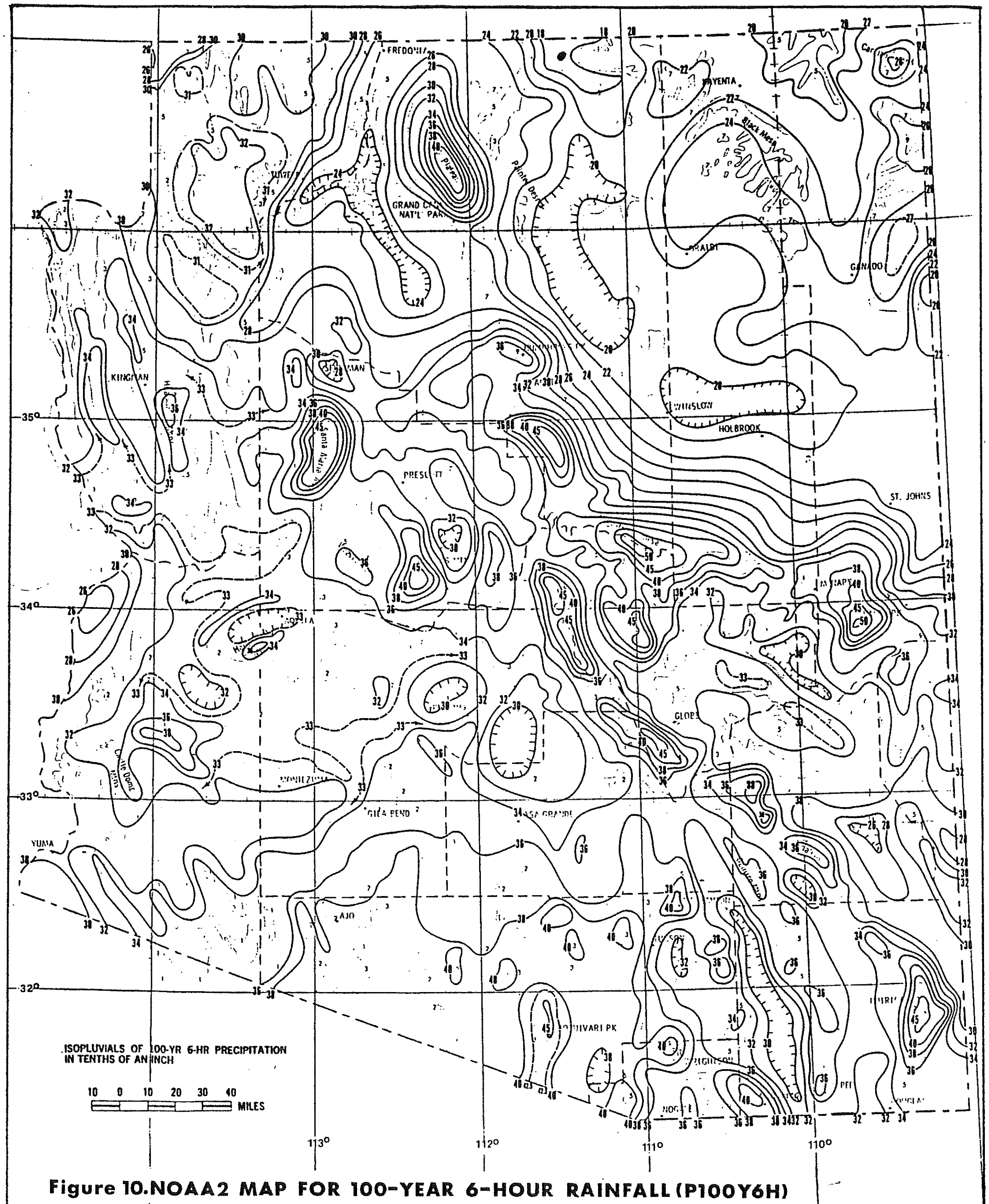

Figure 10. NOAA2 MAP FOR 100-YEAR 6-HOUR RAINFALL (P100Y6H)

(HMR) 50 [13] (Hansen et al., 1981). That report included 26 major rainstorms that have struck Arizona and an equal number in arid parts of five surrounding states. Of most importance to the highway program is their section on local storms which they define as "heavy rains exceeding 3 inches in 3 hours or less, that are reasonably isolated from surrounding rains." It is very unlikely for such a local storm, let alone its epicenter, to land in a raingage of the sparse NWS network gages. One of these storms produced 8 inches within 45 minutes near Fort Mohave, Az. Another gave 3.5 inches in 40 minutes near Globe, Az. HMR 50 also discussed "cloud mergers" where synergistic (working together or cooperating) effects produce far greater rain than the sum of the water from separate clouds, without colliding. The significance is that such complex mechanisms produce very heavy short-duration rain which impacts man in his ever expanding urbanization. These violent, local, short-duration storms are not depicted well in the 6- or 24-hour annual maximum series, which comprise both summer and winter storms. Floods from the huge number of watersheds smaller than 200 square miles result from short duration, high intensity [14] (Hershfield and Engman, 1978) summer thunderstorms.

Some scientists are concerned that relationships between maximum rains for durations of 6-hour, or even worse of P24h, are used in NOAA2 to estimate P1h or shorter rains. The 24-hour maxima normally occur in the winter, while the short duration extremes occur in the summer. It is no wonder that NOAA2 100-year estimates for 30-minutes or less have been exceeded by 30 percent over a dense network in southeastern Arizona [15] (Osborn et al., 1987). Similarly, reanalysis of 45 years of NWS data for rainfalls of 30 minutes or less at Billings, Montana, showed 5- to 15-minute estimates for 5- through 100-year frequencies were 1.6 to 1.3 times greater than NOAA2 values [16] (Peterson, 1986).

In 1977 the City of Tucson abandoned NOAA2 for an updated IDF analysis [17] (Reich, 1978). Its 100 square mile incorporated area is relatively clear from the mountains, so the assumption that one station was a random representation of the jurisdictional area appeared reasonable. Highway or county authorities must consider the validity of using NOAA2's contorted isolines, that were illustrated in Fig. 10. Future analyses should consider zones for which single values apply. Gradual transition can be simply achieved as the design point moves near to zonal boundaries [6] (Aron et al., 1986). If the Arizona analysis is able to solve these problems, other arid states will be able to plan their reanalyses of short-duration rainfall intensities more effectively.

III.3 Extreme Valne Distribution, Used by NWS, To Be Tested for Arizona

Even after many other hydrologists were blindly applying the Log Pearson Type III (LP3), the NWS continued using the Extreme Value (EV) distribution. Their experience still suggests that EV is the most appropriate choice for storm rainfall. Recent analysis [18] (Reich et al, 1981) of long records station-year combinations in southeastern Arizona show EV to be a good choice for short-duration rainfall. It is also very easy to pre-test various distributions on a PC [19] (deRoulhoc, 1987). The recent choice of LP3 for the latest PSU study [6](Aron et al, 1986) was not adequately justified. Early testing and acceptance of the selected probability distribution are essential prerequisites to the envisioned investigation. The proposed study should therefore pre-test a few series of annual maxima for some durations at stations typifying Arizona's major meteorological and climatological regions. This will hopefully show, by graphical plots, that EV is the appropriate statistical distribution for Arizona.

IV TIME/AREAL DISTRIBUTION REDUCTION MANUAL

The budget proposed in Table 1 is for the preparation of a Storm Rainfall Probability Atlas and does not include time required to determine the interduration variation of rainfall amounts for different durations and frequencies nor does it include a study of the reduction of point values to an area. Normally, in hydrologic design, engineers are concerned with the order in which amounts for selected durations occur in addition to the average depth of precipitation over a particular drainage area. It is estimated that such a study would require about 20 percent more time and money.

Fortunately, several studies (listed in Appendix A) and unprocessed data elsewhere are available for such studies. A detailed study [20] (Frederick, 1979) was prepared for southeastern states in 1979 suggests how the interduration variability of rainstorms could be handled. Several studies related to the areal variations of precipitation over small watersheds have been prepared by the ARS [21] (Osborn et al, 1979) based on data from the Walnut Gulch Watershed in southeastern Arizona. Data from additional small networks in Arizona are also available (see Fig. 6).

V RECOMMENDED ANALYSES FOR PROPOSED IDF ATLAS

A flowchart of various research tasks and analyses is represented in Fig. 1. The tasks have been listed numerically from 1 to 35. Tasks 1 through 14, e.g., require the creation of a database. These tasks alone will probably require many person-months to assemble and quality control the data. Statistical analyses are required in Tasks 15 through 21. These can be prepared using standard statistical techniques considered appropriate for Arizona. Tasks 22 and 25 are necessary to fill in areas devoid of data. These will require high level meteorological skill and coordination with NWS. Climatological and hydrometeorological studies of the variations in Arizona rainfall should reveal parameters or factor considerations appropriate for interstation interpolation. Incorporation of all of the Tasks 30 through 35 are needed to prepare the final probability atlas and research report.

Tasks 26 through 29 concern the time distribution and areal reduction aspects of convective thunder storms discussed in section IV. If $24,000 additional pre-overhead dollars were added to the original $218,500 budget, detailed in Table 1, it will be possible to complete this aspect concurrently. Simultaneous funding will save time lost in advertising and accepting a separate proposal on this aspect. In fact, the Time/Area Distributions Reduction results could be released as a partial completion report six months before the overall 2 year project, of which it would be a part. Futhermore, this information would be more readily available to engineers who need Time/Area criteria when adapting nationally-used rainfall-runoff models to Arizona designs.

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APPENDIX A

APPENDIX
to
Storm Rainfall Probability Atlas for Arizona
by Reich, B.M., Brazel, A.J., & Clark, R.A.

Data-analysis Frequency Non-arid Overseas Statistical Sci/eng-journal	Adams, B.J., Fraser, H.G., Howard, C.D.D., & Hanafy, M.S. "Meteorological Data Analysis for Drainage System Design," *Jour. Env. Engr., ASCE, Vol. 112(5)*, 827-848 (1986).
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IDF-curves
Isohyetal-maps
<6-hours
Regional-extrapolation
Time-distribution

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APPENDIX B

This appendix contains a listing of stations that could be employed in a new analysis, based on the criteria of 15 years of data. In addition, the listing includes stations not used in the NOAA2 Atlas. This listing is not to be considered a final listing at this point. Detailed analyses as part of the Atlas project itself may reveal more stations that could be used.

The code for the listing in this appendix is:

Station Name	
Network	agency monitoring or collecting data
I D #	only for the National Weather Service
County	
Gage Type	N = non-recording R = recording N,R= both nonrecordingandrecording site
Observer	
Record Length	N = Year beginning for nonrecording R = Year beginning for recording

Aguila
Network: NWS ID#: 0060
Lat: 33 57 Long:113 11 Elev: 2165 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1924-

Ajo
Network: NWS ID#: 0080
Lat: 32 22 Long:112 52 Elev: 1800 ft.
County: Pima
Gage Type: N, R, Standard 8", F & P
Observer: Company Time: 0800
Record Length: N:1913-, R:1940-

Alamo Dam
Network: NWS ID#: 0100
Lat: 34 14 Long:113 35 Elev: 1290 ft.
County: La Paz
Gage Type: N, R, Standard 8", Universal 12"
Observer: State Time: 0800
Record Length: N:1965-, R:1965-

Alpine
Network: NWS ID#: 0159
Lat: 33 51 Long:109 08 Elev: 8050 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1904-

Anvil Ranch
Network: NWS ID#: 0287
Lat: 31 59 Long:111 23 Elev: 2750 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1943-

Apache Powder Company
Network: NWS ID#: 0309
Lat: 31 54 Long:110 15 Elev: 3690 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Company Time: 1700
Record Length: 1923-

Arcadia R67
Network: Water Resources Res. Ctr. ID#:
Lat: 32 13 Long:110 50 Elev: e2570 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Arcadia R61

Network: Water Resources Res. Ctr. ID#:
Lat: 32 14 Long:110 52 Elev: e2530 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Arcadia R62

Network: Water Resources Res. Ctr. ID#:
Lat: 32 13 Long:110 52 Elev: 2590 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Arcadia R63

Network: Water Resources Res. Ctr. ID#:
Lat: 32 12 Long:110 52 Elev: 2620 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Arcadia R69

Network: Water Resources Res. Ctr. ID#:
Lat: 32 14 Long:110 53 Elev: 2530 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Arivaca 1 E

Network: NWS ID#: 0380
Lat: 31 35 Long:111 19 Elev: 3675 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1956-

Arnett Canyon

Network: US Corps of Engineers ID#:
Lat: 33 17 Long:111 05 Elev: 3400 ft.
County: Final
Gage Type: N,
Observer: US Corps of Engineers Time:
Record Length: 1960-?

Ash Fork 2

Network: NWS ID#: 0487
Lat: 35 13 Long:112 29 Elev: 5080 ft.
County: Yavapai
Gage Type: R, F & P
Observer: State Time:
Record Length: 1940-

Ashurst Hayden Dam
Network: NWS ID#: 0498
Lat: 33 05 Long:111 15 Elev: 1638 ft.
County: Pinal
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1956-

Bartlett Dam
Network: NWS ID#: 0632
Lat: 33 49 Long:111 38 Elev: 1650 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Company Time: 0700
Record Length: 1940-

Beaver Creek R S
Network: NWS ID#: 0670
Lat: 34 40 Long:111 43 Elev: 3820 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1957-

Beaver Dam
Network: NWS ID#: 0672
Lat: 36 54 Long:113 56 Elev: 1875 ft.
County: Mohave
Gage Type: N, Standard 8"
Observer: individual Time: SS
Record Length: 1951-

Below McMicken Dam
Network: MCFCD ID#:
Lat: 33 41 Long:112 24 Elev: 1340 ft.
County: Maricopa
Gage Type: R,
Observer: MCFCD Time:
Record Length: 1957-

Betatakin
Network: NWS ID#: 0750
Lat: 36 41 Long:110 32 Elev: 7286 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1939-

Bisbee
Network: NWS ID#: 0768
Lat: 31 26 Long:109 55 Elev: 5306 ft.
County: Cochise
Gage Type: N, R, Standard 8", F & P
Observer: Individual Time: 1630
Record Length: N: 1889-1984 R: 1940-1984

Black River Pumps
Network: NWS ID#: 0808
Lat: 33 29 Long: 109 46 Elev: 6040 ft.
County: Graham
Gage Type: N, R, Standard 8 ", F & P
Observer: Company Time: 0700
Record Length: N: 1947- R: 1947-

Blue
Network: NWS ID#: 0855
Lat: 33 35 Long: 109 10 Elev: 5420 ft.
County: Greenlee
Gage Type: N, Standard 8 "
Observer: Individual Time: 1700
Record Length: 1959-

Blue Ridge R S
Network: NWS ID#: 0871
Lat: 34 37 Long: 111 07 Elev: 6880 ft.
County: Coconino
Gage Type: N, Standard 8 "
Observer: Federal Time: 0800
Record Length: 1965-

Bouse
Network: NWS ID#: 0949
Lat: 33 57 Long: 114 02 Elev: 925 ft.
County: La Paz
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1952-

Bowie
Network: NWS ID#: 0958
Lat: 32 20 Long: 109 29 Elev: 3770 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1899-

Bright Angel R S
Network: NWS ID#: 1001
Lat: 36 12 Long: 112 04 Elev: 8400 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1925-

Buckeye
Network: NWS ID#: 1026
Lat: 33 22 Long: 112 35 Elev: 870 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: City Time: 1600
Record Length: 1893-

Cameron 1 NNE
Network: NWS ID#: 1169
Lat: 35 53 Long:111 24 Elev: 4165 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: State Time: 1700
Record Length: 1962-

Canelo 1 NW
Network: NWS ID#: 1231
Lat: 31 33 Long:110 32 Elev: 5010 ft.
County: Santa Cruz
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1910-

Canyon de Chelly
Network: NWS ID#: 1248
Lat: 36 09 Long:109 32 Elev: 5610 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1908-

Carefree
Network: NWS ID#: 1282
Lat: 33 49 Long:111 54 Elev: 2530 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Airport Time: 0800
Record Length: 1962-

Casa Grande
Network: NWS ID#: 1306
Lat: 32 53 Long:111 45 Elev: 1395 ft.
County: Pinal
Gage Type: N, Standard 8"
Observer: Private Time: 1700
Record Length: 1880-

Casa Grande Ruins N M
Network: NWS ID#: 1314
Lat: 33 00 Long:111 32 Elev: 1419 ft.
County: Pinal
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1700
Record Length: N:1908-, R:1940-

Cascabel
Network: NWS ID#: 1330
Lat: 32 19 Long:110 24 Elev: 3145 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1965-

Castle Hot Springs
Network: NWS ID#: 1353
Lat: 33 59 Long:112 22 Elev: 1990 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: State Time: 1900
Record Length: 1959-

CCEF
Network: USFS ID#:
Lat: 33 43 Long:109 11 Elev: 8000 ft.
County: Greenlee
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1956-

Chandler Heights
Network: NWS ID#: 1514
Lat: 33 13 Long:111 41 Elev: 1425 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1941-

Chevelon R S
Network: NWS ID#: 1574
Lat: 34 32 Long:110 55 Elev: 7006 ft.
County: Coconino
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 0800
Record Length: N:1937-, R:1982-

Childs
Network: NWS ID#: 1614
Lat: 34 21 Long:111 42 Elev: 2650 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1915-

Chino Valley
Network: NWS ID#: 1654
Lat: 34 45 Long:112 27 Elev: 4750 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1942-

Chiricahua N M
Network: NWS ID#: 1654
Lat: 32 00 Long:109 21 Elev: 5300 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Federal Time: 1300
Record Length: 1940-

Clay Springs
Network: NWS ID#: 1760
Lat: 34 23 Long:110 19 Elev: 6320 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1971-

Clifton
Network: NWS ID#: 1849
Lat: 33 03 Long:109 17 Elev: 3460 ft.
County: Greenlee
Gage Type: N, Standard 8"
Observer: Individual Time: 0800
Record Length: 1906-

Cochise 4 SSE
Network: NWS ID#: 1870
Lat: 32 04 Long:109 54 Elev: 4180 ft.
County: Cochise
Gage Type: R, F & P
Observer: Company Time:
Record Length: 1942-

Colorado City
Network: NWS ID#: 1920
Lat: 37 00 Long:112 59 Elev: 5010 ft.
County: Mohave
Gage Type: N, Standard 8"
Observer: Individual Time: SS
Record Length: 1961-

Cordes
Network: NWS ID#: 2109
Lat: 34 18 Long:112 10 Elev: 3771 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1925-

Coronado N M Hqrs
Network: NWS ID#: 2140
Lat: 31 21 Long:110 15 Elev: 5242 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1960-

Crown King
Network: NWS ID#: 2329
Lat: 34 12 Long:112 20 Elev: 5920 ft.
County: Yavapai
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1300
Record Length: N:1915-, R:1980-

Dateland Whitewing Ranch
Network: NWS ID#: 2434
Lat: 32 59 Long:113 30 Elev: 545 ft.
County: Yuma
Gage Type: N, Standard 8"
Observer: Company Time: 1700
Record Length: 1972-

Deer Valley
Network: NWS ID#: 2462
Lat: 33 35 Long:112 05 Elev: 1257 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Individual Time: 2400
Record Length: 1950-1985

Doggy Jones
Network: MCFCD ID#:
Lat: 33 42 Long:112 39 Elev: 1700 ft.
County: Maricopa
Gage Type: R,
Observer: MCFCD Time:
Record Length: 1957-

Douglas
Network: NWS ID#: 2659
Lat: 31 21 Long:109 32 Elev: 4040 ft.
County: Cochise
Gage Type: N, R, Standard 8", F & P
Observer: City Time: 1700
Record Length: N: 1944- R: 1942-

Douglas FAA AP
Network: NWS ID#: 2664
Lat: 31 28 Long:109 36 Elev: 4098 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Federal Time: 2100
Record Length: 1948-

Duncan
Network: NWS ID#: 2754
Lat: 32 45 Long:109 07 Elev: 3660 ft.
County: Greenlee
Gage Type: N, R, Standard 8", F & P
Observer: Individual Time: 1800
Record Length: N: 1948- R: 1975-

Eagle Creek 2
Network: NWS ID#: 2781
Lat: 33 21 Long:109 29 Elev: 4870 ft.
County: Greenlee
Gage Type: N, Standard 8"
Observer: Individual Time: 1000
Record Length: 1973-

Eloy 4 NE
Network: NWS ID#: 2807
Lat: 32 50 Long: 111 32 Elev: 1545 ft.
County: Final
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1951-

Flagstaff WSO AP
Network: NWS ID#: 3010
Lat: 35 08 Long: 111 40 Elev: 7006 ft.
County: Coconino
Gage Type: N, R, Standard 8", Universal 12"
Observer: Federal Time: 2400
Record Length: N: 1888- R: 1945-

Florence
Network: NWS ID#: 3027
Lat: 33 02 Long: 111 23 Elev: 1505 ft.
County: Pinal
Gage Type: N, Standard 8"
Observer: City Time: 0800
Record Length: 1892-

Foothills
Network: MCFCD ID#:
Lat: 33 48 Long: 112 16 Elev: e1800 ft.
County: Maricopa
Gage Type: R,
Observer: MCFCD Time:
Record Length: 1957-

Fort Huachuca
Network: NWS, US Army ID#: 3120
Lat: 31 34 Long: 110 20 Elev: 4664 ft.
County: Cochise
Gage Type: N, R, Standard 8", Standard 8"
Observer: Federal Time: 0800, Hourly
Record Length: N: 1954- R: 1954-

Fort Thomas 2 SW
Network: NWS ID#: 3150
Lat: 33 01 Long: 110 00 Elev: 2800 ft.
County: Graham
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1966-

Fort Valley
Network: NWS ID#: 3160
Lat: 35 16 Long: 111 44 Elev: 7347 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 0900
Record Length: 1909-

Ganado
Network: NWS ID#: 3303
Lat: 35 43 Long:109 34 Elev: 6340 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: State Time: 0700
Record Length: 1929-

Gila Bend
Network: NWS ID#: 3393
Lat: 32 57 Long:112 43 Elev: 7035 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Individual Time: 1600
Record Length: 1889-

Gilbert-G.M. Proving Ground
Network: Private ID#:
Lat: 33 19 Long:111 38 Elev: 1393 ft.
County: Maricopa
Gage Type: N,
Observer: Company Time: 0800
Record Length: 1958-

Gisela
Network: NWS ID#: 3448
Lat: 34 07 Long:111 17 Elev: 2900 ft.
County: Gila
Gage Type: N, Standard 8"
Observer: Individual Time: 0700
Record Length: 1925-

Grand Canyon N.P. 2, G.C. N.P., G.C.
Network: NWS ID#: 3596, 3595, 3581
Lat: 36 03 Long:112 09 Elev: 6785 ft.
County: Coconino
Gage Type: N, R, Standard 8", Universal 12"
Observer: Federal Time: 1900
Record Length: N:1942-, R:1942-

Greer
Network: NWS ID#: 3683
Lat: 34 01 Long:109 28 Elev: 8490 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Individual Time: 1600
Record Length: 1956-

Griggs 3 W
Network: NWS ID#: 3702
Lat: 33 30 Long:112 29 Elev: 1160 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Company Time: 2400
Record Length: 1950-

Happy Jack R S
Network: NWS ID#: 3828
Lat: 34 45 Long:111 25 Elev: 7480 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1966-

Hawley Lake
Network: NWS ID#: 3926
Lat: 33 59 Long:109 45 Elev: 8180 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1967-

Heber R S
Network: NWS ID#: 3961
Lat: 34 24 Long:110 33 Elev: 6590 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1915-

Hewitt Canyon
Network: US Corps of Engineers ID#:
Lat: 33 24 Long:111 13 Elev: 3440 ft.
County: Pinal
Gage Type: N,
Observer: US Corps of Engineers Time:
Record Length: 1960-?

High School R50
Network: Water Resources Res. Ctr. ID#:
Lat: 32 13 Long:110 56 Elev: 2440 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

High School R51
Network: Water Resources Res. Ctr. ID#:
Lat: 32 14 Long:110 57 Elev: e2460 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

High School R52
Network: Water Resources Res. Ctr. ID#:
Lat: 32 14 Long:110 55 Elev: e2490 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

High School R53
Network: Water Resources Res. Ctr. ID#:
Lat: 32 13 Long:110 55 Elev: e2490 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Hillside 4 NNE
Network: NWS ID#: 4053
Lat: 34 29 Long:112 53 Elev: 3320 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1955-

Holbrook
Network: NWS ID#: 4089
Lat: 34 54 Long:110 10 Elev: 5080 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: Individual Time: 0700
Record Length: 1886-

Horseshoe Dam
Network: NWS ID#: 4182
Lat: 33 59 Long:111 43 Elev: 2020 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Association Time: 0700
Record Length: 1948-

Irving
Network: NWS ID#: 4391
Lat: 34 24 Long:111 37 Elev: 3795 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1934-

Jacob Lake
Network: NWS ID#: 4418
Lat: 36 44 Long:112 13 Elev: 7827 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: State Time: 0800
Record Length: 1955-

Jerome
Network: NWS ID#: 4453
Lat: 34 45 Long:112 07 Elev: 5245 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: City Time: 0800
Record Length: 1897-

Keams Canyon
Network: NWS ID#: 4586
Lat: 35 49 Long:110 12 Elev: 6205 ft.
County: Navajo
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1700
Record Length: N: 1936- R: 1942-

Kingman 2
Network: NWS ID#: 4645
Lat: 35 12 Long:114 01 Elev: 3539 ft.
County: Mohave
Gage Type: N, R, Standard 8", F & P
Observer: Company Time: 0800
Record Length: N: 1967- R: 1967-

Kitt Peak
Network: NWS ID#: 4675
Lat: 31 58 Long:111 36 Elev: 6800 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Association Time: 0800
Record Length: 1960-

Klagetoh 12 WNW
Network: NWS ID#: 4686
Lat: 35 33 Long:109 42 Elev: 6500 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Company Time: 1700
Record Length: 1964-

Kofa Mine
Network: NWS ID#: 4702
Lat: 33 16 Long:113 52 Elev: 1775 ft.
County: Yuma
Gage Type: N, Standard 8"
Observer: Company Time: SS
Record Length: 1952-

Lake Havasu
Network: NWS ID#: 4759
Lat: 34 27 Long:114 22 Elev: 482 ft.
County: Mohave
Gage Type: N, Standard 8"
Observer: Airport Time: 0800
Record Length: 1967-

Laveen 3 SSE
Network: NWS ID#: 4829
Lat: 33 20 Long:112 09 Elev: 1115 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Individual Time: SS
Record Length: 1948-

Lees Ferry
Network: NWS ID#: 4849
Lat: 36 52 Long:111 36 Elev: 3210 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1916-

Litchfield Park
Network: NWS ID#: 4977
Lat: 33 30 Long:112 22 Elev: 1030 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Individual Time: 0800
Record Length: 1917-

Lukachukai
Network: NWS ID#: 5129
Lat: 36 25 Long:109 14 Elev: 6520 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1944-

Luke AFB
Network: USAF ID#:
Lat: 33 33 Long:112 22 Elev: 1101 ft.
County: Maricopa
Gage Type: N, 3 H, Standard 8"
Observer: USAF Time: 3 H
Record Length: E 1941-

Maricopa 4N
Network: NWS ID#: 5270
Lat: 33 07 Long:112 02 Elev: 1160 ft.
County: Pinal
Gage Type: N, Standard 8"
Observer: Federal Time: 1800
Record Length: 1960-

Mayer 3 NNW
Network: NWS ID#: 5325
Lat: 34 26 Long:112 15 Elev: 4640 ft.
County: Yavapai
Gage Type: R, F & P
Observer: Individual Time:
Record Length: 1969-

McNary
Network: NWS ID#: 5412
Lat: 34 04 Long:109 51 Elev: 7320 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1944-

McNeal

Network: NWS ID#: 5418
Lat: 31 36 Long: 109 34 Elev: 4170 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1960-

Mesa Experiment Farm

Network: NWS ID#: 5467
Lat: 33 25 Long: 111 52 Elev: 1230 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: University Time: 0700
Record Length: 1896-

Miami

Network: NWS ID#: 5512
Lat: 33 24 Long: 110 53 Elev: 3560 ft.
County: Gila
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1914-

Montezuma Castle N M

Network: NWS ID#: 5635
Lat: 34 37 Long: 111 50 Elev: 3180 ft.
County: Yavapai
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1800
Record Length: N:1938-, R:1979-

Mormon Flat

Network: NWS ID#: 5700
Lat: 33 33 Long: 111 27 Elev: 1715 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Company Time: 0700
Record Length: 1923-

Morristown

Network: MCFCD ID#:
Lat: 33 52 Long: 112 36 Elev: 1980 ft.
County: Maricopa
Gage Type: R,
Observer: MCFCD Time:
Record Length: 1957-

Mt. Lemmon

Network: NWS ID#: 5732
Lat: 32 27 Long: 110 45 Elev: 7794 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Individual Time: 1400
Record Length: 1960-

N Lazy H Ranch
Network: NWS ID#: 5908
Lat: 32 07 Long:110 41 Elev: 3050 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Individual Time: 1900
Record Length: 1941-

New River
Network: Private ID#:
Lat: 33 50 Long:112 10 Elev: 2000 ft.
County: Maricopa
Gage Type: N,
Observer: DSET Labs Time:
Record Length: 1955-

Nogales 6 N
Network: NWS ID#: 5924
Lat: 31 25 Long:110 57 Elev: 35 60 ft.
County: Santa Cruz
Gage Type: N, R, Standard 8", F & P
Observer: City Time: 0800
Record Length: N:1952-, R:1984-

Oak Creek Canyon
Network: NWS ID#: 6037
Lat: 34 58 Long:111 45 Elev: 5075 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1935-

Okohatk
Network: US Bureau of Indian Affairs ID#:
Lat: 32 30 Long:112 01 Elev: 1680 ft.
County: Pima
Gage Type: R,
Observer: Bureau of Indian Affairs Time:

Record Length: 1969-

Oracle 2 SE
Network: NWS ID#: 6119
Lat: 32 36 Long:110 44 Elev: 4510 ft.
County: Final
Gage Type: N, R, Standard 8", F & P
Observer: Individual Time: 1700
Record Length: N:1891-, R:1940-

Organ Pipe Cactus N M
Network: NWS ID#: 6132
Lat: 31 56 Long:112 47 Elev: 1678 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1944-

Page

Network: NWS ID#: 6180
Lat: 36 56 Long: 111 27 Elev: 4270 ft.
County: Coconino
Gage Type: N, R, Standard 8", Universal 12"
Observer: City Time: 0800
Record Length: N:1957-, R:1957-83

Painted Rock Dam

Network: NWS ID#: 6194
Lat: 33 05 Long: 113 02 Elev: 550 ft.
County: Maricopa
Gage Type: R, Universal 12"
Observer: Federal Time:
Record Length: 1962-

Painted Desert N P

Network: NWS ID#: 6190
Lat: 35 04 Long: 109 46 Elev: 5760 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1973-

Parker

Network: NWS ID#: 6250
Lat: 34 10 Long: 114 17 Elev: 425 ft.
County: La Paz
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1893-

Payson

Network: NWS ID#: 6323
Lat: 34 14 Long: 111 20 Elev: 4913 ft.
County: Gila
Gage Type: N, R, Standard 8", F & P
Observer: Individual Time: 0800
Record Length: N:1948-, R:1949-

Peach Springs

Network: NWS ID#: 6328
Lat: 35 33 Long: 113 24 Elev: 4970 ft.
County: Mohave
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1943-

Petrified Forest N P

Network: NWS ID#: 6468
Lat: 34 49 Long: 109 53 Elev: 5446 ft.
County: Navajo
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1600
Record Length: N:1931-, R:1941-

Phantom Ranch
Network: NWS ID#: 6471
Lat: 36 06 Long:112 06 Elev: 2570 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1935-

Phoenix WSFO AP
Network: NWS ID#: 6481
Lat: 33 26 Long:112 01 Elev: 1110 ft.
County: Maricopa
Gage Type: N, R, Standard 8", Universal 12"
Observer: Federal Time: 2400
Record Length: N:1934-, R:1940-

Phoenix City
Network: NWS ID#: 6486
Lat: 33 27 Long:112 04 Elev: 1098 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1972-

Pinetop Fish Hatchery
Network: NWS ID#: 6601
Lat: 34 07 Long:109 55 Elev: 7200 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: State Time: 0800
Record Length: 1938-

Pipe Springs Natl Mon
Network: NWS ID#: 6616
Lat: 36 52 Long:112 44 Elev: 4920 ft.
County: Mohave
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1963-

Pleasant Valley R S
Network: NWS ID#: 6653
Lat: 34 06 Long:110 56 Elev: 5050 ft.
County: Gila
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1918-

Portal 4 SW
Network: NWS ID#: 6716
Lat: 31 53 Long:109 12 Elev: 5390 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Association Time: 1800
Record Length: 1965-

Prescott

Network: NWS ID#: 6796
Lat: 34 34 Long:112 28 Elev: 5205 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: City Time: 0800
Record Length: 1865-

Punkin Center

Network: NWS ID#: 6840
Lat: 33 52 Long:111 19 Elev: 2350 ft.
County: Gila
Gage Type: N, Standard 8"
Observer: Individual Time: 0800
Record Length: 1947-

Queen Wells

Network: US Bureau of Indian Affairs ID#:
Lat: 32 16 Long:111 38 Elev: 2030 ft.
County: Pima
Gage Type: R,
Observer: Bureau of Indian Affairs Time:

Record Length: 1969-

Railroad R73

Network: Water Resources Res. Ctr. ID#:
Lat: 32 11 Long:110 55 Elev: e2510 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Railroad R70

Network: Water Resources Res. Ctr. ID#:
Lat: 32 12 Long:110 57 Elev: e2420 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Railroad R71

Network: Water Resources Res. Ctr. ID#:
Lat: 32 12 Long:110 56 Elev: 2470 ft.
County: Pima
Gage Type: R,
Observer: U of A Time:
Record Length: e1971-

Redington

Network: NWS ID#: 7036
Lat: 32 26 Long:110 29 Elev: 2870 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Individual Time: 0800
Record Length: 1941-

Roosevelt 1 WNW
Network: NWS ID#: 7281
Lat: 33 40 Long:111 09 Elev: 2205 ft.
County: Gila
Gage Type: N, Standard 8"
Observer: Association Time: 0700
Record Length: 1905-

Rucker Canyon
Network: NWS ID#: 7334
Lat: 31 45 Long:109 25 Elev: 5370 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1911-

Rudd Knoll
Network: USFS ID#:
Lat: 33 56 Long:109 22 Elev: 8338 ft.
County: Apache
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1966-?

Sacaton
Network: NWS ID#: 7370
Lat: 33 04 Long:111 45 Elev: 1285 ft.
County: Pinal
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1908-

Safford Agricultural CTR
Network: NWS ID#: 7390
Lat: 32 49 Long:109 41 Elev: 2954 ft.
County: Graham
Gage Type: N, Standard 8"
Observer: University Time: 0800
Record Length: 1948-

Safford ARS-2
Network: ARS ID#:
Lat: 31 51 Long:109 30 Elev: e3400 ft.
County: Graham
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: 1939-1975

Safford ARS-3
Network: ARS ID#:
Lat: 31 51 Long:109 30 Elev: e3400 ft.
County: Graham
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: 1939-1975

Safford ARS-9
Network: ARS ID#:
Lat: 31 37 Long:109 37 Elev: e3500 ft.
County: Graham
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: 1939-72

Safford ARS-11
Network: ARS ID#:
Lat: 31 37 Long:109 40 Elev: e3800 ft.
County: Graham
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: 1939-72

Safford ARS-12
Network: ARS ID#:
Lat: 31 25 Long:109 40 Elev: e4400 ft.
County: Graham
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: 1939-72

Safford ARS-14
Network: ARS ID#:
Lat: 31 25 Long:109 43 Elev: e4600 ft.
County: Graham
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: 1939-72

Safford ARS-15
Network: ARS ID#:
Lat: 31 27 Long:109 44 Elev: e4800 ft.
County: Graham
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: 1939-72

Sahuarita 8 W
Network: NWS ID#: 7419
Lat: 31 54 Long:111 04 Elev: 3560 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Company Time: 1700
Record Length: 1963-

Saint Johns
Network: NWS ID#: 7435
Lat: 34 31 Long:109 23 Elev: 5790 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1909-

San Carlos Reservoir
Network: NWS ID#: 7480
Lat: 33 10 Long:110 31 Elev: 2532 ft.
County: Gila
Gage Type: N, Standard 8"
Observer: Federal Time: 0700
Record Length: 1921-

San Manuel
Network: NWS ID#: 7530
Lat: 32 37 Long:110 39 Elev: 3560 ft.
County: Pinal
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1955-

San Simon 9 ESE
Network: NWS ID#: 7567
Lat: 32 10 Long:109 05 Elev: 3880 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1962-1986

Sanders
Network: NWS ID#: 7488
Lat: 35 13 Long:109 20 Elev: 5853 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: State Time: 1800
Record Length: 1965-

Sanders 11 ESE
Network: NWS ID#: 7496
Lat: 35 10 Long:109 10 Elev: 6250 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1961-1986

Santa Rita Exp Range
Network: NWS ID#: 7593
Lat: 31 46 Long:110 51 Elev: 4300 ft.
County: Pima
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1700
Record Length: N: 1916- R: 1942-

Santa Rosa School
Network: US Bureau of Indian Affairs ID#:
Lat: 32 21 Long:112 04 Elev: 1840 ft.
County: Pima
Gage Type: R,
Observer: Bureau of Indian Affairs Time:

Record Length: 1969-

Sasabe
Network: NWS ID#: 7619
Lat: 31 29 Long: 111 33 Elev: 3590 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1959-

Sasabe 7 NW
Network: NWS ID#: 7622
Lat: 31 35 Long: 111 36 Elev: 3825 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: Individual Time: 0700
Record Length: 1950-

Scottsdale
Network: NWS ID#: 7661
Lat: 33 28 Long: 111 53 Elev: 1200 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: City Time: 1800
Record Length: 1968-1986

Sedona Ranger Station
Network: NWS ID#: 7708
Lat: 34 52 Long: 111 46 Elev: 4220 ft.
County: Coconino
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1600
Record Length: N: 1943- R: 1973-

Seligman
Network: NWS ID#: 7716
Lat: 35 19 Long: 112 53 Elev: 5250 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: City Time: 1500
Record Length: 1904-

Show Low Airport
Network: NWS ID#: 7855
Lat: 34 15 Long: 110 00 Elev: 6411 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: Airport Time: 0800
Record Length: 1965-

Sierra Ancha
Network: USFS (also NWS) ID#:
Lat: 33 48 Long: 110 58 Elev: 5100 ft.
County: Gila
Gage Type: R, F & P
Observer: RMFRES Time:
Record Length: 1947-

Snowflake
Network: NWS ID#: 8012
Lat: 34 30 Long: 110 05 Elev: 5642 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: Individual Time: SS
Record Length: 1910-

Snowflake 15 W
Network: NWS ID#: 8018
Lat: 34 30 Long: 110 20 Elev: 6080 ft.
County: Navajo
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1965-

South Phoenix
Network: NWS ID#: 8112
Lat: 33 23 Long: 112 04 Elev: 1155 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1915-

Springerville
Network: NWS ID#: 8162
Lat: 34 08 Long: 109 17 Elev: 7060 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Federal Time: 1600
Record Length: 1911-

Steep Slopes
Network: USFS ID#:
Lat: 33 48 Long: 110 58 Elev: 5300 ft.
County: Gila
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1949-1971

Stewart Mountain
Network: NWS ID#: 8214
Lat: 33 34 Long: 111 32 Elev: 1422 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Company Time: 0700
Record Length: 1939-

Summit
Network: USFS (also NWS) ID#:
Lat: 33 33 Long: 110 56 Elev: 3635 ft.
County: Gila
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1948-1982

Sunflower 3 NNW
Network: NWS ID#: 8273
Lat: 33 54 Long:111 29 Elev: 3720 ft.
County: Maricopa
Gage Type: N, R, Standard 8", F & P
Observer: State Time: 1800
Record Length: N:1945-1985, R:1980-

Superior
Network: NWS ID#: 8348
Lat: 33 18 Long:111 06 Elev: 2995 ft.
County: Pinal
Gage Type: N, Standard
Observer: Company Time: 0800
Record Length: 1920-

Tacna 3 NE
Network: NWS ID#: 8396
Lat: 32 43 Long:113 55 Elev: 324 ft.
County: Yuma
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1967-

TCSF
Network: USFS ID#:
Lat: 33 40 Long:109 16 Elev: 8400 ft.
County: Greenlee
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1962-

Teec Nos Pos
Network: NWS ID#: 8468
Lat: 36 54 Long:109 06 Elev: 5290 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: State Time: 1800
Record Length: 1962-

Tempe-ASU
Network: NWS ID#: 8499
Lat: 33 25 Long:111 56 Elev: 1170 ft.
County: Maricopa
Gage Type: N, R, Standard 8", TB
Observer: University Time: 1700
Record Length: N:1942-, R:1981-

Tolleson 1 E
Network: NWS ID#: 8598
Lat: 33 27 Long:112 14 Elev: 1025 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Association Time: 1600
Record Length: 1951-

Tombstone
Network: NWS ID#: 8619
Lat: 31 42 Long:110 03 Elev: 4610 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1897-

Truxton Canyon
Network: NWS ID#: 8778
Lat: 35 23 Long:113 40 Elev: 3820 ft.
County: Mohave
Gage Type: R, F & P
Observer: Federal Time:
Record Length: 1970-

Tucson-Davis Monthan AFB
Network: USAF ID#:
Lat: 32 10 Long:110 52 Elev: E 2600 ft.
County: Pima
Gage Type: N, 3H, Standard 8"
Observer: USAF Time: 3 H
Record Length: E 1941-

Tucson Camp Ave Exp Fm
Network: NWS, UA ID#: 8796
Lat: 32 17 Long:110 57 Elev: 2330 ft.
County: Pima
Gage Type: N, R, Standard 8", ?
Observer: University Time: 1700
Record Length: N: 1949-, R: 1967-

Tucson Univ of Arizona
Network: NWS, UA ID#: 8815
Lat: 32 15 Long:110 57 Elev: 2444 ft.
County: Pima
Gage Type: N, R, Standard 8", ?
Observer: University Time: 2400
Record Length: N: 1891-, R: 1962-

Tucson WSO AP
Network: NWS ID#: 8820
Lat: 32 08 Long:110 56 Elev: 2584 ft.
County: Pima
Gage Type: N, R, Standard 8", Universal 12"
Observer: Federal Time: 2400
Record Length: N:1941-, R:1941-

Tucson Mag Observatory
Network: NWS ID#: 8800
Lat: 32 15 Long:110 57 Elev: 2444 ft.
County: Pima
Gage Type: N, Standard 8"
Observer: University Time: 2400
Record Length: 1934-

Tumacacori Nat Mon
Network: NWS ID#: 8865
Lat: 31 34 Long:111 03 Elev: 3267 ft.
County: Santa Cruz
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1946-

Tuweep
Network: NWS ID#: 8895
Lat: 36 17 Long:113 04 Elev: 4775 ft.
County: Mohave
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1900
Record Length: N:1941-1985, R:1941-

Upper Parker
Network: USFS (also NWS) ID#:
Lat: 33 48 Long:110 57 Elev: 5500 ft.
County: Gila
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1934-1965

Upper Pocket
Network: USFS ID#:
Lat: 33 47 Long:110 57 Elev: 5430 ft.
County: Gila
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1937-1965

W.G.-13
Network: Walnut Gulch ARS ID#:
Lat: 31 44 Long:110 05 Elev: e4600 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-24
Network: Walnut Gulch ARS ID#:
Lat: 31 43 Long:110 04 Elev: e4600 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-4
Network: Walnut Gulch ARS ID#:
Lat: 31 45 Long:110 07 Elev: 4300 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-42

Network: Walnut Gulch ARS ID#:
Lat: 31 41 Long:110 01 Elev: e4600 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-46

Network: Walnut Gulch ARS ID#:
Lat: 31 43 Long:110 00 Elev: e4600 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-44

Network: Walnut Gulch ARS ID#:
Lat: 31 44 Long:110 00 Elev: e4600 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-60

Network: Walnut Gulch ARS ID#:
Lat: 31 44 Long:109 58 Elev: e5000 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-68

Network: Walnut Gulch ARS ID#:
Lat: 31 45 Long:109 53 Elev: e5200 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.G.-80

Network: Walnut Gulch ARS ID#:
Lat: 31 44 Long:110 02 Elev: e4400 ft.
County: Cochise
Gage Type: R, Weighing bucket
Observer: ARS Time:
Record Length: e1954-

W.S.A.-3

Network: USFS ID#:
Lat: 34 29 Long:112 31 Elev: 6000 ft.
County: Yavapai
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1958-

W.S.B.-3
Network: USFS ID#:
Lat: 34 28 Long:112 31 Elev: 5800 ft.
County: Yavapai
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1958-

Wahweap
Network: NWS ID#: 9114
Lat: 36 59 Long:111 29 Elev: 3730 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1961-

Walnut Canyon Nat Mon
Network: NWS ID#: 9156
Lat: 35 10 Long:111 31 Elev: 6685 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1950-

Walnut Creek
Network: NWS ID#: 9158
Lat: 34 56 Long:112 49 Elev: 5090 ft.
County: Yavapai
Gage Type: N, R, Standard 8", F & P
Observer: Individual Time: 1800
Record Length: N:1915-, R:1979-

Walnut Grove
Network: NWS ID#: 9166
Lat: 34 18 Long:112 33 Elev: 3764 ft.
County: Yavapai
Gage Type: N, Standard 8"
Observer: Individual Time: 1800
Record Length: 1889-

Whiteriver 1 SW
Network: NWS ID#: 9271
Lat: 33 50 Long:109 58 Elev: 5120 ft.
County: Navajo
Gage Type: N, R, Standard 8", F & P
Observer: Federal Time: 1100
Record Length: N:1940-, R:1944-

Whitlow Ranch Dam
Network: US Corps of Engineers ID#:
Lat: 33 18 Long:111 16 Elev: 2040 ft.
County: Final
Gage Type: R,
Observer: US Corps of Engineers Time:
Record Length: 1960-?

Willcox
Network: NWS ID#: 9334
Lat: 32 18 Long:109 51 Elev: 4175 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Individual Time: 1700
Record Length: 1880

Williams AFB (Chandler)
Network: USAF ID#:
Lat: 33 18 Long:111 40 Elev: 1395 ft.
County: Maricopa
Gage Type: N, 3H, Standard 8"
Observer: USAF Time: 3 H
Record Length: E 1941-

Williams
Network: NWS ID#: 9359
Lat: 35 15 Long:112 11 Elev: 6750 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: City Time: 1600
Record Length: 1907-

Willow Beach
Network: NWS ID#: 9376
Lat: 35 52 Long:114 39 Elev: 760 ft.
County: Mohave
Gage Type: N, Standard 8"
Observer: Federal Time: 0800
Record Length: 1967-

Willow Creek EF
Network: USFS ID#:
Lat: 33 40 Long:109 19 Elev: 8880 ft.
County: Greenlee
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1958-1983

Window Rock 4 SW
Network: NWS ID#: 9410
Lat: 35 37 Long:109 07 Elev: 6900 ft.
County: Apache
Gage Type: N, Standard 8"
Observer: Company Time: 1700
Record Length: 1937-

Winslow WSO AP
Network: NWS ID#: 9439
Lat: 35 01 Long:110 44 Elev: 4890 ft.
County: Navajo
Gage Type: N, R, Standard 8", Universal 12"
Observer: Federal Time: 2400
Record Length: N:1915-, R:1940-

Wittman

Network: MCFCD ID#:
Lat: 33 47 Long:112 32 Elev: 1680 ft.
County: Maricopa
Gage Type: R,
Observer: MCFCD Time:
Record Length: 1957-

WKMF

Network: USFS (also NWS) ID#:
Lat: 33 49 Long:110 55 Elev: 6950 ft.
County: Gila
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1940-

WKNF

Network: USFS ID#:
Lat: 33 49 Long:110 55 Elev: 6900 ft.
County: Gila
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1952-1983

WKSF

Network: USFS ID#:
Lat: 33 49 Long:110 55 Elev: 6900 ft.
County: Gila
Gage Type: R,
Observer: RMFRES Time:
Record Length: 1953-1983

Workman Creek 1

Network: NWS ID#: 9534
Lat: 33 49 Long:110 55 Elev: 6970 ft.
County: Gila
Gage Type: R, F & P
Observer: RMFRES Time:
Record Length: 1940-1986

Wupatki Nat Mon

Network: NWS ID#: 9542
Lat: 35 31 Long:111 32 Elev: 4908 ft.
County: Coconino
Gage Type: N, Standard 8"
Observer: Federal Time: 1700
Record Length: 1939-

Y Lightning Ranch

Network: NWS ID#: 9562
Lat: 31 27 Long:110 13 Elev: 4550 ft.
County: Cochise
Gage Type: N, Standard 8"
Observer: Individual Time: 0800
Record Length: 1939-

Youngtown
Network: NWS ID#: 9634
Lat: 33 36 Long:112 18 Elev: 1135 ft.
County: Maricopa
Gage Type: N, Standard 8"
Observer: Association Time: 1700
Record Length: 1932-

Yucca 1 NNE
Network: NWS ID#: 9645
Lat: 34 53 Long:114 08 Elev: 1950 ft.
County: Mohave
Gage Type: N, Standard 8"
Observer: Company Time: 0800
Record Length: 1953-

Yuma Citrus Station
Network: NWS ID#: 9652
Lat: 32 37 Long:114 39 Elev: 191 ft.
County: Yuma
Gage Type: N, Standard 8"
Observer: University Time: 0800
Record Length: 1920-

Yuma Proving Ground
Network: NWS ID#: 9654
Lat: 32 50 Long:114 24 Elev: 324 ft.
County: Yuma
Gage Type: N, H, Standard 8"
Observer: Federal Time: 2400
Record Length: 1958-

Yuma Valley
Network: NWS ID#: 9657
Lat: 32 43 Long:114 43 Elev: 120 ft.
County: Yuma
Gage Type: N, Standard 8"
Observer: University Time: 0800
Record Length: 1930-

Yuma WSO AP
Network: NWS ID#: 9660
Lat: 32 40 Long:114 36 Elev: 206 ft.
County: Yuma
Gage Type: N, R, Standard 8", Universal 12"
Observer: Federal Time: 2400
Record Length: N:1946-, R:1949-